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EDITED BY

*WILLIAM CROOKES, F.R.S., &c.*

VOLUME XXXVIII.—1878.

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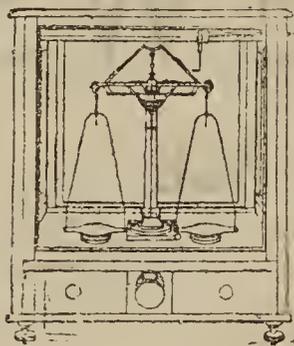
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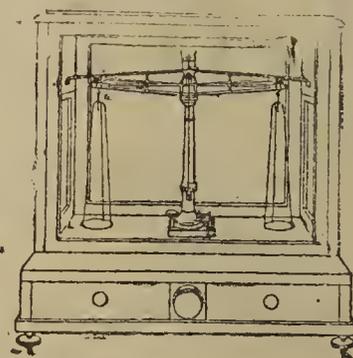
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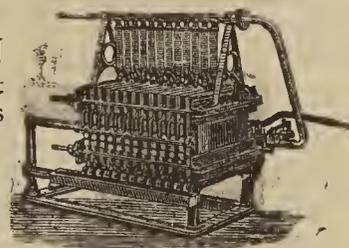
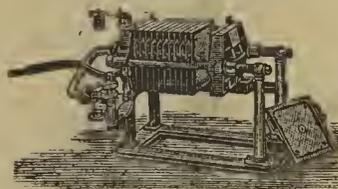
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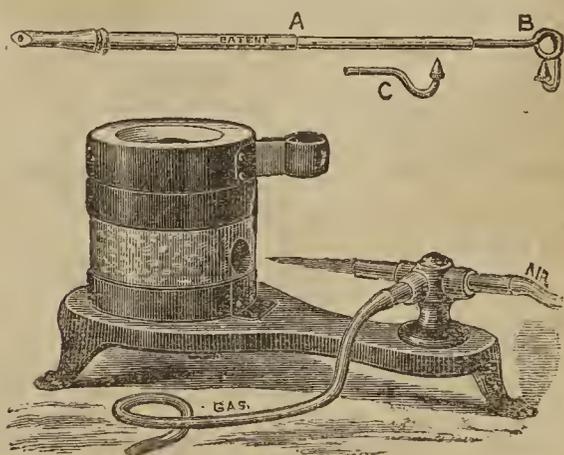
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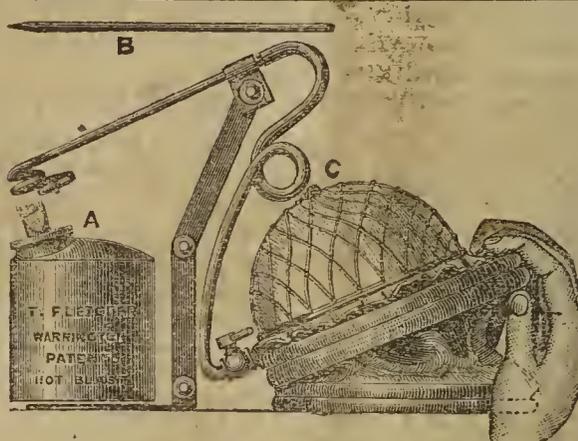
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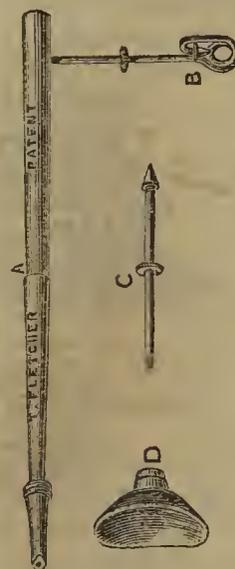
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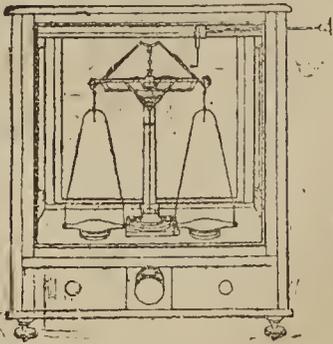
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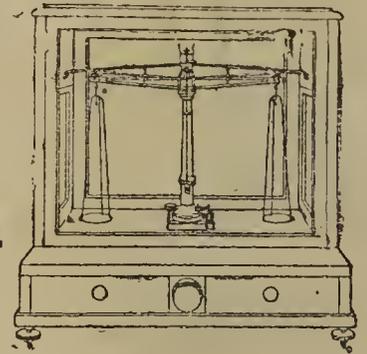
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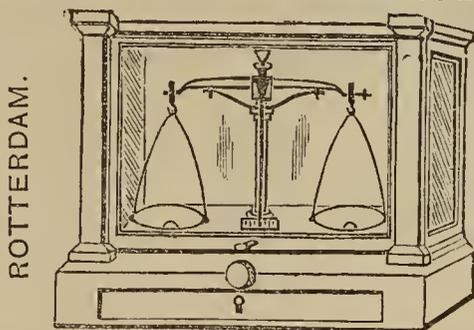
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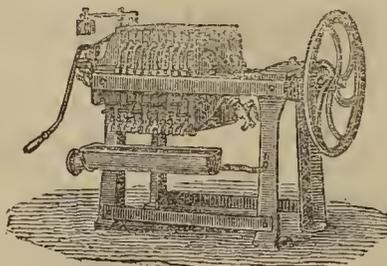
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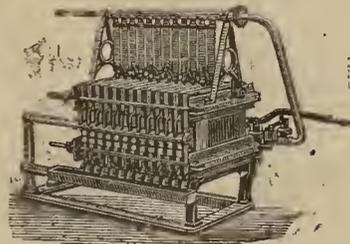
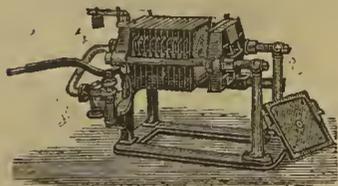
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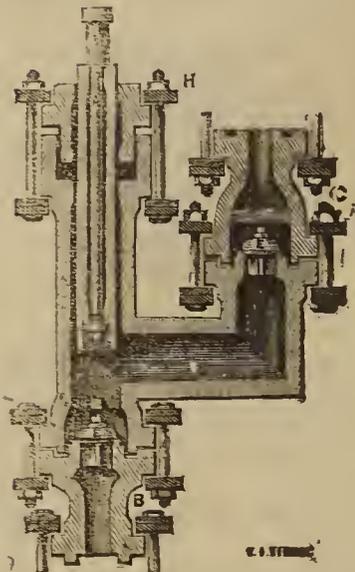
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## AND JOURNAL OF PHYSICAL SCIENCE

Edited by  
Wm. Crookes, F.R.S.]

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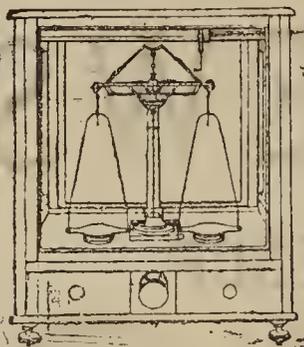
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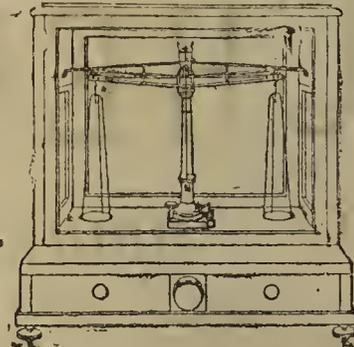


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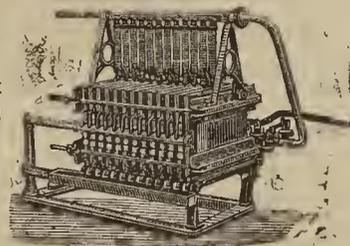
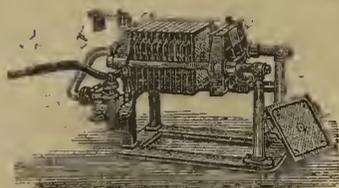
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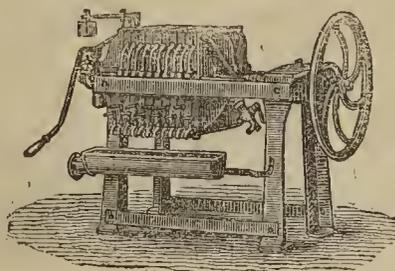
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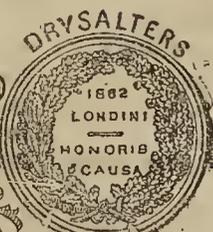
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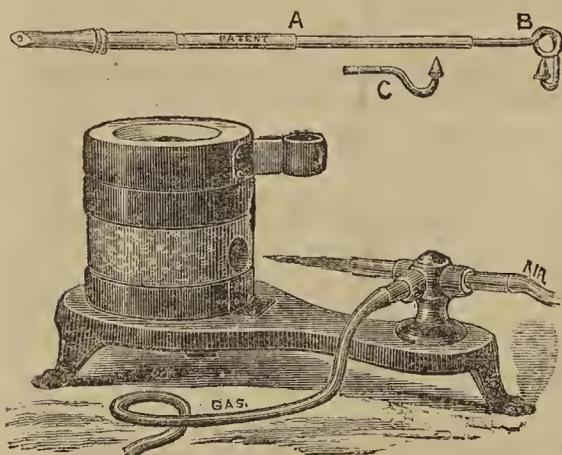
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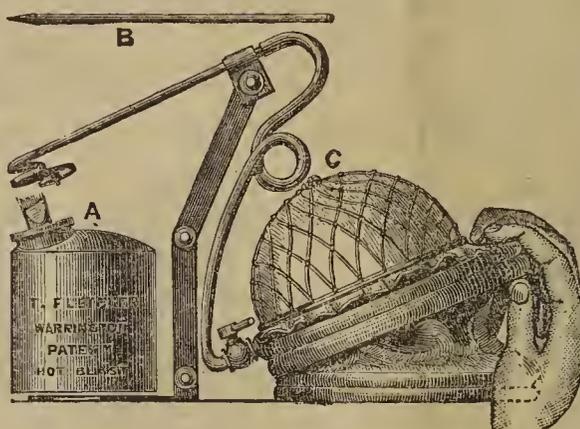
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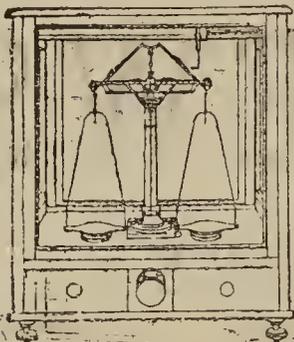
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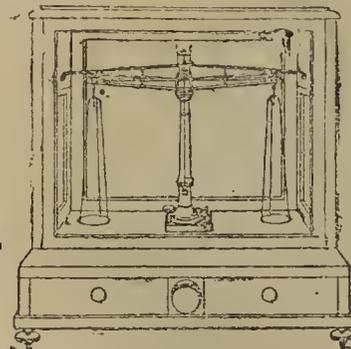
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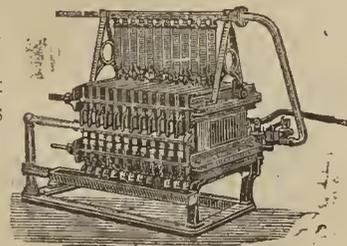
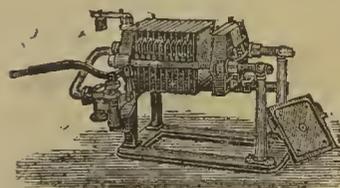
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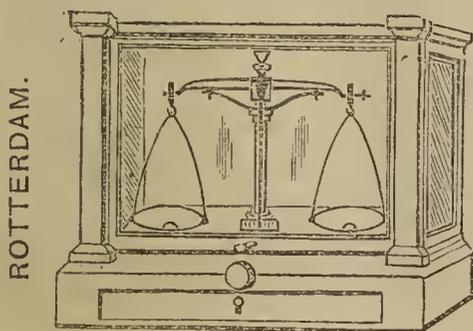
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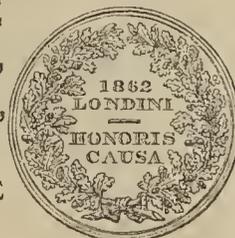
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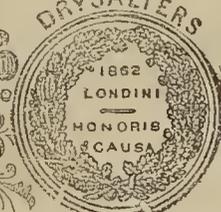
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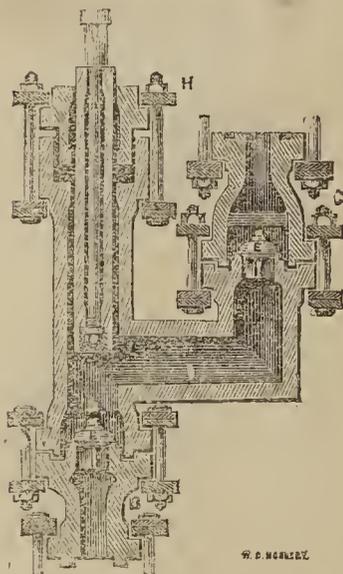
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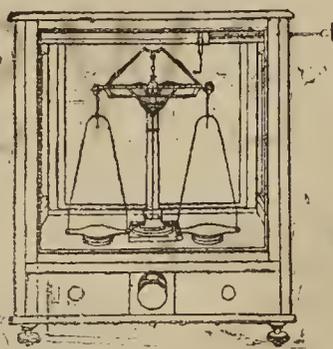
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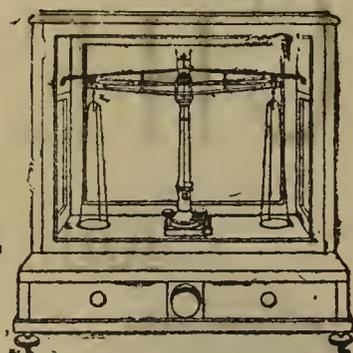
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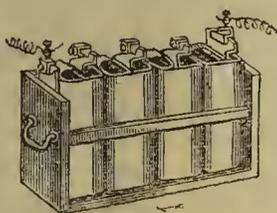
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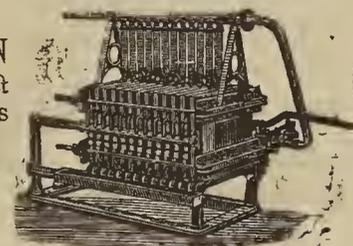
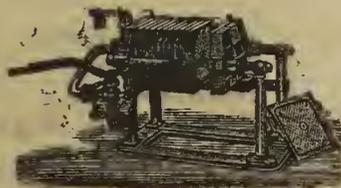
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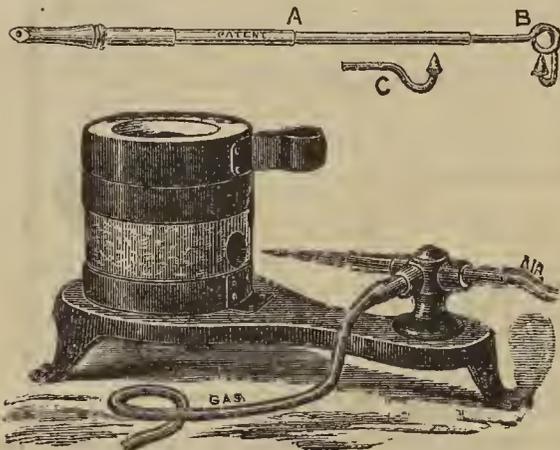
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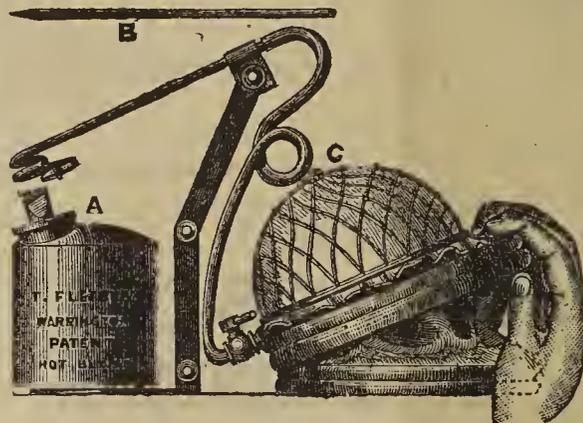
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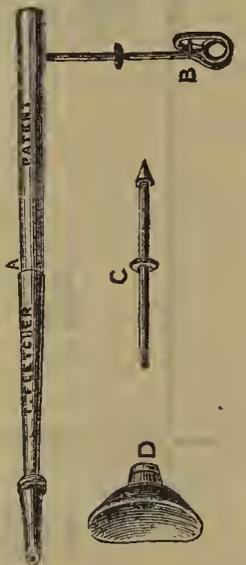
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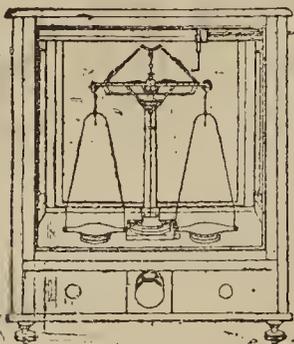
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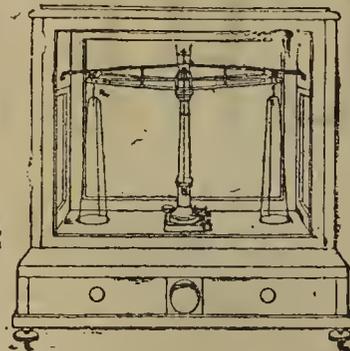
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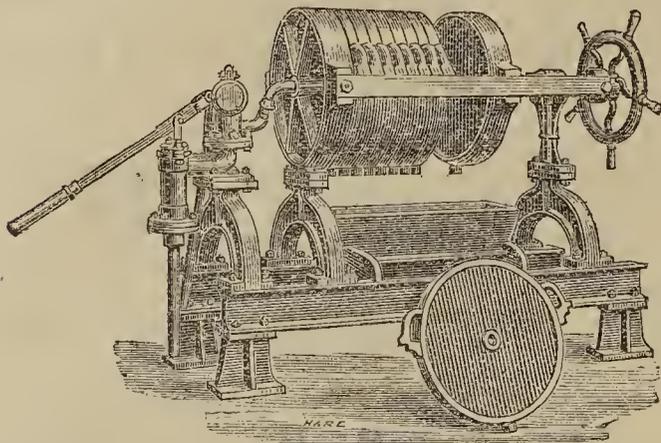
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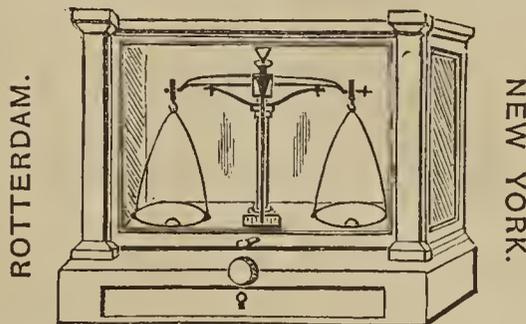
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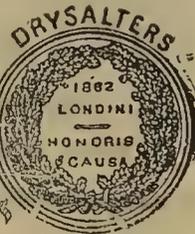
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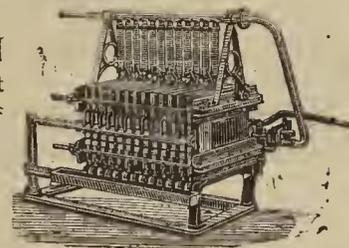
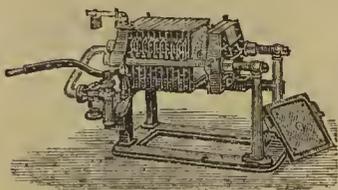
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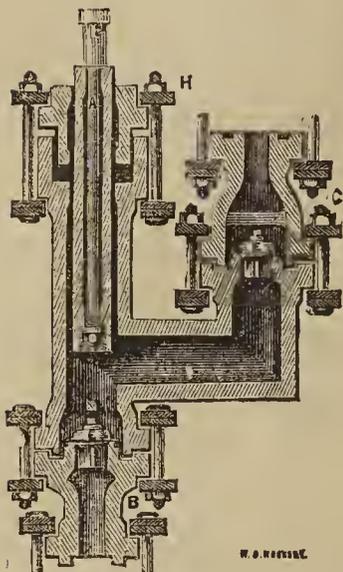
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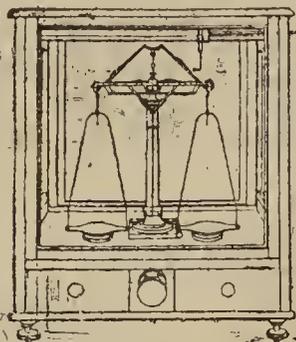
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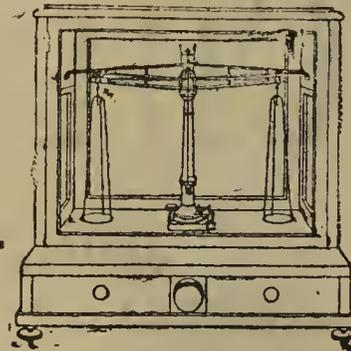
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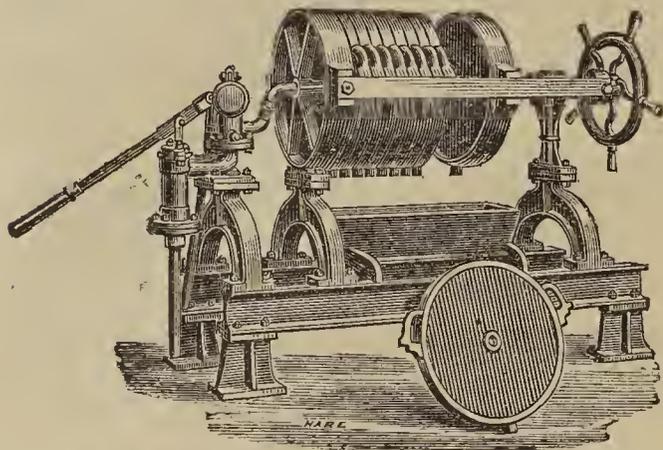
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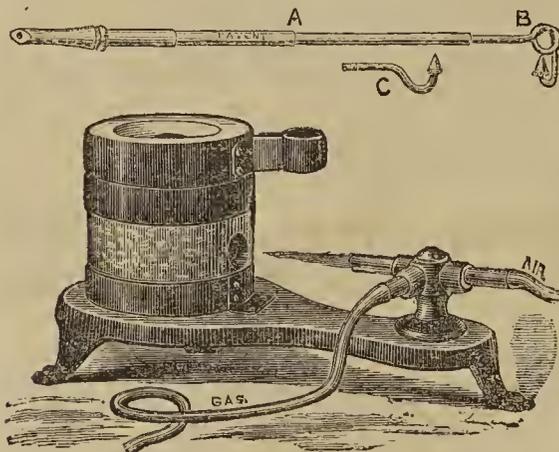
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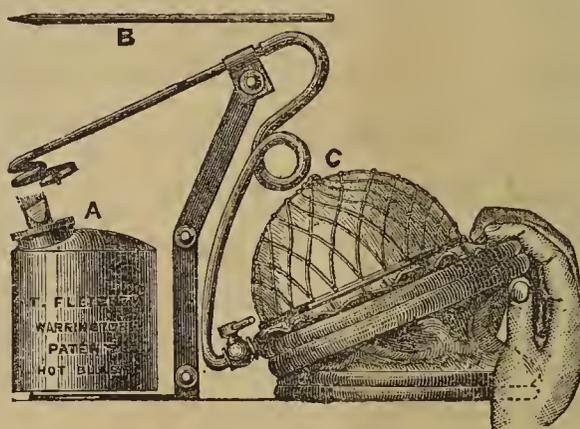
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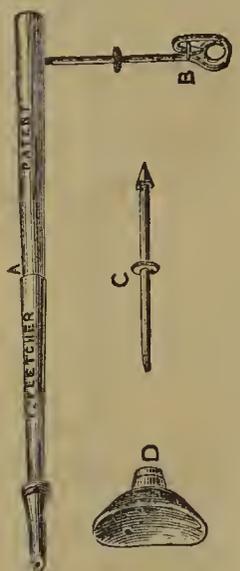
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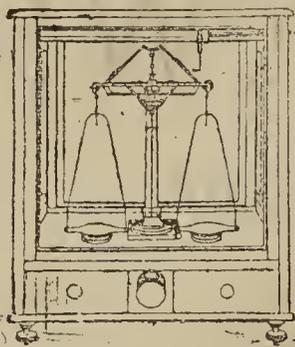
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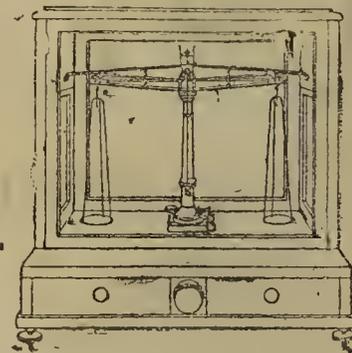


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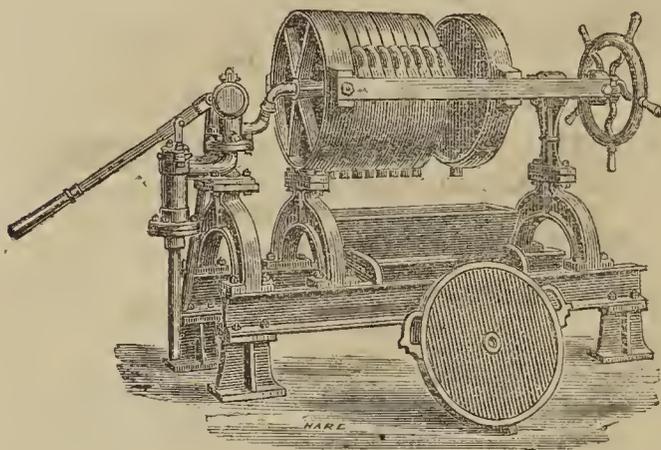
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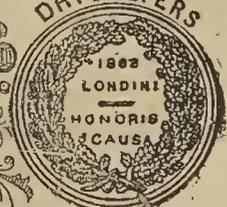
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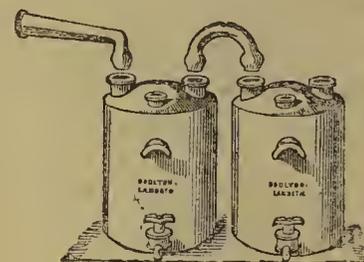
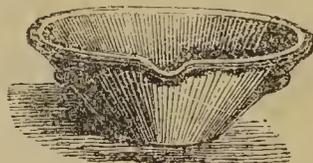
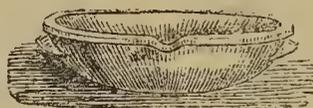
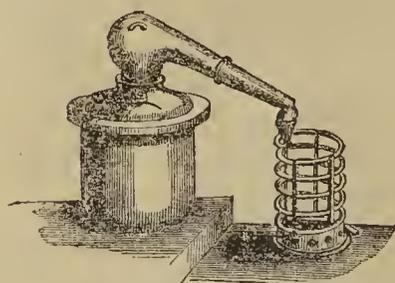
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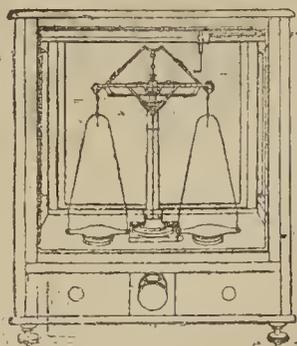
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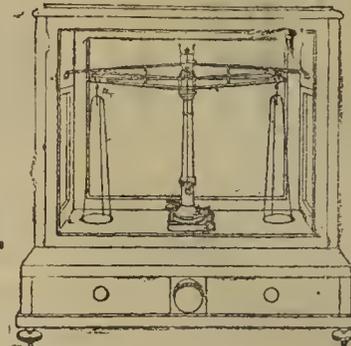
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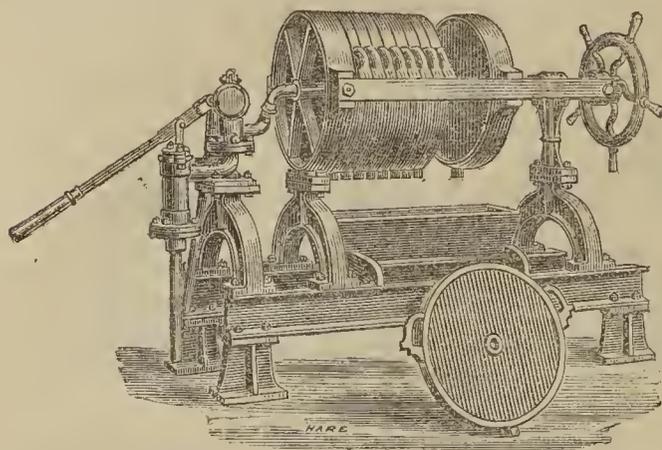
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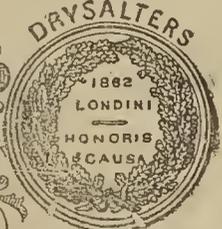
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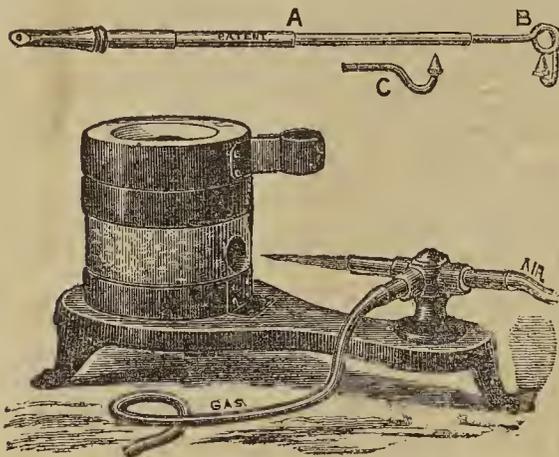
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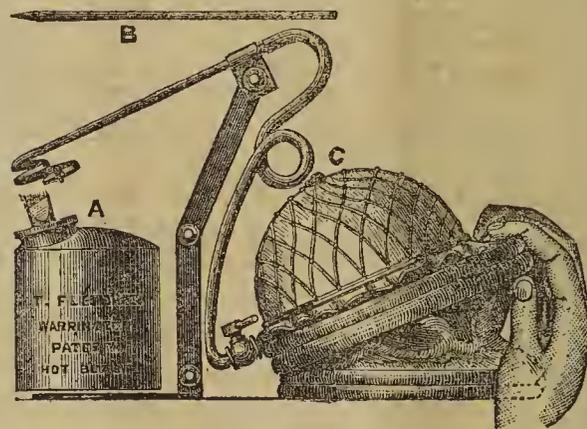
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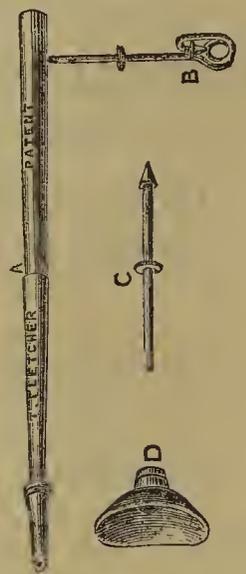
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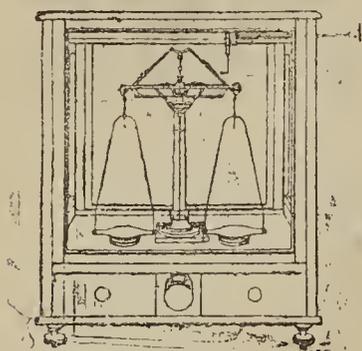
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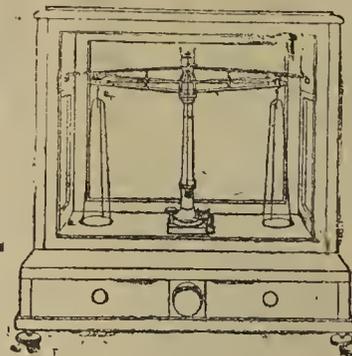
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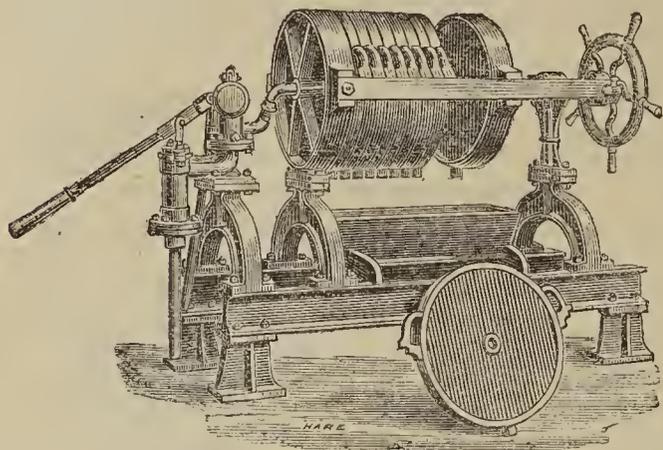
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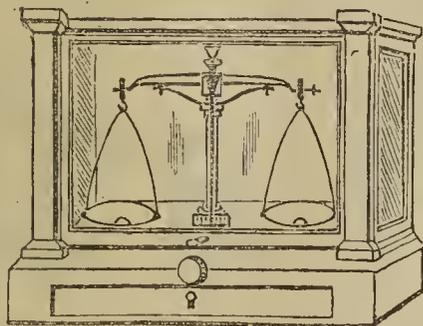
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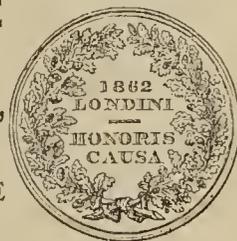
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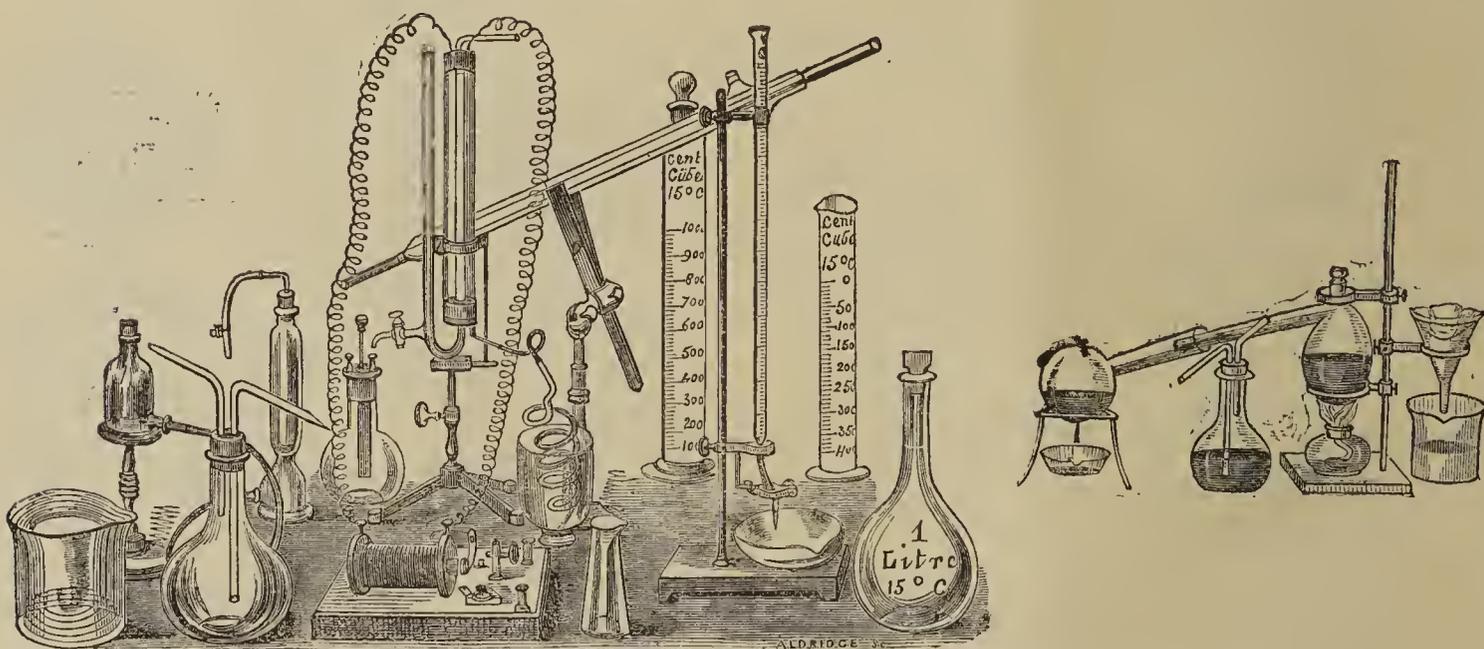
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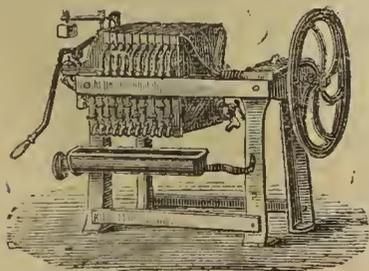
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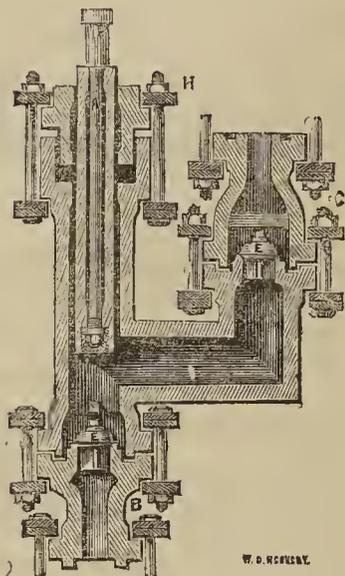
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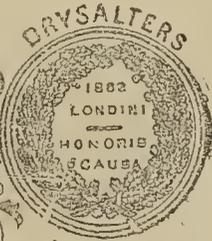


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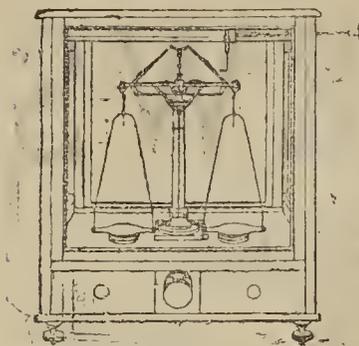
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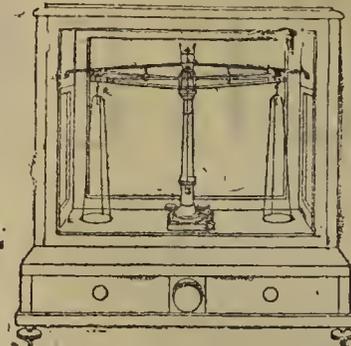
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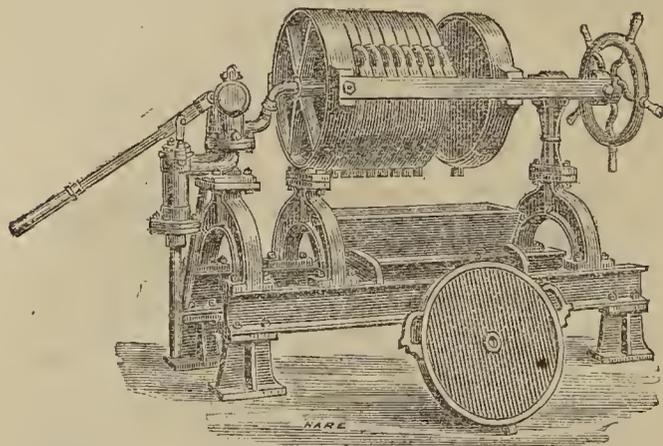
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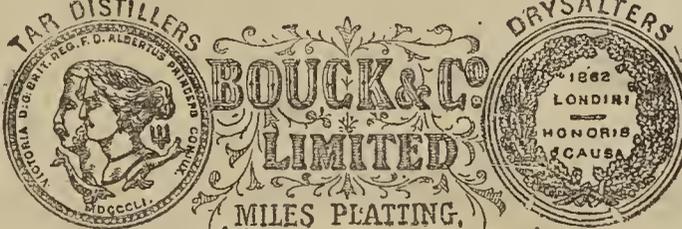
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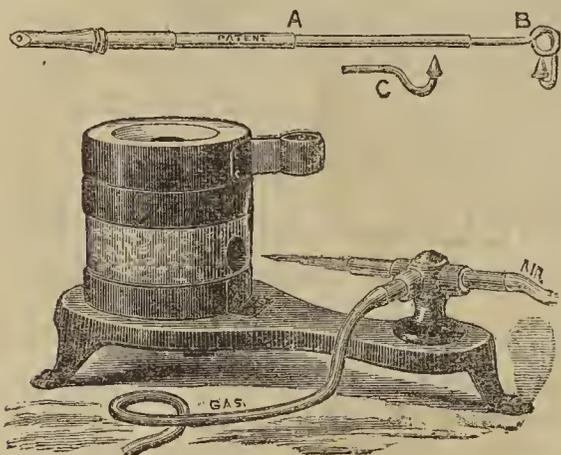
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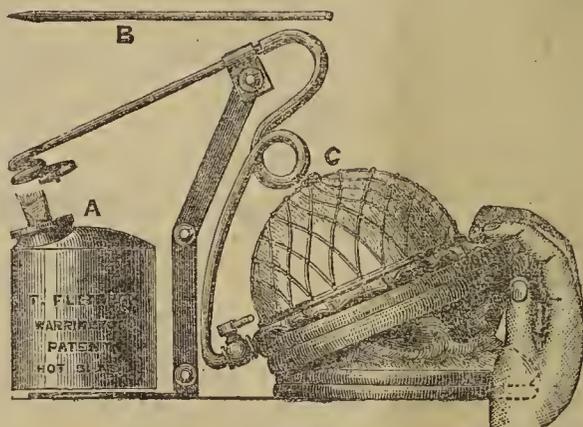
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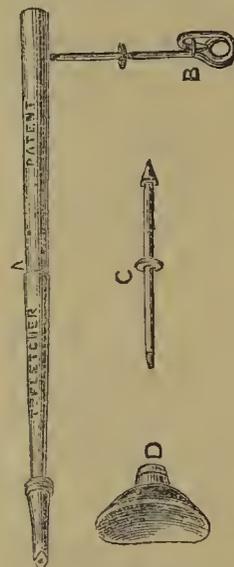
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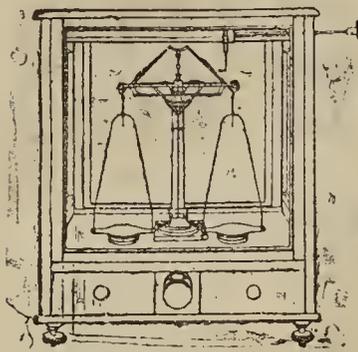
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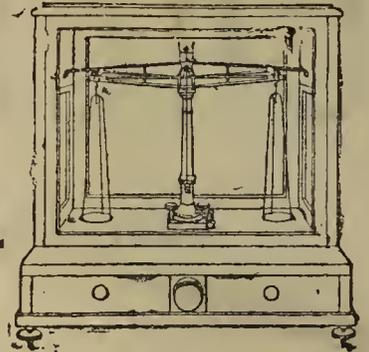
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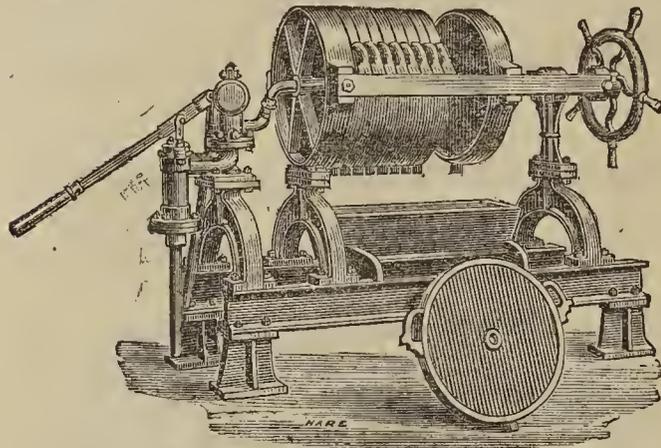
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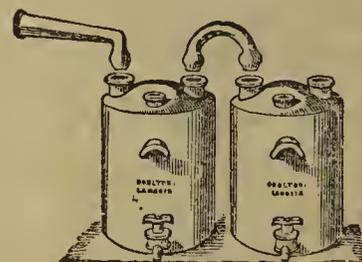
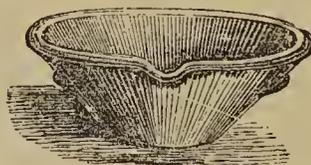
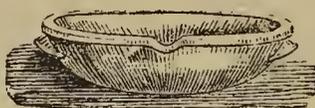
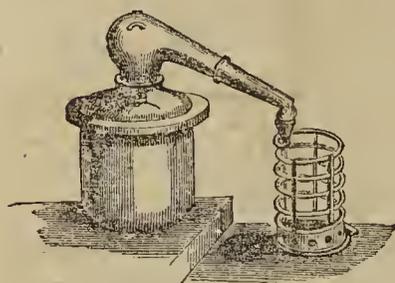
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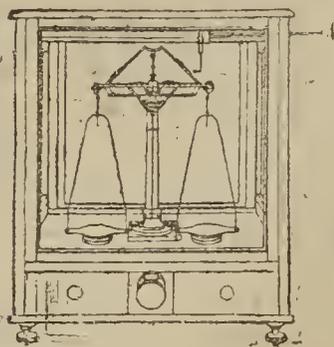
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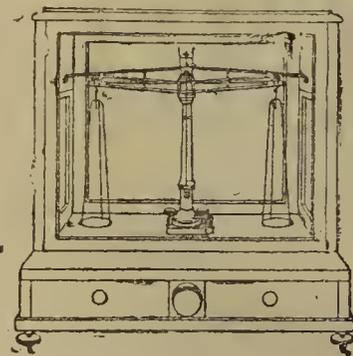
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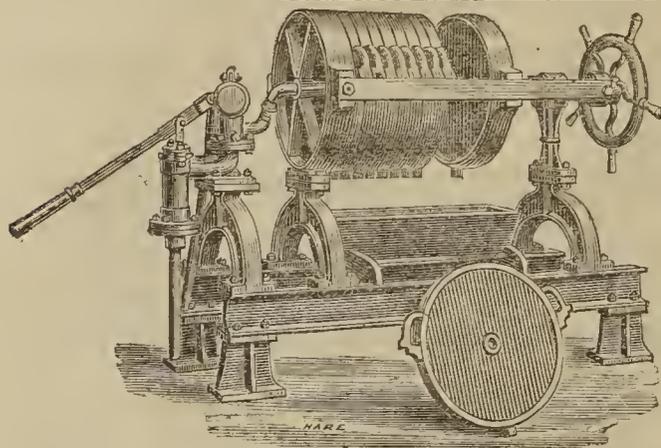
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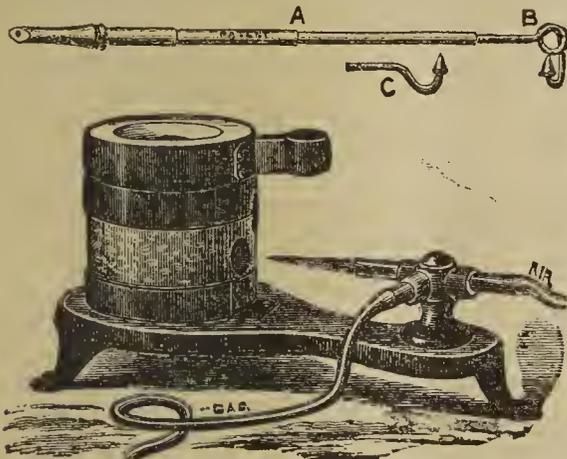
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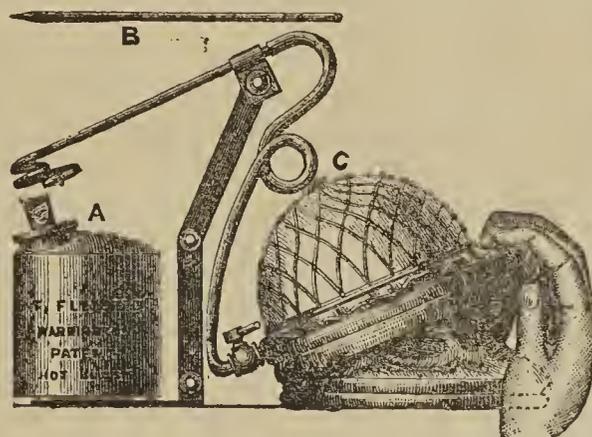
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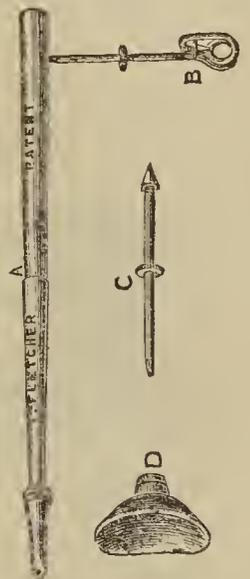
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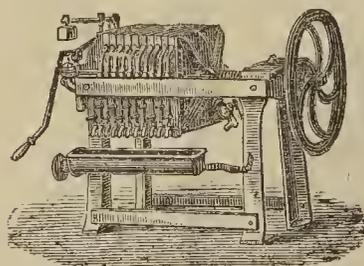
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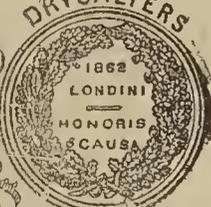


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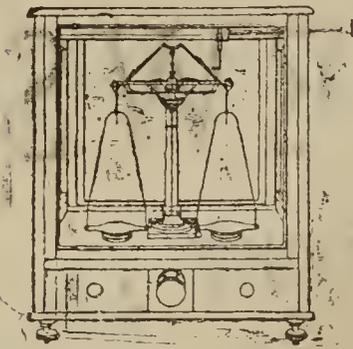
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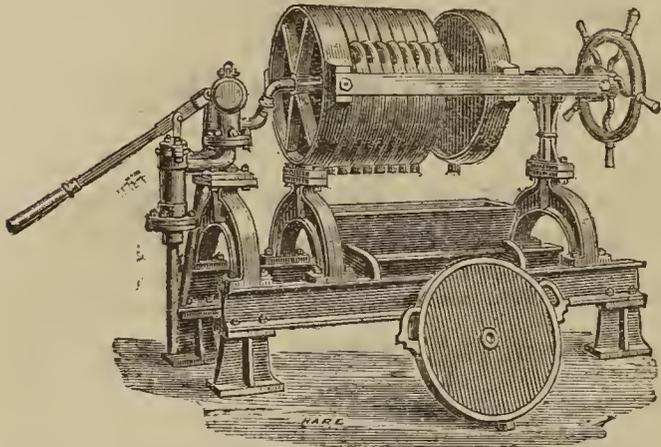
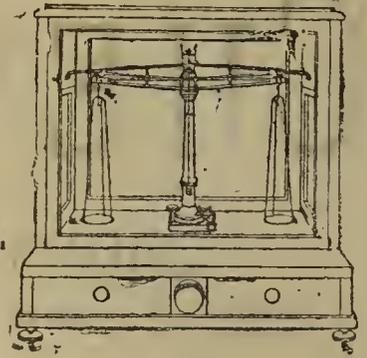
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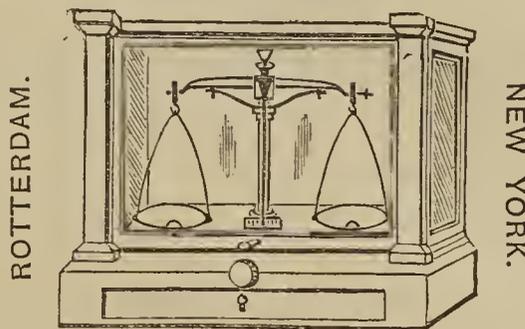
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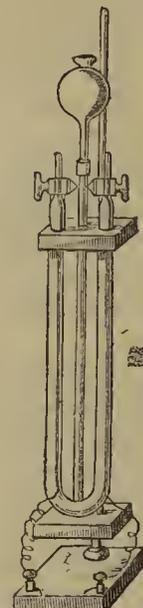
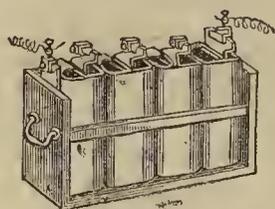
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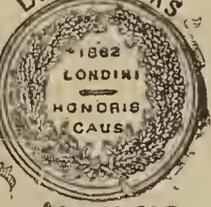
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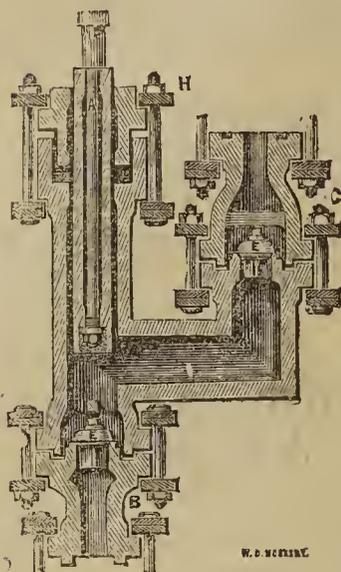
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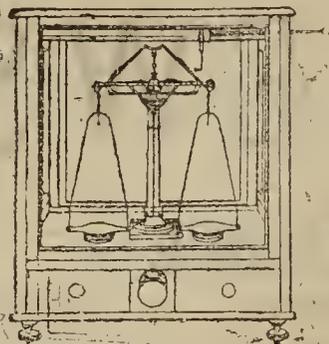
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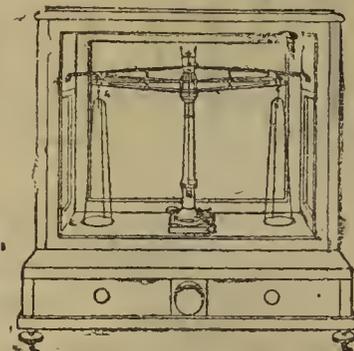
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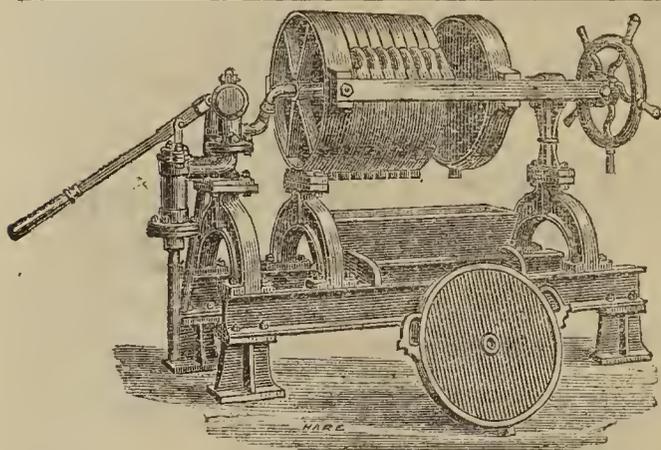
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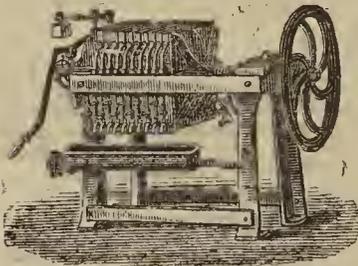
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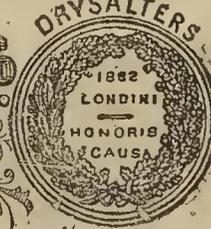


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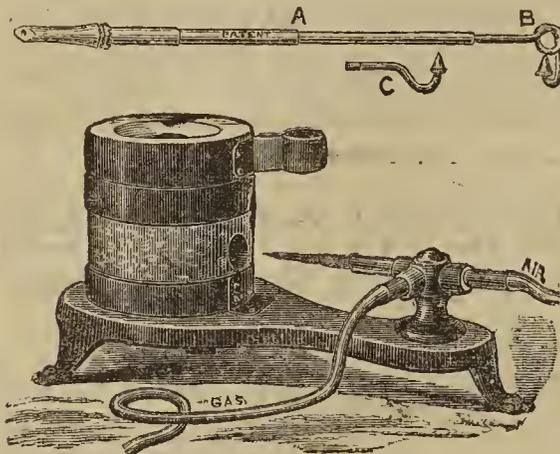
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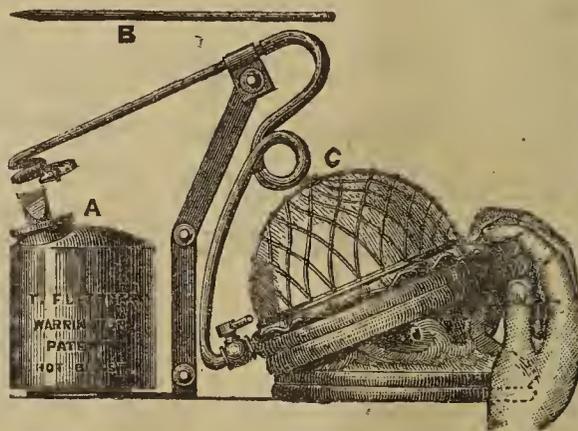
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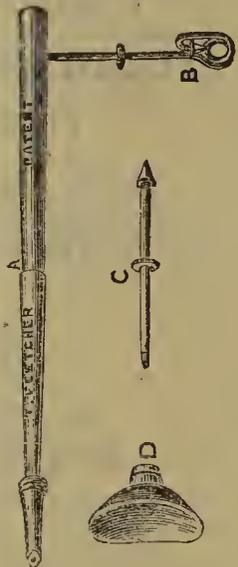


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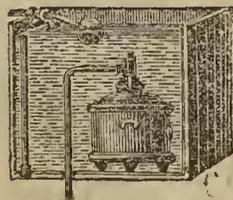
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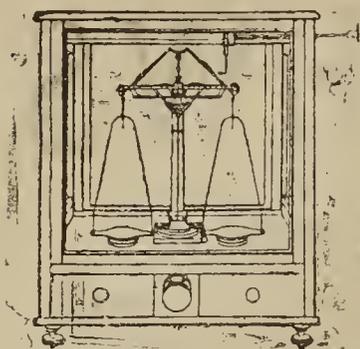
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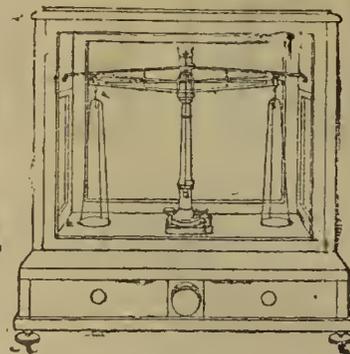
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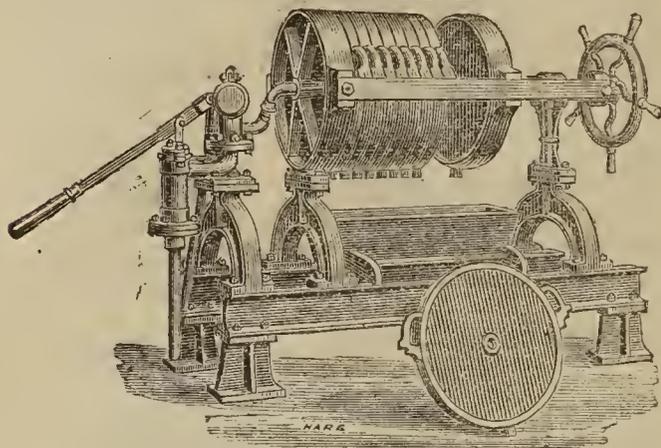
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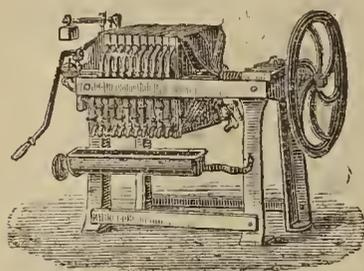
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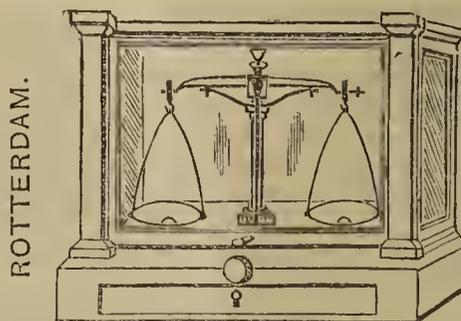
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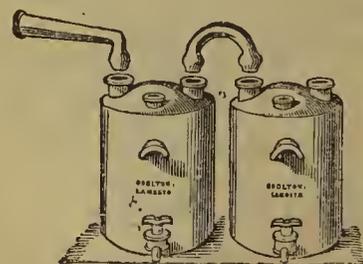
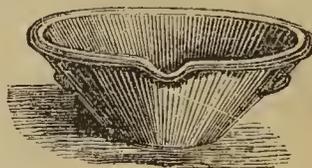
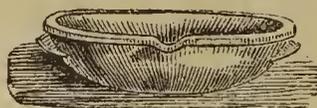
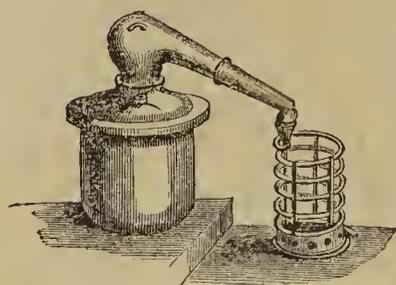
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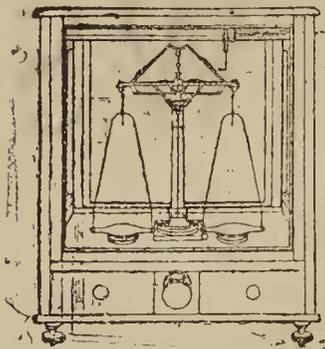
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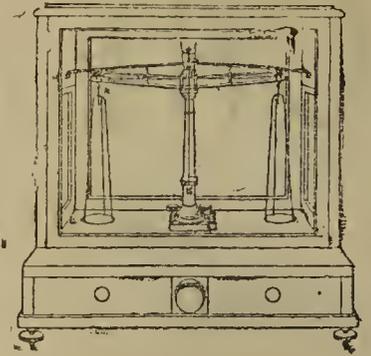


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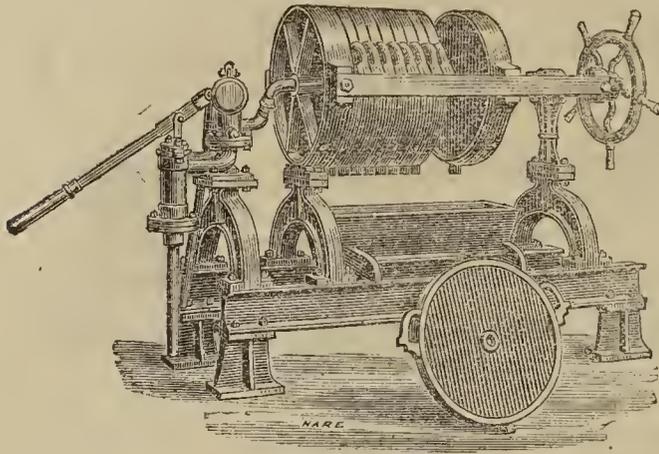
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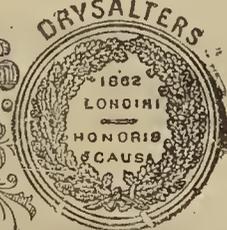
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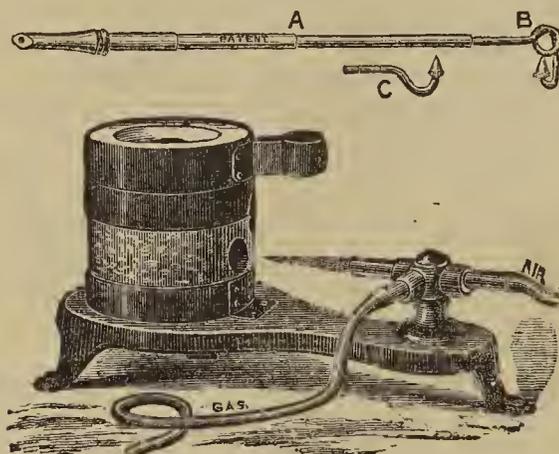
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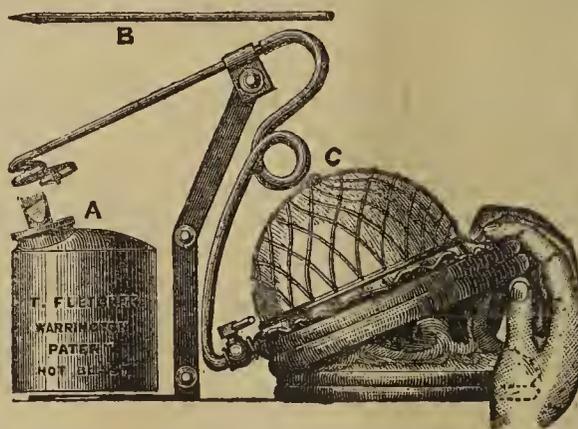
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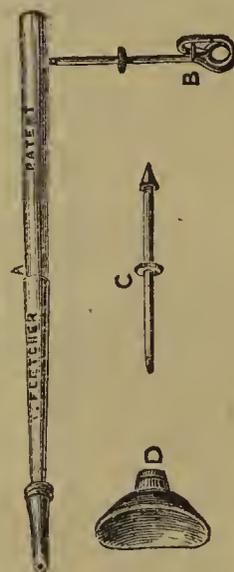


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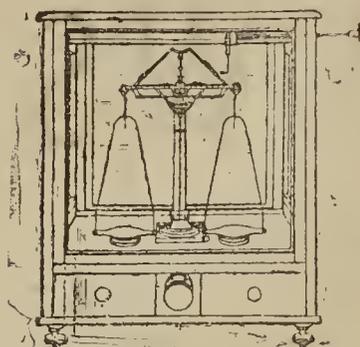
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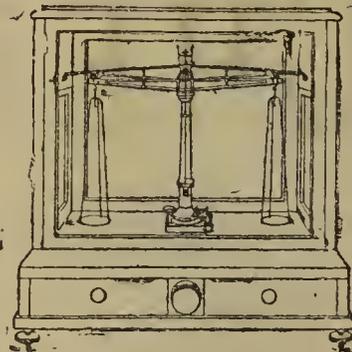
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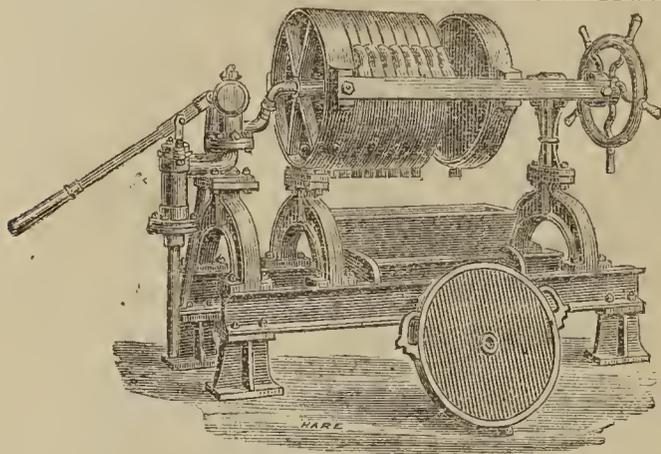
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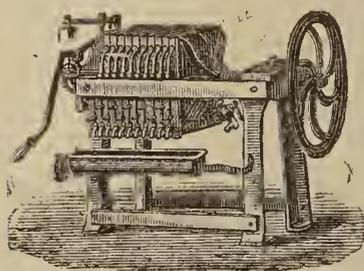
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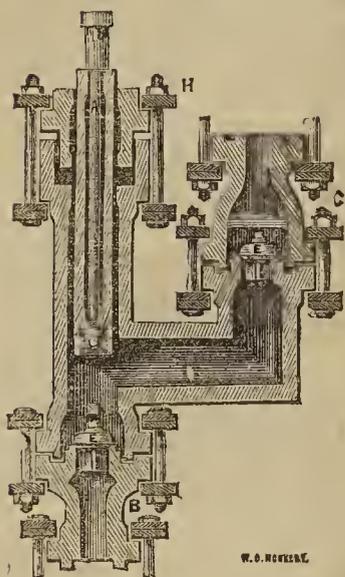
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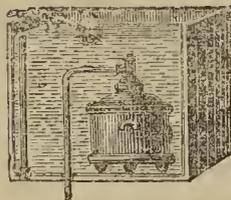
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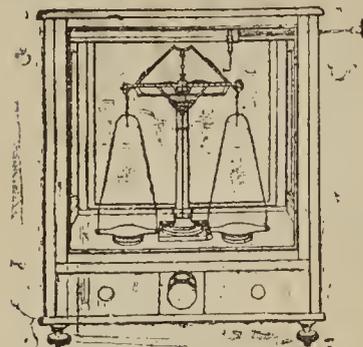
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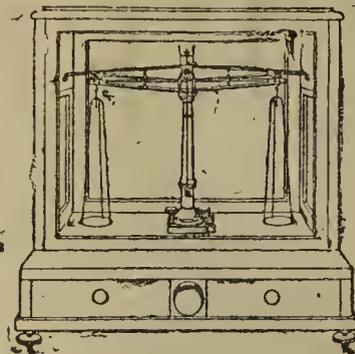
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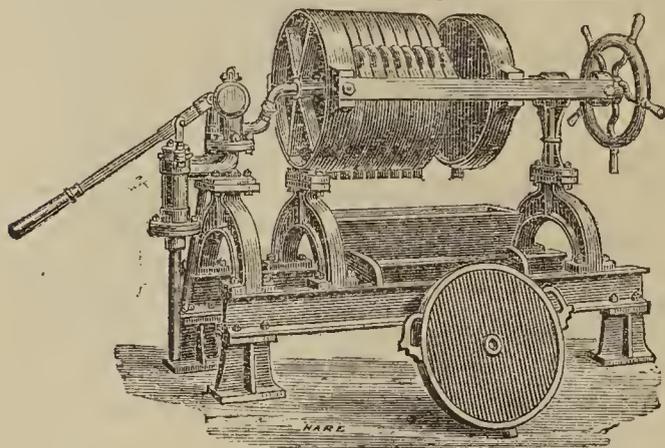
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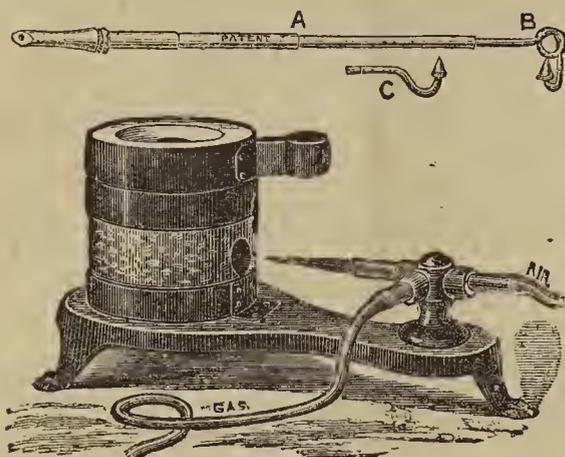
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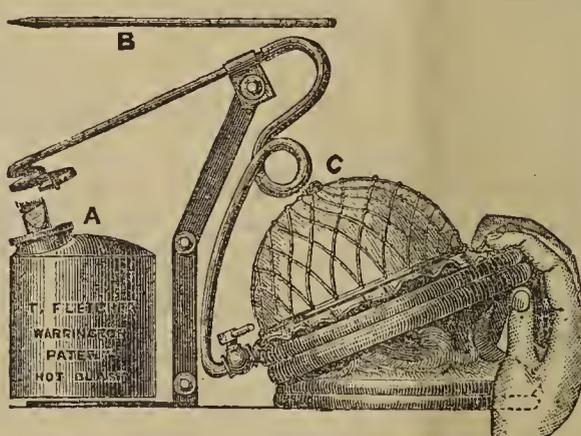
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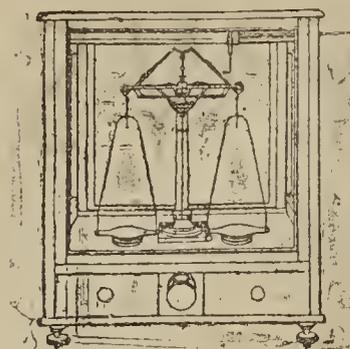
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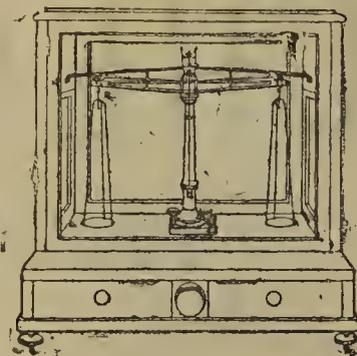
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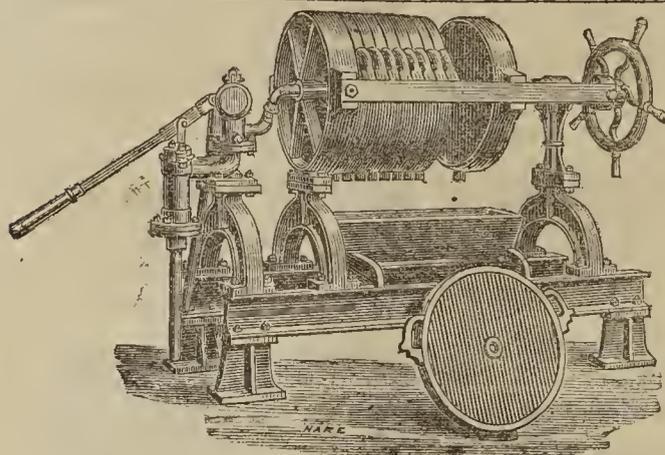
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MEETINGS FOR THE WEEK.

WEDNESDAY, Nov. 20th.—Society of Public Analysts, 8. "On the Sale of Food and Drugs Act, in its Relation to the Dilution of Spirits," by C. Heisch, F.C.S. "On the Sale of Food and Drugs Act, in its Relation to the Dilution of Spirits," by Dr. Dupré, F.R.S. "On the Clauses of the Sale of Food and Drugs Act, which Relate to the Purchase of Samples," by G. W. Wigner, F.C.S. "On the Estimation of Alum in Flour," by Dr. Dupré, F.R.S. "On the Analysis of Cleopatra's Needle," by G. W. Wigner, F.C.S. "On the Nitrogenous Constituents of Cocoa," by G. W. Wigner, F.C.S. Society of Arts, 8. Geological, 8. Meteorological, 8. "Report on the Phenological Observations for 1878," by Rev. T. A. Preston, M.A., F.M.S. "Up-Bank Thaws," by Rev. Fenwick W. Stow, M.A., F.M.S. "Comparison of Thermometric Observations made on Board Ship," by Capt. Henry Toynbee, F.R.A.S.

THURSDAY, 21st.—Chemical, 8. "The Processes and their Comparative Value for Determining the Quantity of Organic Matter in Potable Waters," by Dr. C. M. Tidy. "A Chemical Study of Vegetable Albinism," by Prof. A. H. Church. "Researches on the Action of the Copper-zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe. "On a New Gravimetric Method for the Estimation of Minute Quantities of Carbon," by Dr. Dupré and Dr. Hake.

SATURDAY, 23rd.—Physical, 3. "On a Condenser of Variable Capacity," by C. Boys.

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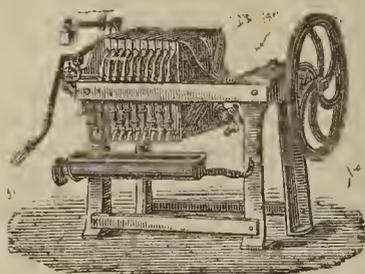
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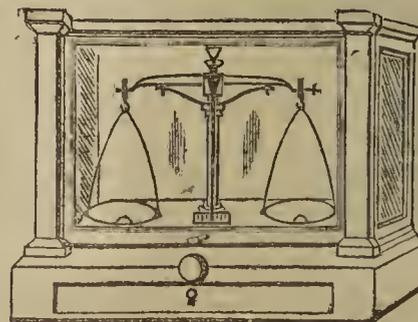
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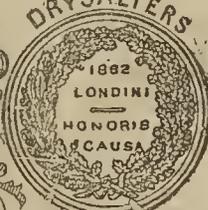
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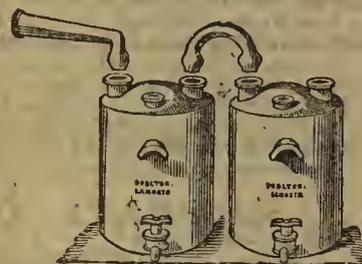
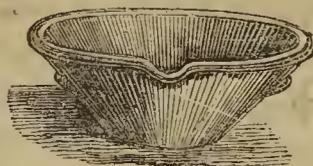
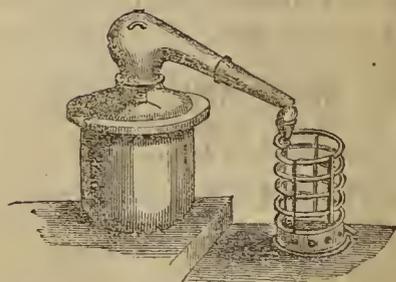
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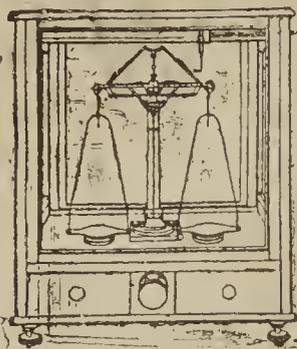
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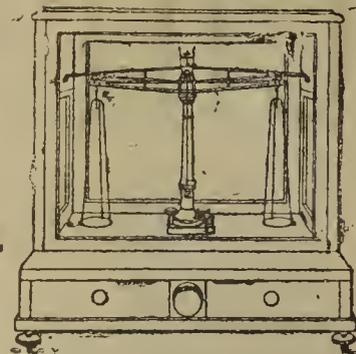
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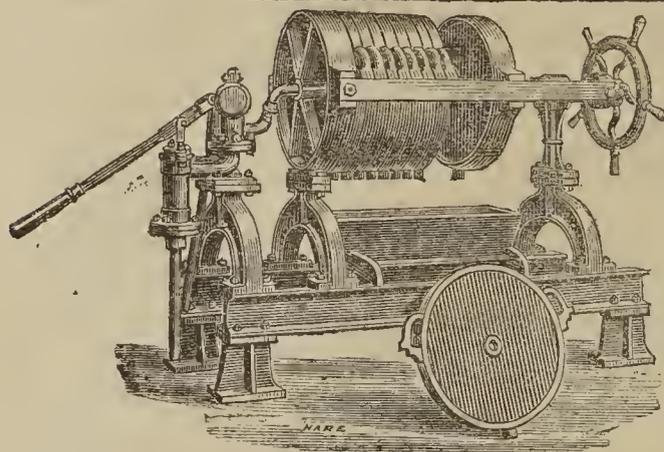


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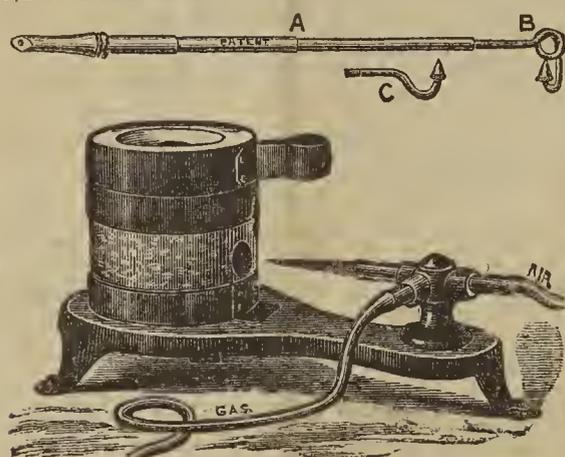
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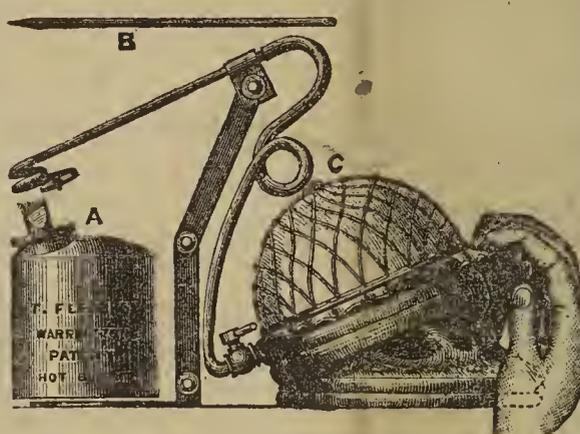
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1. That they have Infringed the above Patents, and that the Artificial Alizarine they have sent into England has been Manufactured in violation of the said Patented Processes, and not under the Patent of May 28, 1869, No. 1642, which Brönnner took out in conjunction with Mr. Gutzkow, and they further acknowledge that their said Patent. No. 1642, 1869, is invalid.
2. They admit the validity of our above-mentioned Patents.
3. They undertake that they will not sell in, or send into, the United Kingdom, either directly or indirectly, any Artificial Alizarine during the duration of our above-mentioned Patents.
4. They have likewise paid Damages for past Infringements, and Judicial and Extra-judicial Expenses incurred by us in the proceedings taken against them, and have authorised the Undersigned to give publicity to the provisions of the said Agreement.

WE FURTHER GIVE NOTICE that any Person or Persons infringing our above-mentioned Patents, whether by PURCHASING (except from us or our Licensees) or SELLING, Importing, or being concerned in Importing, or in any way Using, Artificial Alizarine in the United Kingdom other than Alizarine made here by us or imported by us or our Licensees will be immediately proceeded against.

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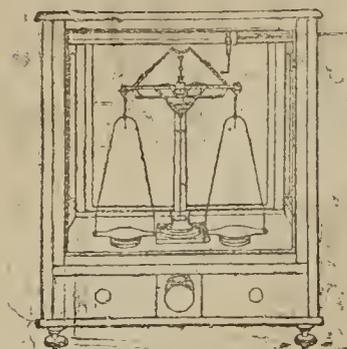
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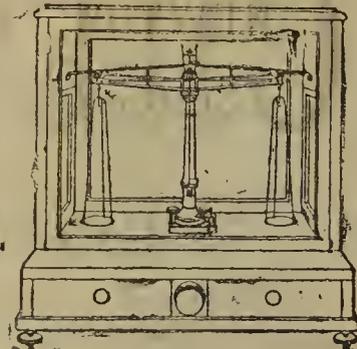
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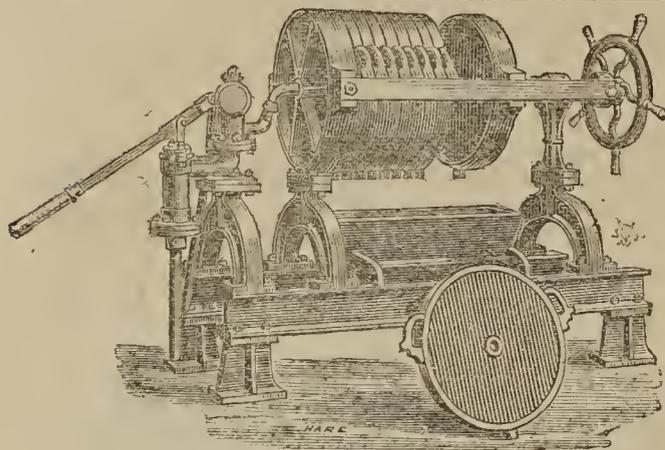
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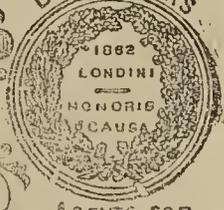


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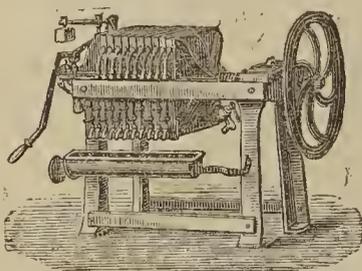
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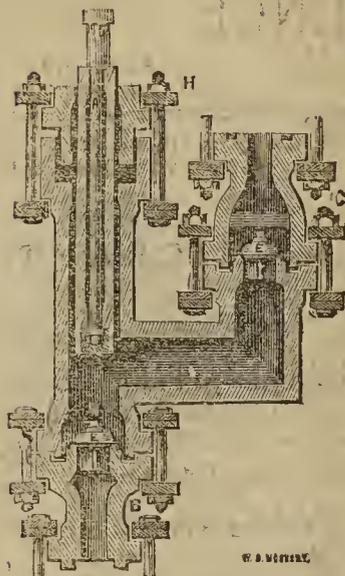
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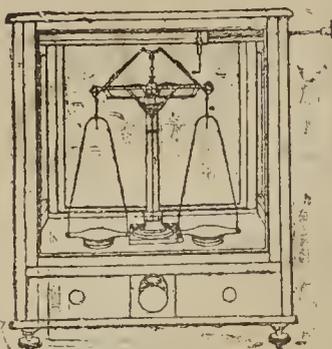
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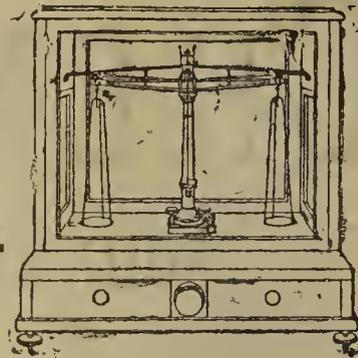
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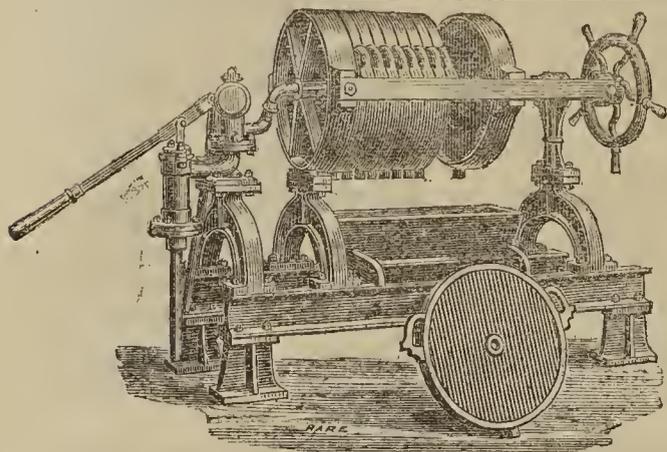
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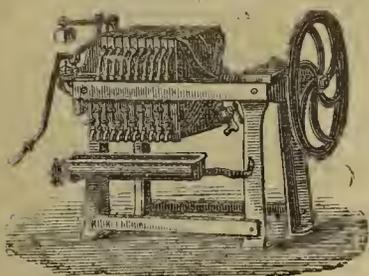
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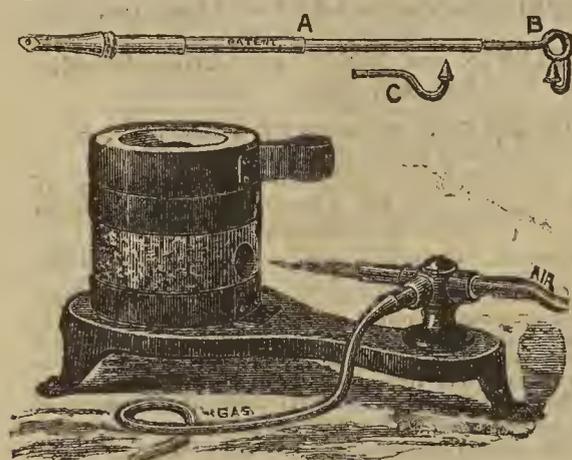
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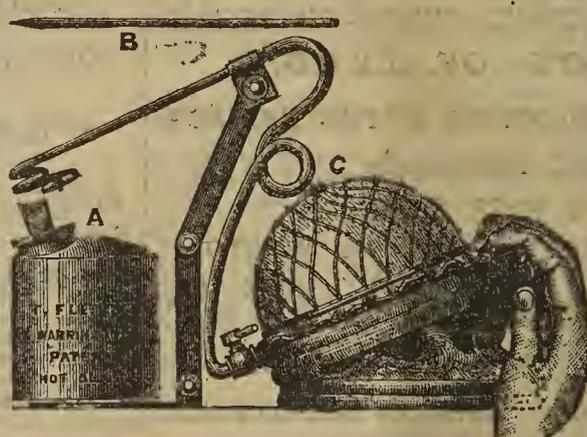
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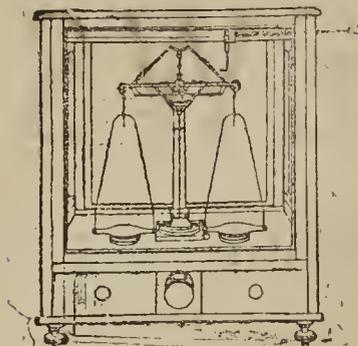
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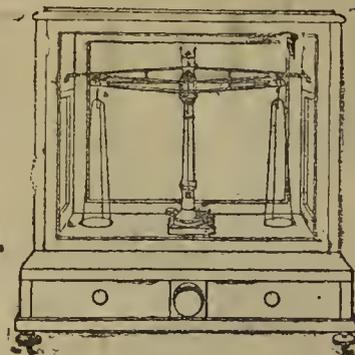


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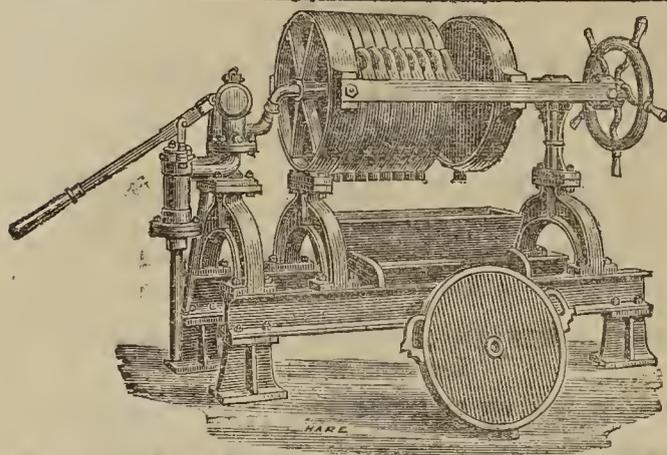
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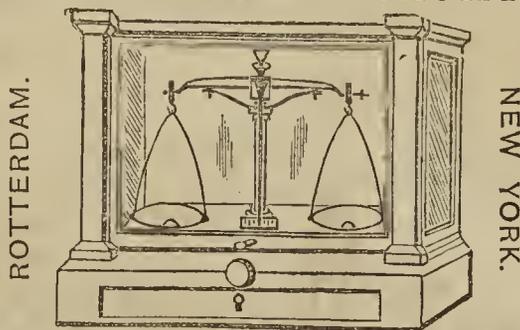
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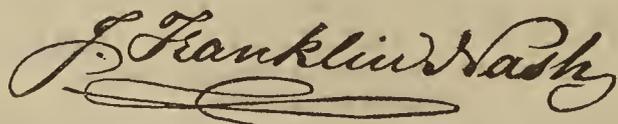
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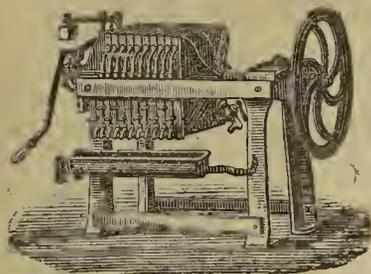
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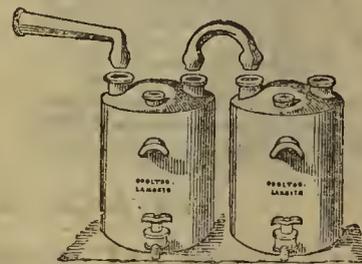
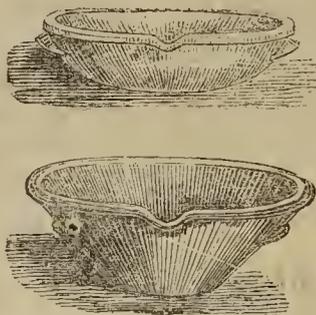
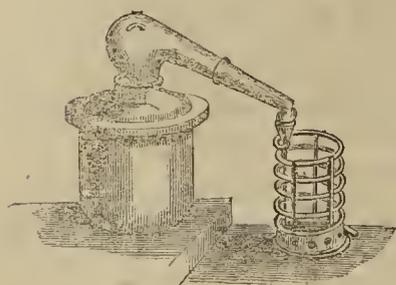
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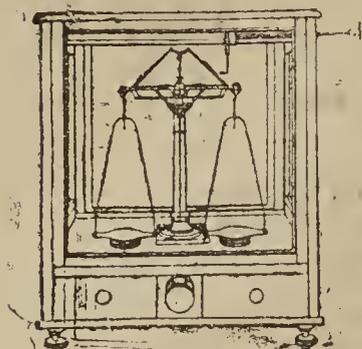
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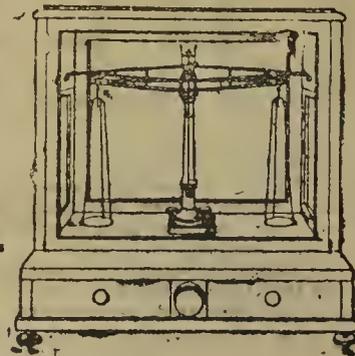


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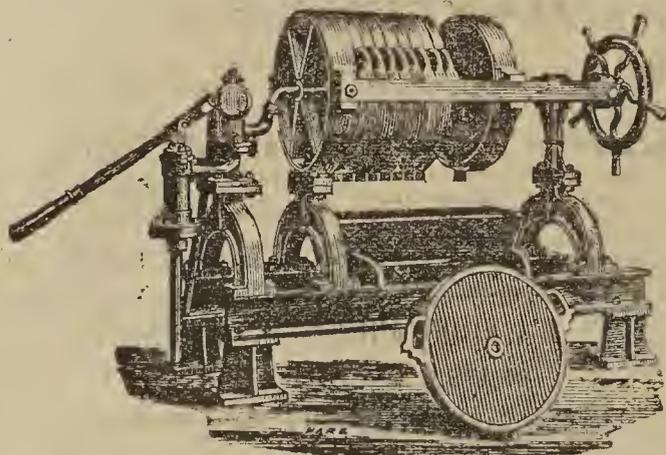
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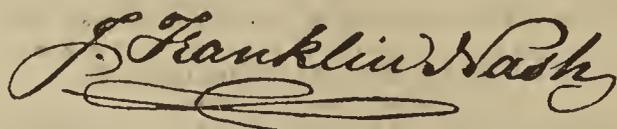
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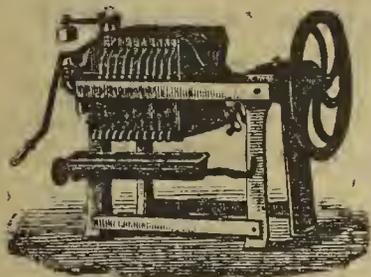
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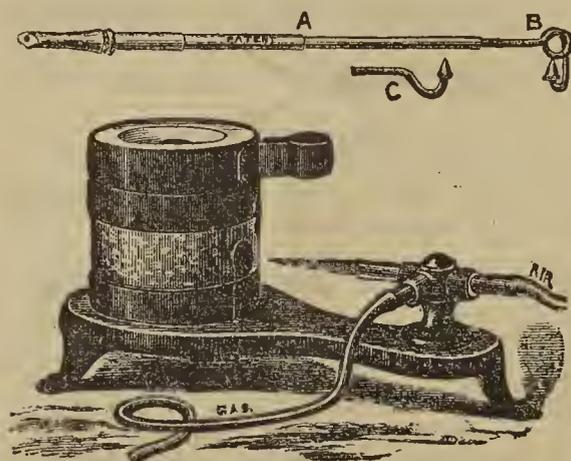
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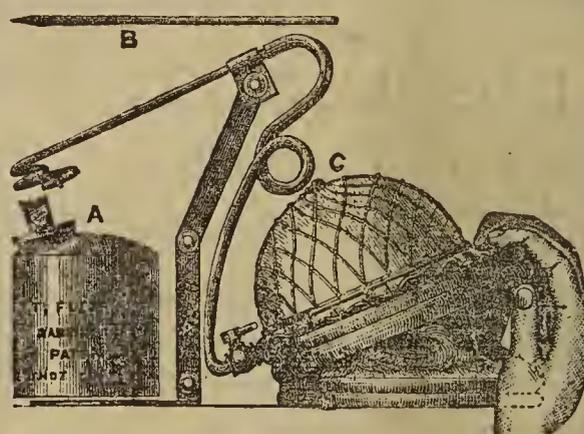
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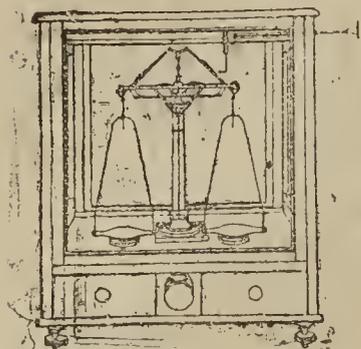
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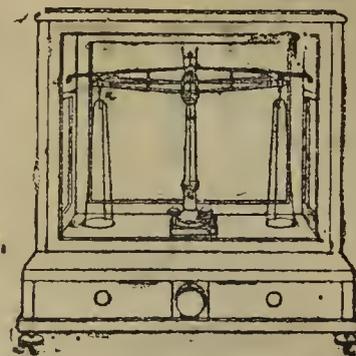
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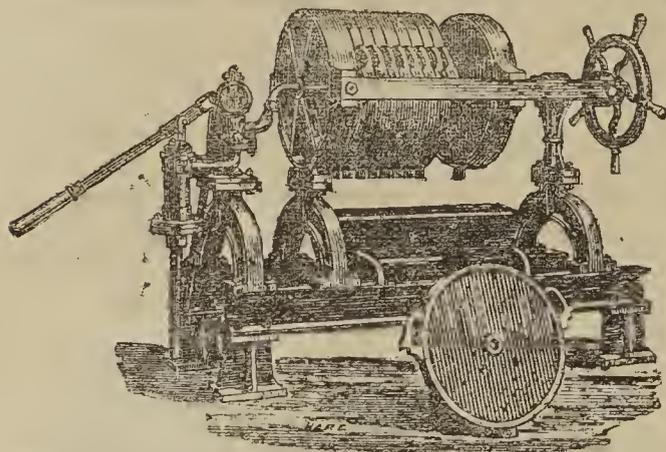
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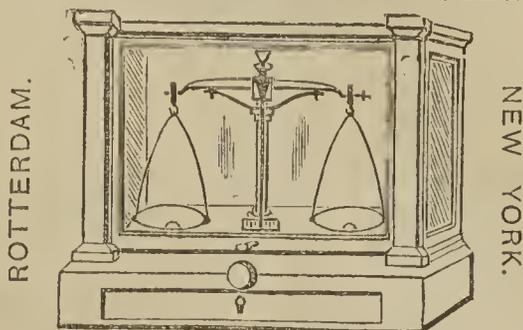
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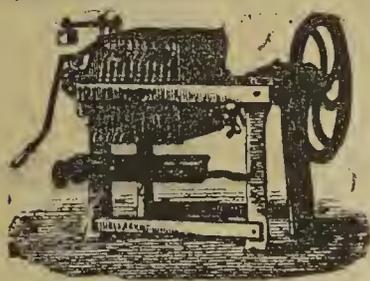
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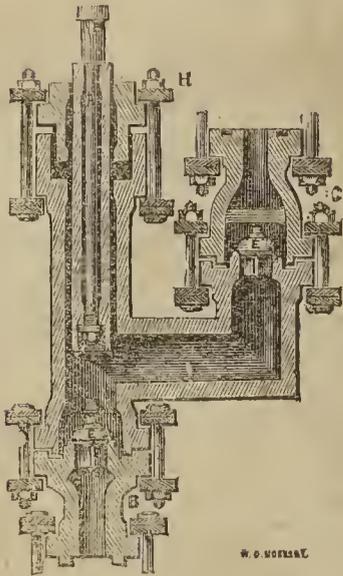
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No. 971.—JULY 5, 1878.

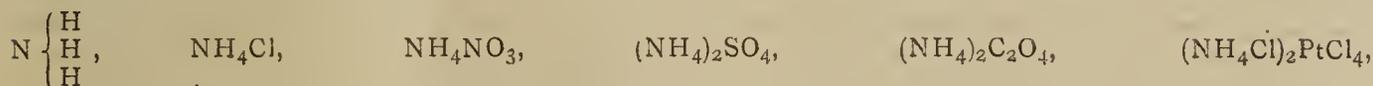
## ATTEMPTS TO PREPARE ALUMS CONTAINING ANILINE AND ROSANILIN.

By W. H. WOOD, Senior Assistant, Chemical Laboratory, Yorkshire College, Leeds.

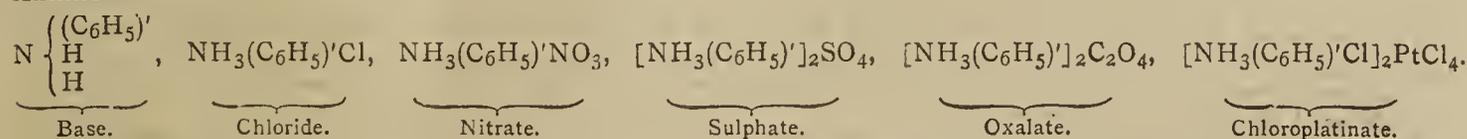
### I. Aniline.

1. THE analogy existing between the combinations formed by ammonia, methylamin (considered as a type of the primary monamines of the methyl series), and aniline are well known, resulting, as they do according to theory, from the similarity of their constitution. Thus, comparing the combinations of ammonia and aniline, we have—

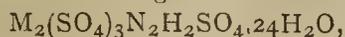
Ammonia—



Aniline—



Methylamin and ethylamin form analogous compounds. Ammonia and the bases just mentioned likewise enter into combination (as sulphates) with the sulphates of the metals aluminium, chromium, iron, and manganese,\* containing two equivalents of metal to three equivalents of  $\text{SO}_4$ , forming alums of the general formula—



where  $\text{M} = \text{Al}, \text{Cr}, \text{Fe}, \text{or Mn}$ , and  $\text{N} = \text{NH}_3, \text{CH}_5\text{N}, \text{or C}_2\text{H}_7\text{N}$ .

2. It was considered a subject of sufficient theoretical importance to determine whether the parallelism existed with respect to the formation of alums containing aniline, on which point no experiments appear to be recorded. With this object the following experiments were made:— It will be observed that aluminium sulphate was alone used, along with aniline sulphate in endeavouring to obtain the double salt, the reason being that alums containing aluminium are usually obtainable with greater facility and are more stable than those into whose composition chromium, iron, or manganese enters; conse-

\* Perhaps it would be more correct to say that ammonia forms these compounds, and that there is every probability of methylamin and ethylamin forming similar ones, as their sulphates have been obtained in combination with  $\text{Al}_2(\text{SO}_4)_3$ .

quently any deductions which follow in the course of this paper apply only to aluminium sulphate.

3. The first experiment was made with commercial sulphates of aniline and aluminium. 14.2 grms. of commercial aniline sulphate were taken and dissolved in 40 c.c. of hot water. This solution was then mixed with 36.63 grms. of aluminium sulphate, dissolved in 120 c.c. of hot water, the weights mentioned being in the proportion of  $(\text{C}_6\text{H}_7\text{N})_2\text{H}_2\text{SO}_4$  to  $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ . The mixed solution was placed in an evaporating dish over strong sulphuric acid, to evaporate and crystallise over night. Next morning the solution was in great part crystallised, the crystals were drained, re-dissolved, filtered after

addition of a little animal charcoal to decolourise the solution, and the solution evaporated. The crystals thus obtained were dried between filter-paper, after draining thoroughly, and tested qualitatively for Al,  $\text{C}_6\text{H}_7\text{N}$ , and  $\text{SO}_4$ , all of which were shown to be present. The amount of  $\text{SO}_4$  they contained was then estimated by precipitating as barium sulphate and weighing:—

a. 0.2170 grm. of crystals gave—	
0.2175 grm. $\text{BaSO}_4 = 33.06$ per cent $\text{SO}_4$ .	
b. 0.1975 grm. of crystals gave—	
0.1565 grm. $\text{BaSO}_4 = 32.77$ " "	
Mean .. .. . 32.915 " "	
Theory requires for $(\text{C}_6\text{H}_7\text{N})_2\text{H}_2\text{SO}_4$	33.802 " "
And for—	
$(\text{C}_6\text{H}_7\text{N})_2\text{H}_2\text{SO}_4\text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$	36.250 " "

4. The above analytical results appearing to indicate that the crystals were practically aniline sulphate with a little aluminium sulphate as an impurity. Further experiments were made with a view to test the validity of this conclusion; first, with pure aniline sulphate (prepared from pure aniline) and commercial aluminium sulphate, and afterwards with pure aniline sulphate, together with pure aluminium sulphate. The pure aniline was

obtained from pure aniline hydrochlorate,\* by adding sodium hydrate in excess, separating the liberated aniline by means of a separating funnel, and distilling in a current of hydrogen; aniline and water first distilled, then aniline almost colourless. The distillate was fractionated, water and aniline distilled at 100° to 104° C.; the temperature then quickly rose to 184° to 185° (uncorrected), at which point it remained stationary until the whole of the liquid had passed over. Aniline free from water and quite colourless was thus obtained as a highly-refracting oily liquid.

5. About 12 grms. of the aniline so obtained were mixed with the quantity of pure sulphuric acid (slightly diluted) requisite to neutralise it, and a saturated solution of the aniline sulphate prepared by addition of boiling water, the solution being aided by heating. A hot saturated solution of commercial aluminium sulphate was also made, the amount used being that requisite to form the alum with the aniline sulphate; to this solution the solution of aniline sulphate was added, the mixture heated to boiling for some time, and then filtered. The filtrate was of a brown colour, and speedily deposited needle-shaped crystals on cooling. The crystals were drained and re-dissolved, a small quantity of animal charcoal added to the solution, † which was then boiled and filtered. Crystals—plates and needles—having a pearly hue separated out from the filtrate; these were allowed to drain, dried between filter-paper, and the percentage of SO<sub>4</sub> determined.

a. 0.9690 grm. of salt gave—  
0.777 grm. BaSO<sub>4</sub> = 33.075 per cent SO<sub>4</sub>.  
b. 0.4975 grm. of salt gave—  
0.404 grm. BaSO<sub>4</sub> = 33.447 " "  
Mean .. .. 33.261 " "

By precipitation with ammonia before determining the SO<sub>4</sub> *a* gave 0.004 Al<sub>2</sub>O<sub>3</sub> = 0.413 per cent, while *b* gave a barely weighable quantity, showing that aluminium was simply present as an impurity.

Some of the crystals just analysed were subjected to a second solution, filtration, and re-crystallisation, the result on analysis being:—0.5555 grm. of salt gave 0.4560 grm. BaSO<sub>4</sub> = 33.807 per cent of SO<sub>4</sub>; theory requires for aniline sulphate 33.802 per cent SO<sub>4</sub>. The product was therefore aniline sulphate in a state of purity.

To determine the amount of non-volatile matter (Al<sub>2</sub>O<sub>3</sub>, &c.) in the original specimen from which this last was prepared, a weighed quantity was heated in a platinum crucible until all organic matter was burnt off.

2.021 grm. of salt gave on ignition 0.040 grm. of residue. Assuming this to be pure alumina it is equal to 1.979 per cent Al<sub>2</sub>O<sub>3</sub>; but after heating with KNaCO<sub>3</sub> (free from SO<sub>4</sub>), dissolving in water, and acidifying with HCl, BaCl<sub>2</sub> gave a tolerably abundant precipitate of BaSO<sub>4</sub>, showing that even this small residue was by no means pure Al<sub>2</sub>O<sub>3</sub>. It is evident, therefore, that the salt contained less than 1 per cent Al<sub>2</sub>O<sub>3</sub> as indicated by the determination previously quoted.

6. To obtain pure aluminium sulphate, ammonia alum was dissolved in hot water, the solution heated to boiling, and Al<sub>2</sub>(HO)<sub>6</sub> precipitated by addition of excess of ammonia; after boiling, the precipitate was allowed to subside, the liquid run off by means of a syphon, hot water poured on, and the washing continued by decantation until the wash-water was free from sulphates. The precipitate was then collected upon a filter, and dried in a water-bath. A weighed quantity was then heated in a platinum crucible to determine the amount of water it contained, when 0.9215 grm. lost 0.3428 grm. of water = 37.20 per cent. The aluminic hydrate consequently

contained 1 equiv. Al<sub>2</sub>O<sub>3</sub> to rather more than 3 equivs. H<sub>2</sub>O. Nearly 5 grms. of the hydrate were taken, mixed with the requisite quantity of sulphuric acid to form Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. This dissolved in the smallest possible quantity of water, and to it was added the proportionate quantity of pure aniline sulphate (made as before by adding pure slightly diluted sulphuric acid to pure aniline) also dissolved in the smallest possible quantity of water. The mixture was next evaporated down, and then allowed to cool. The crystals obtained were drained and divided into two portions A and B.

The portion A was washed several times with hot water until the greater part was dissolved. The solution (*a*) was then evaporated and re-crystallised. The crystals (*b*) remaining undissolved were also re-crystallised, and the amount of SO<sub>4</sub> contained in the two products determined.

a. { 1. 0.6458 grm. of salt gave—  
0.5123 grm. BaSO<sub>4</sub> = 32.684 per cent SO<sub>4</sub>.  
2. 0.7453 grm. of salt gave—  
0.5890 grm. BaSO<sub>4</sub> = 32.560 " "  
Mean .. .. 32.622 " "

b. 0.1385\* grm. of salt gave—  
0.1030 grm. BaSO<sub>4</sub> = 30.945 " "

All the results more nearly approach to aniline sulphate than to aniline alum.

The portion B was washed three or four times with cold water, which dissolved more than half. The solution (*a*) was evaporated down, and crystallised on cooling, the mass presenting the appearance of aluminium sulphate. † The crystals (*b*) remaining undissolved were also re-crystallised, the crystals obtained resembling those of aniline sulphate. The two crops of crystals were drained, dried, and the SO<sub>4</sub> determined.

a. 2.5690 grms. of salt gave—  
2.7292 grms. BaSO<sub>4</sub> = 43.769 per cent SO<sub>4</sub>.  
b. 0.9698 grm. of salt gave—  
0.7900 grm. BaSO<sub>4</sub> = 33.563 " "

Analysis *a* corresponds with Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.18H<sub>2</sub>O, for which theory requires 43.209 per cent SO<sub>4</sub>, while *b* corresponds with (C<sub>6</sub>H<sub>7</sub>N)<sub>2</sub>H<sub>2</sub>SO<sub>4</sub>, requiring 33.802 per cent SO<sub>4</sub>.

7. It will be observed that all the analytical results accord tolerably closely with the theoretical percentages of SO<sub>4</sub> required either for aniline sulphate or aluminium sulphate, and are either less by about 3 to 5 per cent or greater by 7 per cent than that required by aniline alum. The only seemingly reasonable conclusion to which these results lead is, that aniline sulphate does not form an alum by a combination with aluminium sulphate, and consequently that in this particular no analogy exists between aniline and ammonia and the primary amines of the methyl series. Further, it does not seem probable, when considering the alums of Cr, Fe, and Mn,—the difficulties of their preparation, and their instability as compared with those of Al,—that alums could be obtained containing these metals together with aniline, but on this point no experiments have been made.

## II. Rosanilin.

1. The results of the above experiments with aniline sulphate being purely negative, the probability that rosanilin sulphate would combine with aluminic sulphate was not thought to be very great when it was considered that rosanilin was even further removed from ammonia than aniline, being derivable from that body and toluylidin by the action of oxidising agents, which transform these primary aromatic amines into a secondary triamine containing the two dyad radicles phenylen (C<sub>6</sub>H<sub>4</sub>"") and toluylen (C<sub>7</sub>H<sub>6</sub>""). Still the analogy existing between the

\* The quantity obtained was too small to allow of duplicate analyses.

† The salt contained a trace of aniline.

\* For which, as well as for the pure rosanilin used in the experiments made with that base, I am indebted to the kindness of two friends.

† The animal charcoal appears to decompose the salt to some extent, a slight odour of aniline being recognisable after its addition.

salts of ammonia and those of rosanilin was sufficient to induce the trial of the following experiment.

2. Over 20 grms. of rosanilin base ( $C_{20}H_{19}N_3 \cdot H_2O$ ), nearly chemically pure, were added to the requisite quantity of hot, dilute, pure sulphuric acid, to form rosanilin sulphate [ $(C_{20}H_{19}N_3)_2H_2SO_4$ ], and this was mixed with the quantity of commercial aluminium sulphate in concentrated solution required to form the alum. The mixed solution was evaporated, and, on cooling, crystals having the metallic green lustre separated out. The crystals were drained, dried, and analysed. Heated on platinum-foil they left a residue of alumina. Two determinations of  $SO_4$  gave the following results:—

- a. 1.0643 grms. crystals gave—  
0.295 grm.  $BaSO_4 = 11.420$  per cent  $SO_4$ .
- b. 0.9372 grm. crystals gave—  
0.254 grm.  $BaSO_4 = 11.170$  „ „  
Mean .. .. 11.295 „ „

Theory requires for  $(C_{20}H_{19}N_3)_2H_2SO_4$ , 13.71 per cent  $SO_4$ ; and for  $(C_{20}H_{19}N_3)_2H_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ , 26.04 per cent  $SO_4$ . These results indicate that the crystals consist of rosanilin sulphate, with aluminic sulphate and probably water as impurities.

3. To ascertain if results more nearly accordant with those required by theory for rosanilin sulphate could be obtained, some of the crystals were dissolved in alcohol, filtered, re-crystallised, and dried at  $100^\circ C$ . The  $SO_4$  they contained was then determined.

- 0.2328 grm. of crystals gave—  
0.074 grm.  $BaSO_4 = 13.192$  per cent  $SO_4$ .
- Theory .. .. 13.710 „ „

4. It is evident, therefore, that rosanilin sulphate does not combine with aluminic sulphate to form an alum, and that in this respect it is unlike ammonia and the primary amines of the methyl series, but behaves like aniline, with which it is altogether more closely allied. The remark made, in conclusion, with respect to aniline not forming alums with the sulphates of Cr, Fe, and Mn, applies to rosanilin with equal, if not greater, force.

## ON AREOMETERS.\*—PART II.

By P. CASAMAJOR.

(Continued from p. 268.)

### Correction of the Indications of Areometers for Errors Resulting from Variations of Temperature.

In a paper, "On the Expansion of Sugar Solutions by Heat," in *American Chemist* for June, 1874 (vol. iv., p. 447), and in *Sugar Cane* for September, 1874 (vol. vi., p. 455), I gave a detailed account of the researches I was obliged to make to ascertain the expansion of sugar solutions up to the solution containing 23 per cent of sugar. As my object was limited to solutions which can be introduced directly in the tube of the saccharometer, I did not at that time go beyond 23 per cent of sugar. The extreme temperatures were  $5^\circ$  and  $45^\circ$  Centigrade. I took a certain volume of liquid at  $5^\circ$ , and ascertained the total expansion from  $5^\circ$  to  $45^\circ$ , and afterwards divided this expansion by 40, the total number of degrees, and by the volume at  $5^\circ$  in cubic centimetres, the result being the mean expansion of 1 c.c. for every degree between these limits of temperature. The expansion of pure water was ascertained in this way, also that of sugar solutions containing  $11\frac{1}{2}$  per cent and 23 per cent of sugar.

The mean relative expansion of 1 c.c. of water for every degree Centigrade between  $5^\circ$  and  $45^\circ$  was found to be

0.00021; \* that of the solution containing 23 per cent of sugar was 0.00023, and the solution containing  $11\frac{1}{2}$  per cent, instead of giving the average 0.00022, gave repeatedly 0.000215. As this latter number did not depart very sensibly from the average, I had a right to conclude that the intermediate numbers followed materially the same laws as the extremes.

To apply the expansion 0.00021 to the areometer which I use for testing sugar solutions, we must remember that we found for this areometer  $N=260$ ; therefore, the average expansion for an increase of  $1^\circ C$ . is  $260 \times 0.00021 = 0.0546$  degree.

If we place the same areometer in a solution  $23^\circ$  Balling, the submerged portion is  $260^\circ - 23^\circ = 237^\circ$  Balling, and the average expansion in this case is  $237 \times 0.00023 = 0.0545$ . As we have admitted that the intermediate solutions follow materially the same laws as the extremes, we arrive at this remarkable result:—*That the mean correction for variation of temperature is the same for sugar solutions up to 23 per cent of sugar as for water.* Now, if we remember that the graduation of a Balling areometer increases downward, so that the deeper the instrument sinks the less is the degree indicated; and if we admit that the expansion from degree to degree is  $0.0545^\circ$ , we may see that the indication at any temperature may be restored to that corresponding to the normal by adding 0.0545 as many times to the observed indication as there are degrees between the observed temperature and the normal.

If  $15^\circ$  is the normal, at  $16^\circ$  we would have to add  $0.0545^\circ$ , at  $17^\circ$   $0.109^\circ$ , at  $18^\circ$   $0.163^\circ$ , &c. Between  $12^\circ$  and  $27^\circ C$ ., to which I always brought the temperature of my solutions, the error committed by taking a uniform expansion does not exceed  $0.087^\circ$ .

I have, however, more recently calculated the expansion of water for every degree C. Taking  $15^\circ C$ . as a normal, the numbers of the following table, No. 3, were obtained by multiplying the relative expansions as given in the third column of Table No. 1 by 260. Table No. 4 is calculated by taking  $17\frac{1}{2}^\circ C$ . as a normal, to be used for areometers made in Germany, as these are based on  $17\frac{1}{2}^\circ C$ . ( $14^\circ R$ .)

To make use of either of these tables, we place a Balling's areometer in a sugar solution, and note the degree and tenth of degree indicated, and afterwards place in the same solution a thermometer, and note the temperature. Opposite to the temperature observed we find the number to be added to the indication of the areometer, if above the normal, or to be subtracted if below.

If we take  $15^\circ C$ . as a normal, and the areometer gives  $12.8^\circ$ , while the thermometer shows  $20^\circ$ , the correction in Table No. 3 is 0.218, which is added to 12.8, giving 13.018.

We may, however, correct the indication of the Balling areometer in a simpler and quicker way by using a method entirely analogous to that which I gave for volumetric analysis in the paper read before this Society in December.

This consists in erecting a series of vertical equidistant lines, the space between two of which corresponds to  $1^\circ C$ ., and intersecting these lines by a series of equidistant lines perpendicular to the first, the distances between two of which we may make equivalent to  $0.01^\circ$  Balling. We may then, adopting either  $15^\circ$  or  $17\frac{1}{2}^\circ C$ . as a normal, take on every vertical line a distance corresponding to the hundredths of a degree, as found in the second column of Table No. 3 or No. 4, and afterwards connect the points thus obtained by a curve. By finding the points at which this curve intersects the horizontal lines corresponding to 0.1, 0.2, &c., of a degree, and noting the temperatures at these intersections, we form Table No. 5 for  $15^\circ C$ . as a normal, and Table No. 6 for  $17\frac{1}{2}^\circ C$ . as normal. We may

\* For the sake of comparison we may add the total relative expansion from  $15^\circ$  to  $45^\circ$  ( $0.008312$ ) to the total relative contraction from  $15^\circ$  to  $5^\circ$  ( $0.000612$ ), as found in the third column of Table No. 1, and divide the sum 0.008924 by 40, which gives 0.000223. This number is very nearly the same as the one I found directly. If we consider the series of operations by which the numbers 0.008312 and 0.000612 were obtained, as explained in the paper read before this Society in December, the coincidence, or quasi-coincidence, is certainly satisfactory.

TABLE NO. 3.—CORRECTIONS OF BALLING'S AREOMETER.  
(Normal Temperature 15° C.)

Degrees C.	Correction of Areometer.	Degrees C.	Correction of Areometer.	Degrees C.	Correction of Areometer.
5	0.159	19	0.169	33	1.049
6	0.161	20	0.218	34	1.128
7	0.159	21	0.269	35	1.212
8	0.153	22	0.323	36	1.297
9	0.143	23	0.380	37	1.384
10	0.127	24	0.438	38	1.473
11	0.109	25	0.506	39	1.570
12	0.086	26	0.567	40	1.659
13	0.062	27	0.631	41	1.755
14	0.032	28	0.697	42	1.854
15	normal	29	0.764	43	1.954
15	0.038	30	0.833	44	2.054
17	0.079	31	0.898	45	2.158
18	0.123	32	0.972		

TABLE NO. 4.—CORRECTIONS OF BALLING'S AREOMETER.  
(Normal Temperature 17½° C.)

Degrees C.	Correction of Areometer.	Degrees C.	Correction of Areometer.	Degrees C.	Correction of Areometer.
5.5	0.262	19.5	0.083	33.5	0.983
6.5	0.263	20.5	0.143	34.3	1.037
7.5	0.261	21.5	0.193	35.5	1.120
8.5	0.252	22.5	0.250	36.5	1.204
9.5	0.243	23.5	0.308	37.5	1.344
10.5	0.228	24.5	0.367	38.5	1.381
11.5	0.208	25.5	0.428	39.5	1.473
12.5	0.183	26.5	0.492	40.5	1.573
13.5	0.157	27.5	0.557	41.5	1.664
14.5	0.110	28.5	0.622	42.5	1.762
15.5	0.076	29.5	0.700	43.5	1.862
16.5	0.040	30.5	0.765	44.5	1.964
17.5	normal	31.5	0.832	45.5	2.079
18.5	0.045	32.5	0.907		

notice that in Table No. 5 the correction +0.1° happens at 17½° C., so that Table No. 6 is easily obtained by subtracting 0.1 from the indications of the preceding table.

TABLE NO. 5.

Degrees Centigrade.	Degree Balling to be added.
9.5	-0.15
11.8	-0.1
15.0	normal
17.5	0.1
19.7	0.2
21.6	0.3
23.4	0.4
25.2	0.5
26.7	0.6
28.2	0.7
29.5	0.8
31.0	0.9
32.5	1.0
34.0	1.1
35.0	1.2
36.4	1.3
37.7	1.4
38.8	1.5
40.0	1.6
40.7	1.7
41.8	1.8
43.0	1.9
44.0	2.0
45.0	2.1

TABLE NO. 6.

Degrees Centigrade.	Degree Balling to be added.
9.5	-0.25
11.8	-0.2
15.0	-0.1
17.5	normal
19.7	0.1
21.6	0.2
23.4	0.3
25.2	0.4
26.7	0.5
28.2	0.6
29.5	0.7
31.0	0.8
32.5	0.9
34.0	1.0
35.0	1.1
36.4	1.2
37.7	1.3
38.8	1.4
40.0	1.5
40.7	1.6
41.8	1.7
43.0	1.8
44.0	1.9
45.0	2.0

We may, instead of either of these tables, use a thermometer with an ivory scale, having, on one side of the mercury column, the degrees C., and on the other side the numbers in the second column of either Table No. 5 or Table No. 6, exactly as for the thermometer which I de-

scribed in detail in the paper read before this Society in December.

If, instead of the areometer giving the percentage of sugar, we wish to use one giving the specific gravities, we must remember that, in the case of water, we may use Table No. 2 by simply adding the numbers opposite to the temperatures observed to obtain the correct reading at the normal temperature. We have shown, besides, that for Balling's areometer *the correction of temperature is the same for all sugar solutions up to 23 per cent of sugar as for water.* Therefore, for any sugar solution up to sp. gr. 1.1, we have merely to add the numbers opposite to the temperatures observed, as found in Table No. 2, to restore the indication of the areometer to the specific gravity at 15° C.

If, as it is usual in Germany, we take 17½° C. as a normal, we may use the following table, No. 7:—

TABLE NO. 7.

Degree Centigrade.	Quantity to add to sp. gr.	Degree Centigrade.	Quantity to add to sp. gr.
7.5	-0.001	34.7	0.004
13.0	-0.0005	36.2	0.0045
17.5	0	37.4	0.005
20.2	0.0005	39.0	0.0055
23.0	0.001	40.5	0.006
25.0	0.0015	42.0	0.0065
27.0	0.002	43.4	0.007
29.0	0.0025	44.2	0.0075
31.0	0.003	45.0	0.008
32.5	0.0035		

As in previous cases, we may, instead of using the Tables No. 2 and No. 7, write the corrections directly on the ivory scale of a thermometer on one side of the column of mercury, opposite to the corresponding temperatures on the other side.

In describing the methods that I have given for correcting the errors in the indications of areometers in the case of sugar solutions up to the solution holding 23 p. c. of sugar, I have proved that the total correction for expansion is the same as for pure water from 5° to 45° C., but I have not afforded any proof that sugar solutions vary in expansion from degree to degree in a manner exactly parallel to the expansion of water, although I have assumed that such is the case. I can say, however, that I have the best of reasons for knowing that no appreciable error is committed by this assumption, for, by making a great number of tests of the same sugar at different temperatures and at different degrees of dilution, I have repeatedly obtained the same coefficient of purity within less than ½ p. c. As such facts have presented themselves hundreds of times in my practice, I have no hesitation in recommending the method I have given for solutions within the limits mentioned.

This conclusion is confirmed by what happens when a solution containing 11½ p. c. or 23 p. c. of sugar is placed in a dilatometer and cooled down to 5° C., and afterwards the dilatometer is placed in a water-bath kept at 45° C. The volume of the solution increases at first very slowly, but gradually the rate of increase, for equal spaces of time, becomes greater, and towards the end the increase of volume is very rapid. As the rate at which the temperature of the solution increases is proportional to the excess of the temperature of the bath over that of the contents of the dilatometer, the rate of increase of temperature is greater at first than towards the end. This circumstance renders the increase of the rate of expansion towards the end more remarkable, and shows that the law of expansion for these sugar solutions is very nearly the same as for water.

As to thicker sugar solutions, I have lately determined the expansion of the solution of specific gravity 1.192 (23.2° Beaumé), and that of the solution of specific gravity 1.3116 (34.2° Beaumé), between 5° and 45° C., which are given in the table below. To compare the corrections

to be made with areometers of even scales, in the case of these expansions, with the corrections in the case of solutions containing 23 p. c. of sugar or less, I have expressed the densities of all these solutions in Beaumé degrees, as Beaumé's areometer, in which  $N = 144$  is commonly used for sugar solutions of all kinds, while the areometer in which  $N = 260$  is only suitable for weak solutions, as I have already explained.

Degrees Beaumé.	Average Expansion of 1 c.c. between 5° and 45° C.	Number of Areometer Degrees Submerged.	Correction—Product of 2nd by 3rd Column.
0	0.00021	144.0	0.03024
13 (23 p. c. sugar)	0.00023	131.0	0.03013
23.2	0.00028 $\frac{1}{2}$	120.8	0.03473
34.2	0.000328	109.8	0.03601

We may see in this table that at 0° and 13° Beaumé the correction is materially the same as I have shown for the areometer in which  $N = 260$ .

In the case of thicker solutions, up to 34° Beaumé, we may also see that the corrections are represented by larger numbers, and we are naturally led to inquire whether for such solutions we may still correct the indications of areometers by using the tables I have given without incurring the risk of committing serious errors.

As the error committed would be the greatest with a solution of 34.2° Beaumé, we may find the maximum error by calculating on the base of a mean correction for every degree Centigrade = 0.03601°, and supposing that the observation is taken at 45° C. The total correction in this case is  $0.03601^\circ \times 30 = 1.083^\circ$ , while, if the mean correction for every degree C. is 0.0302°, the total correction is  $0.0302 \times 30 = 0.906$ ; the difference, 0.177, is the maximum error we may commit by using the table I have given. For thinner solutions and for lower temperatures the error would be less.

In the case of sugar solutions having 23 p. c. of sugar or less, I have given my reasons for thinking that their laws of expansion are similar to those of pure water. I may add that solutions of density equal to 23.2° and 34.2° Beaumé show the same peculiarity in the dilatometer of greater expansion for equal spaces of time as the temperature increases.

### TIN IN CANNED FOOD.

By ALBERT E. MENKE.

IN opening a tin can of pine-apples, I found that at the place where the tin had been soldered corrosion had taken place, which induced me to test for tin, having found indications of it, and made a quantitative analysis with the following results:—I first poured the syrup off, and squeezed out the juice from the fruit; then oxidised with chlorate of potash and hydrochloric acid, boiled, and then reduced the tin to the stannous state with sulphite of soda; sulphuretted hydrogen was then passed through the liquid, the tin sulphide was then filtered off, dissolved in strong hydrochloric acid, largely diluted, and titrated with potassium permanganate. 0.151335 gramme of tin was found in a tin of pine-apple, which weighed 1 $\frac{1}{4}$  lbs. I next tried lobster and apples, and found in the lobster 0.010089 gramme, and in the apples 0.00672 gramme of tin, showing that the pine-apple was the worst, which would support the theory that it was due to the corrosion.

Chemical Laboratory, King's College,  
June 28, 1878.

Ozone.—According to M. Erémine, the decomposition of ozone in daylight is slower than in the dark, and if kept for some time after its preparation without being used, its disinfecting power is increased.—*Les Mondes*.

### ON BOTTLE-GLASS.

By Dr. H. MACAGNO,

Director of Agricultural Station of Gattinara (Italy).

IN the following table are indicated the results of analyses made on several samples of bottle-glass. Every bottle is named by the quality of wine it is commonly employed for keeping; the specific gravity and the chemical composition were determined by the ordinary processes; the solubility in water is given by the quantity of materials dissolved in 5 litres of water boiling for an hour with 100 grms. of the finely-powdered glass; the corrosion degree is ascertained also by boiling for an hour 100 grms. of the same powder in 5 litres of potassium bitartrate solution at 0.33 per cent, and estimating the quantity of tartaric acid neutralised. An inverted Liebig's condenser maintained the liquid volume constant in both these operations.

No. 24 contained a little manganese. In all the samples magnesia was sought, but only in Nos. 16, 17, 19, 21, 27, and 34 the quantity found could be estimated, and was included with the lime. (For Table see next page.)

These results lead to the conclusion that the chemical composition of bottle-glass is not a sufficient character for judging of its quality. The amount of alkali or lime does not indicate the resisting power of the glass to water or acids, which is the most important condition for wine keeping.

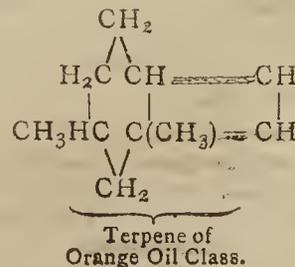
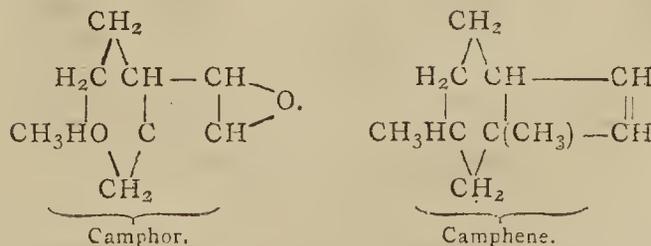
Therefore the superior quality of the French glasses is well shown by these results, while, on the contrary, the Rhine, Madeira, Malaga, and Xeres bottles seem of a very bad composition. In order of colour we must set in the first rank the deep green; in the second, the white and common green: the clear green, the red-brown, and the yellow-brown are the worst, and they must be regarded as easily dangerous to ordinary wines rich in potassium bitartrate.

### PROCEEDINGS OF SOCIETIES.

#### CHEMICAL SOCIETY.

Thursday, June 20, 1878.

THE last communication made to the meeting was by Dr. ARMSTRONG, entitled "Laboratory Notes." (1.) The author described and exhibited a simple apparatus for fractional distillation. (2.) A method for the separation of mensitylene and pseudo-cumene was described, based on the fact that the sulpho-acid of the former is decomposed much more readily than that of the latter on heating with hydrochloric acid. (3.) The author suggested new formulæ for camphor and the terpenes of the lemon oil and camphene classes, which are appended:—



		Chemical Composition per cent.					Solubility in Water.	Corrosion Degree.	Origin.
	Specific Gravity.	Potash and Soda.	Lime.	Alumina and Iron.	Silicic Acid.				
<i>White Glass.</i>									
1.	Used for Rhenish .. ..	2'423	13'48	7'56	1'83	77'13	2'605	1'650	Austria.
2.	„ Bordeaux .. ..	2'429	13'22	8'89	1'75	76'14	2'450	1'275	France.
3.	„ Lunel, first quality ..	2'489	16'10	8'54	1'82	73'54	2'740	2'100	„
4.	„ „ second quality ..	2'461	18'45	6'64	1'13	73'95	2'930	2'750	„
5.	„ Chianti .. ..	2'462	11'29	9'65	3'09	75'97	2'360	2'325	Italy.
	Mean .. ..	2'453	14'51	8'22	1'92	75'34	2'617	2'020	
<i>Clear Green Glass.</i>									
6.	Used for Tokay, first quality ..	2'408	13'82	7'09	4'93	74'16	2'900	3'000	Hungary.
7.	„ „ second quality ..	2'484	14'58	6'40	4'00	75'00	4'460	5'775	„
8.	„ Fellner .. ..	2'529	18'16	9'69	7'48	64'67	2'170	3'150	„
	Mean .. ..	2'474	15'52	7'73	5'47	71'27	3'177	3'975	
<i>Common Green Glass.</i>									
9.	Used for Rhenish .. ..	2'513	19'42	7'89	5'37	67'32	4'700	6'975	Austria.
10.	„ „ .. ..	2'492	20'89	6'01	5'35	67'75	7'600	9'525	„
11.	„ Bordeaux .. ..	2'559	3'75	16'06	14'27	65'92	2'550	2'550	France.
12.	„ „ .. ..	2'600	10'76	15'02	13'96	60'26	1'650	1'350	„
13.	„ „ .. ..	2'577	7'94	15'09	8'79	68'18	1'450	1'500	„
14.	„ „ .. ..	2'702	3'88	23'59	16'25	56'28	1'530	1'575	Italy.
15.	„ Champagne .. ..	2'659	6'59	19'36	11'96	63'09	1'000	2'325	France.
16.	„ „ .. ..	—	4'48	28'15	7'21	58'52	—	—	Italy.
17.	„ Rohitscher .. ..	2'522	15'62	11'49	8'27	64'62	1'740	2'400	Hungary.
18.	„ Xeres .. ..	2'561	9'67	11'94	15'61	62'78	1'480	1'125	Spain.
19.	„ „ .. ..	2'516	17'18	11'55	6'68	64'59	2'300	2'700	„
	Mean .. ..	2'570	10'92	15'10	10'34	63'56	2'600	3'202	
<i>Deep Green Glass.</i>									
20.	Used for Bourgogne .. ..	2'674	2'86	23'36	14'92	58'86	1'270	1'275	France.
21.	„ „ .. ..	—	3'91	29'81	6'15	58'32	—	—	Italy.
	Mean .. ..	2'674	3'38	26'58	10'53	58'59	1'270	1'275	
<i>Red-brown Glass.</i>									
22.	Used for Rhenish .. ..	2'513	19'34	6'94	7'45	66'27	4'610	6'675	Austria.
23.	„ „ .. ..	2'519	19'68	8'49	6'56	65'27	3'180	5'100	„
24.	„ Bourgogne .. ..	2'510	17'76	11'29	5'60	65'35	3'350	3'900	France.
25.	„ Ruster .. ..	2'462	20'01	4'75	3'57	71'76	4'580	7'265	Hungary.
26.	„ Rohitscher .. ..	2'578	9'82	13'12	11'22	65'84	1'630	1'500	„
27.	„ Rhine .. ..	—	8'04	21'08	6'91	62'21	—	—	France.
	Mean .. ..	2'516	15'77	9'28	6'88	66'15	3'470	4'888	
<i>Yellow-brown Glass.</i>									
28.	Used for Bordeaux .. ..	2'629	3'82	26'25	11'17	58'76	1'370	1'500	France.
29.	„ Madeira, first quality ..	2'537	19'07	10'25	5'86	64'82	2'470	3'300	Spain.
30.	„ „ second qual. ..	2'565	15'68	11'75	10'53	62'04	2'380	2'925	„
31.	„ Malaga .. ..	2'519	19'11	11'51	7'96	61'42	2'660	4'125	„
32.	„ Mosler .. ..	2'556	16'75	10'11	10'32	62'91	2'670	3'750	Croatia.
33.	„ Xeres .. ..	2'511	17'68	10'42	5'14	66'76	3'470	4'725	Spain.
34.	„ Little Champagne .. ..	—	10'21	20'11	5'14	63'15	—	—	Italy.
	Mean .. ..	2'553	14'62	14'35	8'02	62'84	2'504	3'387	

## NOTICES OF BOOKS.

*Handbook of Modern Chemistry, Inorganic and Organic, &c.* By CHARLES MEYMOTT TIDY, M.B., &c., Professor of Chemistry at the London Hospital. London: J. A. Churchill. 1878.

DR. MEYMOTT TIDY'S Manual of Chemistry is the very latest contribution to chemical literature, and is in every respect one of the most complete minor treatises on the subject which has yet appeared. The author, by judicious condensation, and by the avoidance of anything approaching to verbosity or fine writing, has managed to compress an enormous amount of information, practical and theo-

retical, into some 730 pages. The mere collection of such a mass of details from all points of the compass must have been a colossal task, and we are bound to say that the way in which they are arranged shows that the hand of the experienced professor has been at work as well as that of the patient and careful compiler. A book like the present must of necessity be to a great extent based on those which have gone before, and it is only by the mode in which its principles and facts are classified and correlated that the author can lay claim to any originality. A striking instance of this occurs at the end of the description of the halogens and their compounds, where Dr. Tidy shows the relations of those elements to each other in a very complete manner. He first shows the student that in their origin, atomicity, action on water

and organic bodies, bleaching, oxidising, and disinfecting powers, and their metallic salts, they closely resemble each other, while in their form, colour, specific gravity, and atomic weight, as well as in many of their reactions, they exhibit a remarkable sequence of properties. We do not remember to have seen these relations so fully described in any other manual, the existence of orders, genera, and species amongst the elements being only too often slurred over.

Dr. Tidy divides his work into three sections,—the chemistry of the non-metals; the chemistry of the metals; and the chemistry of organic bodies; each element and compound being considered under six different heads,—history; natural history; preparation; sensible physical and chemical properties; uses in medicine; and the arts and tests. The author being a professor in a medical school, great prominence is very properly given to the bearing of chemistry on medicine and hygiene, the theoretical, analytical, and technological information given being in no way curtailed.

For the sake of students and teachers who have adopted Dr. Frankland's system of notation, the ordinary and constitutional formulæ of most compounds are given side by side.

Leaving the large amount of information conveyed to the student in so small a compass out of the question, the book is a model of how such a work should be arranged. It is long since we have seen a scientific manual put together in such a thoroughly workmanlike manner. It is printed on good paper in beautifully clear type, and the index, as well as the numerous tables, are particularly copious and well-arranged.

The information supplied is brought down to the very latest date, gallium and Piçet's researches on the liquefaction of gases being found in their proper places.

Dr. Tidy's work is quite worthy of ranking with the classical manuals of Miller and Fownes, and we may safely prophesy that it will speedily take its place side by side with them in all chemical libraries.

*Report on Canadian Graphite, with Special Reference to its Employment as a Refractory Material.* By CHRISTIAN HOFFMANN. Montreal. 1878.

THIS report forms part of those addressed to the Geological Survey of Canada, and is intended to show that the Canadian graphlite is fully equal to that of Ceylon for the manufacture of plumbago crucibles and for similar purposes. Mr. Hoffmann gives us numerous comparative tables showing the specific gravity and composition of different specimens of the two graphites, which seem to show that on an average there is but little to choose between them, some of the Canadian specimens being superior in relative incombustibility and freedom from ash. Specimens from the Ticonderoga Mines, in the State of New York, were found to be much less pure than the Ceylon and Canadian qualities. Taking the relative combustibility of the best specimen of Ceylon graphite at 1.00, two specimens of the Canadian variety ranked at 0.98 and 0.99 respectively.

*On the Filtration of Potable Water.* By Professor W. R. NICHOLS, of the Massachusetts Institute of Technology. Boston: Rand, Avery, and Co. 1878.

THIS is a valuable report addressed by Professor Nichols to the Massachusetts State Board of Health on the different methods of filtering water for public or private purposes at present in use in Europe and America. We learn from it with some surprise that the practice of filtering water on a large scale is only just beginning to come into use in America, and this in spite of our Transatlantic brethren being confirmed water drinkers—at table at least. Poughkeepsie, a small town of some 25,000 inhabitants, on the Hudson, was the first to adopt a

proper system for the artificial filtration of its water supply in 1871, but its good example seems to have been followed in only two or three instances. Certain towns and companies professed to filter their water as far back as 1853, but as the areas of the filter beds were totally inadequate, and the cleansing insufficient and infrequent, the water might just as well have been used in its natural condition. Professor Nichols gives it as his opinion that good animal charcoal is the best filtering material for household filters. At the end of the report there is a long list of works on the subject in English, French, and German.

*Metals; and their Chief Industrial Applications.* By CHARLES R. ALDER WRIGHT, Lecturer on Chemistry at St. Mary's Hospital Medical School. London: Macmillan and Co. 1878.

DR. ALDER WRIGHT'S little book is founded on a course of lectures delivered by him at the Royal Institution in 1877. In the opening chapter the author gives us a general sketch of the physical and chemical principles involved in the extraction of metals from their ores by volatilisation, amalgamation, smelting, liquation, and the various wet processes. The table showing the classification of the different metal extracting processes is an excellent one, and deserves reprinting in larger type for suspension in technological class-rooms. The next three chapters are devoted respectively to the metallurgy of the precious metals; of the more important industrial metals, such as iron, copper, and zinc; and of the less important base metals, such as aluminium, nickel, &c. The physical properties of metals are next treated of, the 6th chapter being given up to their thermic and electric relations, the last chapter giving an account of their chemical relations.

It will be thus seen that, as far as arrangement goes, Dr. Alder Wright has treated his subject in a methodical and logical manner. The matter, both in style and accuracy, is, generally speaking, worthy of the arrangement, although at times the author, as in the first chapter, has yielded to the temptation of going into theoretical considerations which are far above the comprehension of the reading public. The practical part of the book is particularly plain and devoid of abstruse technicalities, the chapter on the physical relations of the metals being particularly good. The information given is brought down to the latest moment, the telephone being described as illustrating the powers of magnetised steel. The work is illustrated by numerous woodcuts.

*A Manual of Microscopic Mounting, with Notes on the Collection and Examination of Objects.* By JOHN H. MARTIN. Second Edition. London: J. and A. Churchill. 1878.

THIS work contains a large amount of information not only on mounting objects for the microscope, but also many valuable hints on microscopic manipulation generally. The first edition of Mr. Martin's manual, which was published in 1872, has long been out of print, and he has done well to publish a second edition. The present edition has been revised (very carelessly, by the way), and several of the illustrations have been re-drawn. The analytical chemist will find a number of interesting details on micro-analysis.

Although professedly a work on mounting only, Mr. Martin might have given us a short account of micro-spectro-analysis. The misprints amongst the Latin names are very numerous, and Mr. Martin's style is often more practical than lucid. He gives us the latest formulæ for various chemical substances, but adheres to such old-fashioned names as potass, carbazotic acid, &c. The work is illustrated by nearly 150 woodcuts, many of which are very badly executed. In spite of these defects, however,

Mr. Martin's book is a very useful one. What does the author mean by dubbing himself a "Fellow" of the "Society of Arts?"

*Report on the Air of Glasgow*, with Tables of Wind, Temperature, and Rainfall, for the Months of September and October, 1877. By E. M. DIXON, B.Sc., in co-operation with the Medical Officer of Health. Presented to the Committee of Health of the Magistrates and Council of Glasgow, February 25, 1878.

A SYSTEMATIC examination of the chemical composition of the air is made at a number of points in the city of Glasgow. At each station the air is drawn for two or three days continuously, in several distinct currents, through as many distinct solutions, each adapted to withdraw some special substance from the stream of air passing through it. Each current is afterwards measured by means of a special gas-meter, and the matter taken up in each solution is finally determined by delicate micro-chemical processes, the details of which will be given on a future occasion. The substances thus sought for have been carbonic acid, sulphur in combination, chlorine, free and combined, nitrogen as ammonia, and nitrogen as "albuminoid ammonia." The rainfall, velocity and direction of wind, and the temperature have been simultaneously recorded. The observers find that the quantity of nitrogenous matter in the air is decidedly increased during the summer months, and that the effect of a fresh breeze in purifying the air of the city is very distinct.

We quite agree with the author that such observations, to be useful, should be made continuously.

*Microscopical Examination of Water.\** By WENTWORTH LASCELLES SCOTT.

THE author insists upon a microscopical examination of water as an adjunct to its chemical analysis, and to facilitate the former process and secure uniformity of results, he proposes to concentrate the vegetable or animal matter, suspended in water in a very small volume, by filtering it through filter papers, the centre of which is rendered impervious to water by means of a fatty composition. In this manner all the organisms may be easily collected in the small water-tight cone at the bottom of the funnel. If the paper is altogether too porous, he proposes to render it less pervious by immersion, in a "thin, structureless collodion."

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 21, May 27, 1878.

Part Played by the Auxiliary Acids in Etherification, from a Thermo-Chemical Point of View.—M. Berthelot.—The author has established by chemical experiments the conditions of the formation of acetic ether, regarded as the type of the ethers of organic acids with the auxiliary concourse of hydrochloric acid. These experiments have thrown a light upon the influence of water and of the compounds which it forms with the hydracid. He now extends his inquiries not merely to the ethers, but to all the other products of the reciprocal action of the six bodies present, alcohol, water, and the hydrochloric acids and ethers.

**Production and Constitution of Chromium Steels.**—M. Boussingault.—The methods followed for the determination of chrome and of carbon in chromium steels and in ferro-chrome is referred to, but not given.

**Transparent Hydrated Silica and Hydrophane, Obtained by the Action of Oxalic Acid upon the Alkaline Silicates.**—E. Monier.—The experiment should be made upon a weight of 500 to 600 grms. silicate of soda at 35° or 40° B., whilst the oxalic acid is diluted to 4° B. If this acid is allowed to act for six months at the ordinary temperature a transparent siliceous layer is obtained of from 1 to 3 millimetres in thickness. An important precaution is to incline the vessel containing the silicate of soda at an angle of 45°, and then pour in the oxalic acid.

**Certain Features Presented by the Disposition of Fire-Damp in Mines.**—J. Coquillion.—The author finds that where the atmosphere is still, fire-damp mixes very slowly with air, and seems to form distinct zones.

**Thermo-chemical Study of Certain Substitution-products of the Acetic and Benzoic Acids.**—W. Louguinine.—This paper does not admit of useful abstraction.

**Researches on Glycolide.**—J. H. Norton and J. Tcherniak.—The authors adopt the following method for the preparation of glycolide. They dissolve sodium in 15 parts of absolute alcohol, and add a concentrated alcoholic solution of chloroacetic acid. After standing for some hours almost the whole of the sodium chloroacetate separates as a white precipitate. This is collected upon a funnel, drained by means of a filter-pump, and dried. It is then heated to 100° in a stove, and when perfectly dry the temperature is gradually raised to 150°. It is well to spread out the salt over large flat surfaces, stirring from time to time. After thus heating the salt for two days it is withdrawn from the stove, powdered, and taken up again with boiling water, thrown upon a filter, and washed as long as the washings are precipitated by nitrate of silver. The residue, dried at 200°, is perfectly pure glycolide.

**On Trimethyl-glyceramin.**—M. Harriot.—The author obtained this compound in the form of orange-coloured tables belonging to the orthorhombic system. These crystals, though anhydrous, effloresce in a dry vacuum from the loss of hydrochloric acid. They dissolve in cold water, and more freely in hot water, and are not decomposed on boiling as much as the impure salt. They are insoluble in alcohol.

**Researches on the Ammoniacal Citrates.**—E. Landrin.—The author examines whether the citrate of ammonia acts merely as a solvent upon metallic oxides, or if it enters into direct combination with such oxides. The citrate of lime, insoluble in water, is soluble in ammonium citrate, and it is the solubility of this salt which hinders the precipitation of lime in Joulie's analytical process. On the other hand, magnesia, alumina, and ferric oxide form, with citric acid and ammonia, well-defined compounds, which have the general character of not precipitating phosphoric acid. Similar compounds are also formed by the oxides of manganese, nickel, cobalt, and copper.

**On an Undescribed Disease of the Wines of the South of France, known as "Vins Tournés."**—A. Gautier.—This malady, till a recent date, has been confounded with the "tourne" or "pousse" of the wines of the Centre. It is most severe after hot but moist autumns, when the grapes are attacked with mouldiness. The alcohol of the wines affected suffers no change, but the tannin, the colouring matter, and the tartar totally disappear. Organic and mineral acids, phenol, sulphurous acid, and especially sulphuretted hydrogen, delay but do not hinder the decomposition. The application of heat, as recommended by M. Pasteur, is also insufficient.

\* Reprinted from the *Monthly Microscopical Journal* for December 1877.

On Ozonoscopic Paper.—M. Daremberg.—Ozone can neither be determined nor even qualitatively detected by means of this paper, since many substances produce an analogous reaction, whilst others prevent the reaction from being manifested even when ozone is present.

*Berichte der Deutschen Chemischen Gesellschaft,*  
No. 6., 1878.

Quinonoid Body found in a Species of Agaric.—W. Thörner.—A tinctorial substance of the composition  $C_{11}H_8O_4$  has been obtained by extracting *Agaricus atramentosus* with ether. The crystals left on the evaporation of the ether after purification form dark brown scales of a metallic lustre, soluble in boiling alcohol or glacial acetic acid, with a vineous red, and in alkalies with a greenish-yellow colour.

Researches on the Bessemer Process.—F. C. G. Müller.—It would be impossible to do justice to this important paper in the compass of an abstract.

Iodine-Derivatives of the Phenols.—H. Kämmerer and E. Benzinger.—If iodine, dissolved in potassic iodide, is added to saturation, hot, and very dilute alkaline solutions of the phenols, precipitates are obtained interesting on account of their insolubility in water and their characteristic colouration. Phenol itself gives a red precipitate, thymol one of a faint violet colour, and commercial creosote at first a greenish-brown fluorescent solution and finally a voluminous dirty-brown precipitate. The authors have made a special examination of the products of the reaction of phenol and iodine.

On Atmospheric Hydrogen Peroxide.—Em. Schöne.—(Third communication.)—An examination of the annual and diurnal periods of the hydrogen peroxide present as vapour in the air. The amount found in 1 litre of dew or hoar-frost is greater in summer than in winter. The air in houses has also been examined. In a lecture-hall which had not been used for four weeks, during which time the windows had been kept closed, there was found on July 21st, 1874, from 7.30 a.m. to 7.30 p.m., an average of 0.17 c.c. hydrogen peroxide in 1000 cubic metres of air.

On Certain Derivatives of Thymol.—L. Barth.—Four acids are obtained by the action of melting potassa upon thymol. Two of them are well known, oxybenzoic acid and oxyterephthalic acid. The third, thymol-oxy-cuminic acid, has the composition  $C_{10}H_{12}O_3$ , and crystallises in fine, colourless, brittle needles, sparingly soluble. The fourth, thymolic acid,  $C_{10}H_{10}O_5$ , is readily soluble in water, and precipitable by sugar of lead from this solution. It yields an intense red colouration with ferric chloride, and appears to be bibasic.

Action of Sulphuryl Chloride upon Acetic Ether.—F. Allihn.—On cautiously adding acetic ether to sulphuryl chloride, large quantities of sulphurous and hydrochloric acids escaped, and a yellowish liquid was obtained, which, when freed from acids, distilled over between 205° and 208°, and agreed with Conrad's di-chloroacetic ether. By using only one molecule sulphuryl chloride to one of acetic ether, a mono-chloroacetic ether was obtained.

Oxytoluyllic and Oxyphthalic Acids.—Oscar Jacobsen.—(Second communication.)—Ten oxytoluyllic acids are theoretically possible, of which, after rejection of Fittica's acid and acceptance of that obtained by the author from orthoxyleneol, seven are known.

Formation of Xanthoid Substances from Albumen by the Pancreatic Digestion.—G. Salomon.—By the action of the pancreatic ferment upon pure blood-fibrin, it is possible to obtain hypoxanthin, and probably also xanthin.

Atomic Weight of Glucinum.—Lothar Meyer.—The author criticises the results of MM. Nilson and Pettersson, contained in the last issue of the *Berichte*. He re-

marks that an element of the atomic weight  $G''' = 13.8$ , would find its place between  $C = 11.97$ , and  $N = 14.01$  in the systematic classification of the elements developed by Mendelejeff and himself,\* where a trivalent, metallic, or semi-metallic and moderately infusible element would not suit. It is, therefore, highly probable if glucinum is really trivalent, that its equivalent weight, as determined by Awdejew, is too high (4.6 glucinum, equivalent to 1 hydrogen), and that its atomic weight is not  $3 \times 4.6 = 13.8$ , but must be below that of carbon and above that of boron, or between 11 and 11.5. With this atomic weight it would form the first member of the aluminium group, with a regular difference of 16 units from the second member ( $Al = 27.3$ ). Boron, hitherto placed along with aluminium, would form the initial member of a separate group, so that in future we should have to admit between that of the alkaline earths and that of nitrogen, not two, but three groups—those of boron, of glucinum, and of carbon. The three elements, cerium, lanthanum, and didymium, with the respective atomic weights 137, 139, and 144, would rank as higher members of these three series.

New Mode of Formation of  $\alpha$ -Oxy-isophthalic Acid.—Malvern W. Iles and Ira Remsen.—Sulphamino-isophthalic acid is converted into oxy-isophthalic acid by fusion with potassa. Several of its salts are described.

Synthesis of Oxindol.—A. Baeyer.—Phenyl-acetic acid, is treated in the water-bath with fuming nitric acid; the resulting mixture, after the expulsion of the nitric acid, is reduced with tin and hydrochloric acid, and the liquid is concentrated after the tin has been precipitated with sulphuretted hydrogen. The acid liquid is neutralised with carbonate of lime, and boiled for a short time with precipitated carbonate of baryta. The isomeric amido acids form salts of barium, which the ortho-acid does not, as it remains in solution. Ether extracts it at once in a pure state, when it may be recognised as oxindol.

Isatin and its Derivatives.—W. Suida.—An examination of acetyl-isatin, and acetyl-isatinic acid.

Electrolysis with the Liberation of Hydrogen at both Poles.—E. Elsässer.—The author observed this phenomenon in 1876 without being aware that it had been described ten years previously by Prof. Beetz. He maintains that the proportion of the volumes of hydrogen is independent of the strength of the current, and to a certain extent of the concentration of the saline solutions employed.

Aldehydines: a New Class of Bases.—A. Ladenburg.—The author applies this name to bodies formed from one molecule of an orthodiamin, and two molecules of aldehyds, with the removal of two molecules of water.

Experimental Method for the Recognition of Orthodiamines as Distinguished from their Isomers. A. Ladenburg.—The hydrochlorate of an orthodiamin, if mixed with a few drops of the oil of bitter almonds, and heated for a few minutes to 100°—120°, evolves hydrochloric acid. This is not the case with the meta- and para-loric diamines.

Action of  $\alpha$ -Dinitro-chlorobenzol upon Ureas, Azo-compounds, Aromatic Hydrocarbons and Sodium-Amalgam.—C. Willgerodt.—Not suited for abstraction.

Notice of a New Mineral Spring at the Foot of the Kaselburg, near Pelm, in the Kyll-Valley.—H. Vohl.—The results of a qualitative analysis.

Colouration of the Shells of Birds' Eggs.—C. Liebermann.—An interesting paper, not suitable for abstraction. The colours in question are closely connected with biliary pigments.

On Rosanilin.—E. and O. Fischer.—The authors had based their constitutional formula for para-rosanilin upon the existence and formation of Hemilian's diphenyl-

phenylen-methan. They now admit that his results are to some extent doubtful.

The Expansion of the Fixed Elements as a Function of their Atomic Weights.—H. W. Wiebe.—The absolute expansion of the atoms appears as a periodic function of the atomic weight.

The Ethylic Derivatives of Phenyl-hydrazin.—W. Ehrhardt and E. Fischer.—The authors have succeeded in separating some of the volatile bases formed on treating phenyl-hydrazin with bromethyl.

Action of Nitrous Acid upon Benzol Sulphinic Acid.—W. Koenigs.—Nitrous acid acts upon the sulphinic acids, even in the cold. The author has obtained two bodies, which, both in their composition and their origin, resemble the hydroxy-azo-disulphate of potassa, and the oxy-azo-trisulphate of potassa of Fremy and Claus.

Action of Halogens upon the Salts of Guaninin.—Iwan Kamenski.—The author has examined the action of bromine and of ioduretted hydriodic acid upon guanidin carbonate. The latter reaction produced a body of the composition  $CN_3H_5HI+I$ .

Conversion of Acetyl Cyanide into its Appertaining Ketonic Acid,  $C_3H_4O_3$ .—L. Claisen and J. Shadwell.—If cyan-acetyl, well cooled, is mixed with concentrated hydrochloric acid, the mixture congeals to a crystalline mass. The body thus obtained contains the elements of cyan-acetyl plus water, and if heated for a short time with dilute hydrochloric acid, it is resolved into sal-ammoniac and the acid in question.

Transformation of the Spectra of Different Colouring Matters.—H. W. Vogel.—It is well known that the absorption-bands of one and the same substance, if dissolved in various solvents, have not always the same position. Kundt proposed the law that the absorption-bands lie the farther towards the red the greater the refractive power of the solvent, and this law holds good in many cases. On the other hand, examples are known where, on change of the solvent, the bands move neither towards the red nor the violet, but the whole character of the spectrum is modified without any chemical action of the solvent upon the dissolved body. After mentioning the modification in the absorption spectrum of purpurin accordingly as dissolved in alcohol or water, and of brasilin and hæmatoxylin in ethereal or aqueous solution, the author gives an account of his recent researches on the spectra of naphthalin red in alcohol, in water, in the solid state, and on paper.

On Meta-diamido-benzol as a Reagent for Nitrous Acid.—P. Griess.—The author had previously recommended diamido-benzol as a reagent for nitrous acid, capable of indicating its presence even when diluted to the extent of 1 part in five millions. He now finds that meta-diamido-benzol, which is more easily procured, is a still better reagent, showing nitrous acid even in 10 million parts of water.

Determinations of Nitrous Acid.—C. Preusse and F. Tiemann.—The authors having examined the above-mentioned method of P. Griess, find that it is practicable in case of dilute solutions. Stronger solutions must be diluted with water free from nitrous acid, just as is required in the application of Neseler's test to ammoniacal solutions. The requisites for the process are: a dilute solution of meta-phenylen-diamin, prepared by diluting 5 grms. of this base in 1 litre of water, and slightly supersaturating with dilute sulphuric acid. A dilute sulphuric acid formed by mixing 1 vol. pure sulphuric acid with 2 vols. distilled water. A solution of alkaline nitrite, 1 c.c. of which contains 0.01 m.gr.  $N_2O_3$ . To prepare this 0.406 grm. pure, dry silver nitrite are dissolved in hot water, and converted into sodium nitrite by the addition of pure sodium chloride. When cold, the solution is made up to 1 litre, let stand till the silver chloride is perfectly precipitated, and 100 c.c. of the clear liquid are again diluted to 1 litre. After a careful

examination of this and of other processes, the authors conclude that, in all waters which cannot be perfectly decolourised, the method with zinc iodide and starch is preferable, after the absence of iron compounds has been ascertained.

Methyl Derivatives of  $\alpha$ -Naphthylamin.—Ludwig Landshoff.—Not capable of useful abstraction.

Derivatives of Caffeic Acid and Hydro-caffeic Acid, and Synthesis of Caffeic Acid.—F. Tiemann and Nagajosi Nagai.—The diacetyl derivatives of caffeic acid can be prepared from protocatechuic-aldehyd by means of sodium acetate with anhydrous acetic acid.

Diacetalpho-homo-protocatechuic Acid.—Nagajosi Nagai.—The author gives an account of the preparation of this compound.

Members of the Catechuic Series.—F. Tiemann.—This lengthy paper is incapable of abstraction.

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*Bulletin de la Societe Chimique de Paris,*  
No. 9, May 5, 1878.

On the Equivalent of Gallium.—M. Lecoq de Boisbaudran.—Already noticed.

Presence of the Ferment of Urea in the Air.—M. Pierre Miquel.—A very lengthy paper, incapable of useful abstraction.

Note on Certain Derivatives of Glycerine.—M. Hanriot.—Already noticed.

Researches on Anthraflavon and Anthraflavic Acid.—M. A. Rosenstiehl.—In the introductory portion of this memoir, the author gives a history of previous investigations on the subject, and quotes from his own earlier papers. He then enters upon a comparison of oxy-anthraflavon  $\alpha$  with isopurpurin, which he considers as identical.

Nitrated Naphthyl-sulphurous Acid  $\delta$  and its Derivatives.—M. P. T. Cleve.—A description of the potassium, ammonium, silver, barium, and lead salts of the acid, its ethylic ether, amide, &c., and the behaviour of phosphorus pentachloride with the chloride of the nitrated acid.

Double Cyanides of Gold.—M. C. G. Lindbom.—An elaborate account of the formation, properties, and composition of twenty-nine compound cyanides of gold.

Amido-sulphonic Acid.—M. E. Berglund.—The author prepares this acid by decomposing the basic barium salt of imido-sulphonic acid, or the mercurio-barytic salt,  $HgN_2(SO_3)_4Ba_2$ , by dilute sulphuric acid. It is most easily isolated by the action of sulphuretted hydrogen upon its silver salt. A considerable number of its salts are described.

Silvering glass.—M. R. Böttger.—Tartrate of silver in very fine powder is suspended in distilled water, and very dilute ammonia is then very carefully added until the tartrate of silver is dissolved. The operator must satisfy himself that a small excess of the silver-salt remains undissolved, and that the liquid gives off no ammoniacal odour. Into this bath the objects to be silvered are plunged, having been first carefully cleaned. In about ten minutes they are covered with a uniform layer of silver.—*Deutsche Industrie Zeitung.*

Purification of Honey by Dialysis.—M. E. Dietrich.—About half the weight of the honey passes through the parchment paper. The residue contained numerous mucilaginous flocks of a faint taste.

Simultaneous Action of Potassium Ferricyanide, and of Certain Acetates upon Indigo.—M. Alb. Scheurer.—Indigo exposed to the oxidising action of a mixture of caustic soda, and of potassium ferricyanide, is at once destroyed. The same reaction is obtained on steaming a vat-blue tissue, upon which has been printed a mixture of ferricyanide, mixed with any acetate what-

soever. Among the acetates, that of lime is the most efficacious. Potassium ferricyanide printed upon a medium blue, along with ammoniac sulphate, destroys the indigo, and gives rise to prussian blue, which, on passage through weak soda, disappears, and gives place to white. Bichromate of potassa, in presence of a metallic sulphate or chloride, and under the influence of steam at 100°, destroys indigo, with the simultaneous production of chromic oxide, chromate of chrome, and chromate of the metal employed.

*Chemiker Zeitung.*  
No. 20, May 16, 1878.

Magnesite is proposed in place of chalk as a material for the evolution of carbonic acid in soda-water manufactories. The residue is to be employed in the manufacture of magnesium sulphate.

A German professional association of analytical chemists is in course of formation. A rule is proposed for the special exclusion of such as make a trade of giving certificates.

No. 21, May 23, 1878.

Improvement in the Determination of Potassa in Chloride of Potassium and in Stassfurt Salts.—The determination of potassa by platinum chloride is the more inaccurate the more foreign salts, such as chloride of sodium, are present. The result obtained is generally too high, since the platino-sodic chloride, if it has become too dry, can no longer be entirely removed by washing with alcohol. Ulex avoids this error by the addition of a little glycerin, which prevents the saline solution from becoming too dry, and materially abridges the washing process.—*Zeitsch. für Anal. Chemie*, xvii., 175.

Dissolution of Ignited Ferric Oxide.—Instead of melting insoluble ferric oxide with sodic bisulphate, A. Classen prefers to boil it with dilute caustic potassa. As soon as the previously pulverulent mass becomes flocculent, the alkaline liquid is decanted off, and the oxide dissolved in concentrated hydrochloric acid.—*Zeitschrift für Anal. Chemie*, xvii., 182.

Rapid Determination of Antimony.—The ore is melted with carbonates of soda and potash and with sulphur; the filtrate from the hot aqueous extract is decomposed with hydrochloric acid, and the precipitate of antimony sulphide is converted into the antimoniate of antimonious oxide.—*Zeitschr. für Anal. Chemie*, xvii., 185.

Working of Glover's Tower.—Vorster having previously maintained that a great part of the oxides of nitrogen are reduced to free nitrogen in the working of the tower is declared by Dr. Lunge to be in error. F. Hurter confirms the statements of Vorster.—*Dingler's Polytech. Journal*, ccxxvii., 465 and 563.

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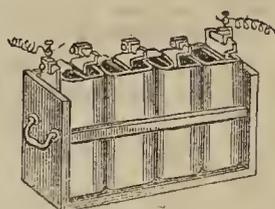
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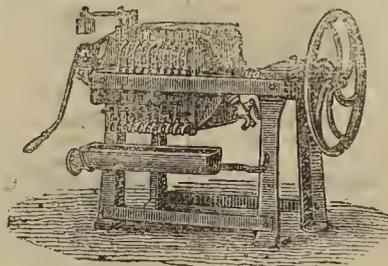
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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 972.

CONTRIBUTIONS TO BLOWPIPE CHEMISTRY.

By P. CASAMAJOR.

II. BLOWPIPE LAMP AND CANDLE.\*

*Blowpipe Lamp.*—The oil lamp most generally used in blowpipe analysis is of a pattern first proposed by Berzelius. The body of this lamp is low and narrow, but its length is quite disproportionate to its other dimensions. This length is nearly 5 inches, while the other dimensions are not quite an inch each way. The foot of this lamp is formed of two cross pieces which come apart when the lamp is dismantled, the length of each piece being about 7 inches. The excessive length of this lamp, and of the cross pieces of its foot, were not objectionable if we consider the plan adopted by Berzelius for carrying his blowpipe instrument when travelling.

These were packed in a surgeon's pouch, made of a

For this manner of carrying instruments they require to be flat and narrow, although they may be quite long. This accounts not only for the elongated shape of the oil lamp, but also for that of alcohol lamp, the anvil and the reagent box adopted by Berzelius.

The blowpipe oil lamp, which I now present you is not adapted for being packed in a leather pouch, like the one before mentioned. I have endeavoured to obtain the minimum of volume combined with every advantage which is found in the lamp of Berzelius.

The lamp is cylindrical and quite flat. In the one we have here the height of the cylindrical portion is 1 inch, and the diameter 3 inches. The top is curved and provided with two openings closed with screw caps. One of the openings is for the wick, and the other is to fill the lamp without disturbing the wick.

The lamp is held in a covered box, as shown in figure 1. When the lamp is to be used, it is taken out of its box, which then serves as a foot. By drawing the cover out, more or less, the lamp may be raised or lowered to suit the convenience of the operator. The lamp on its foot is shown in figure 2.

To make the lamp as low as possible when put away in its box, the wick is lowered down in the lamp, as shown in figure 3. When the lamp is to be used, the wick is pulled up again. This is done by soldering the

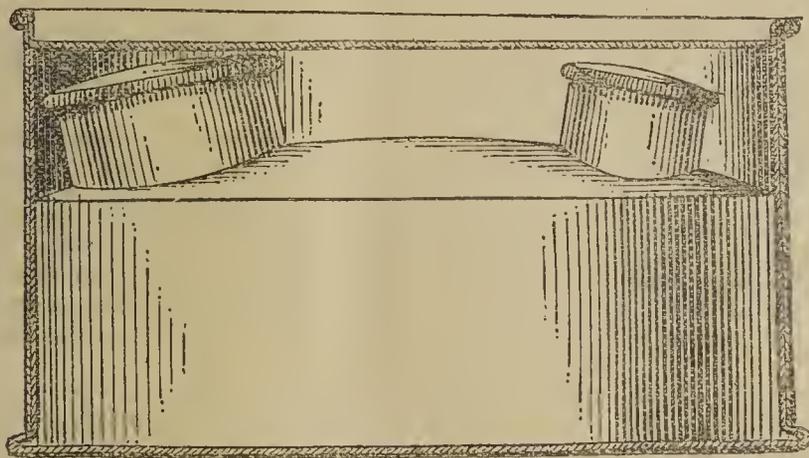


FIG. 1. FULL SIZE.

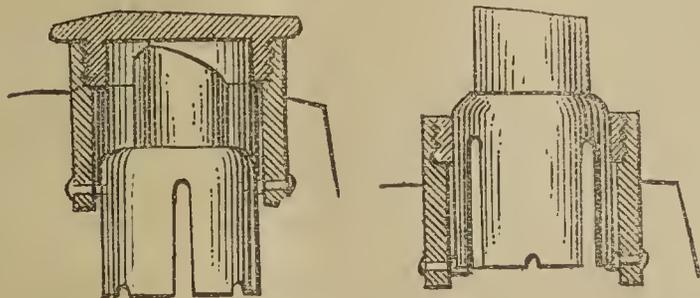


FIG. 3. FULL SIZE. FIG. 4. FULL SIZE.

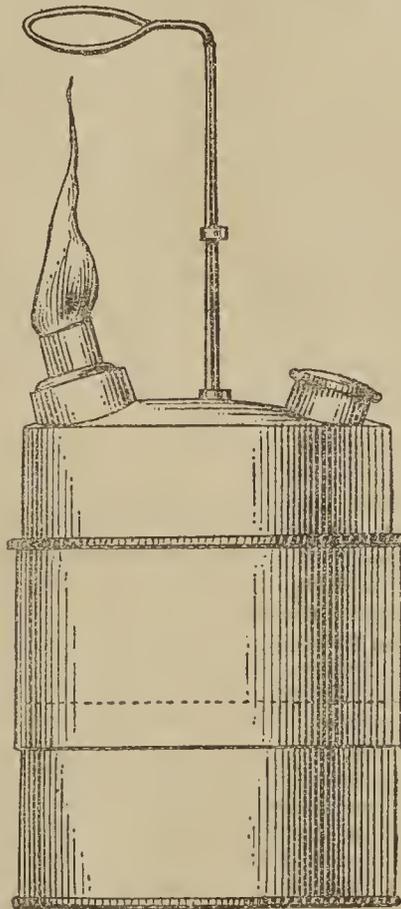


FIG. 2. HALFSIZE.

piece of leather about 40 inches long and 18 inches wide, lined with another piece of the same length, and 10 inches wide. Over these two thicknesses was a third piece 6 inches wide, stitched in several places, so as to make from twenty-five to thirty sheaths for holding the instruments. As the widest piece of leather projected about  $4\frac{1}{2}$  inches on each side of the 10 inch lining, the extra width was folded over, and the edges were tied together with strings. Each sheath was made by placing the six inch leather over each instrument and stitching it down, so that every instrument fitted exactly in its sheath. This pouch, when rolled up, allowed all the instruments to be carried in safety in the smallest possible compass.

tube that carries the wick in a cylinder surmounted by a cap. This cylinder fits loosely in the larger tubulure of the lamp, and is provided with four long slits in which enter four pins attached to this tubulure. When the wick is to be lowered it is turned around until the four slits come opposite the four pins, and the wick tube is pressed down. Besides the four slits, the cylinder attached to the wick tube has four notches into which the same pins enter when the wick tube is raised and turned around an eighth of the circumference. Figure 3 shows the wick lowered down, and figure 4 shows it raised. In figure 3 may be seen one of the slits and two of the notches spoken of, and in figure 4 are two slits and one notch midway between the slits.

For the convenience of heating small dishes or crucibles

\* Read before the American Chemical Society, May 2, 1878.

over the flame, a ring is placed over it, as shown in figure 2. This ring is made of brass wire, which, after being curved round in a circle, is prolonged outwards in the direction of the diameter, and finally curved downwards at right angles. This last portion of the wire is about three-quarters of an inch long, and enters in a vertical tube *a*. The tube *a* enters in another vertical tube *b*, which, in its turn, enters another tube which goes through the lamp, and is soldered to its top and bottom. The tube *a* enters very freely in the tube *b*, and this latter tube enters with equal ease in the tube soldered to the lamp. Each one of the tubes, *a* and *b*, is provided with an appendix made of spring brass, which fits so tightly round the tube that, although it may be moved up and down, it will remain in any position in which it is placed. This appendix, in each tube, rests on the top of the larger tube below it,\* so that by moving either or both up and down, the ring over the flame may be raised or lowered. When the lamp is packed in its box, the tubes *a* and *b* are placed in the space between the top of the lamp and the top of the box (see figure 1). The ring is also placed in the same space, and its shank, which is made to enter the tube *a*, is then placed in the tube that goes round the lamp.

The application of a tube, soldered to the top and bottom of the lamp is equally feasible with the oil lamp of Berzelius. In this lamp, as now used, a tube placed at one of the ends slides up and down a vertical rod. By placing the tube in the middle of the lamp, the cross-pieces of the foot need be no longer than the lamp itself, the reduced length insuring greater stability than can now be obtained with the cross pieces seven inches long. By the use of a foot whose pieces are no longer than the lamp, and vertical rods, analogous to those I have described, the portability of the Berzelius lamp could be very much improved.

The box in which the lamp is packed, besides serving as an adjustable stand, answers the useful purpose of a covering to prevent the lamp from soiling things that might otherwise come in contact with it, as, with the best care and tightest joints, it is impossible to prevent a little oil from leaking out.

The best oil to use is olive oil, which should be of the best quality, as even the best is not any too good. I have lately added to olive oil one-fifth its volume of kerosene oil (refined petroleum), which makes the oil rise more freely in the wick and prevents incrustations, without making the flame perceptibly more smoky.

*Blowpipe Candle.*—The older Swedish chemists of pre-Berzelian times, to whom belongs the honour of laying the foundations of blowpipe chemistry, Cronsted, Bergman, and Gahn, used candles for fuel. Gahn used a triple candle, formed of three small candles in one candlestick, so as to obtain a more powerful flame. He also tried an oil lamp, with which he became disgusted, as it had no provision to prevent a leakage of oil.†

Stearic acid candles give a flame which is, to say the least, as good as that given by the best olive oil. The material itself is less costly than good olive oil, and there is no question that, for travelling, stearic acid candles are infinitely more convenient than oil.

Candles, however, present a serious objection. The heat of the blowpipe flame melts a candle in the part immediately under the flame more rapidly than in any other part, so that the melted material runs all down that side, and the wick gets very little of it.

I have tried several means of preventing this, but only lately have I found a practical way of overcoming the difficulty. This consists in wrapping a sheet of tin-foil, about as thick as fine writing paper, round the candle. The sheet of tin-foil should be of the same length as the candle, and its width should be at least one inch more

than the circumference of the candle. The tin-foil is put over the candle, and its two edges are brought together, so that when the tin-foil is pressed tightly against the candle, there remain two thicknesses of foil about half an inch wide. These two thicknesses are folded over so as to present a projection of four thicknesses a quarter of an inch wide. This is again folded over so as to present eight thicknesses in a projection of one-eighth of an inch, which is finally flattened down on the candle.

When a candle, dressed in tin-foil in this manner, is burnt, the melted material remains in the tin-foil, and no amount of blowing will make it run. If the candle is allowed to burn down, the tin-foil will melt as soon as it rises high enough to come opposite the hot part of the flame, but there will always remain a cup of melted stearic acid to feed the wick.

When a candle dressed in tin-foil is used, the operator can keep the tin-foil at a convenient height with very little trouble. If the blowpipe flame is directed against the envelope, the tin melts down immediately to the level of the melted stearic acid. With a pair of scissors, the tin-foil can also be kept down to the proper height with very little trouble. A very ready way to keep it at the proper height is to poke it away outwards and downwards with the butt end of the blowpipe. It is of the greatest importance that the tin-foil wrapper should be perfectly free from holes, as the stearic acid, which is kept melted at quite a depth, will all run out when it finds an outlet. If a hole is discovered in the tin-foil, the readiest remedy is to place over it another sheet of the same foil about half an inch wide, and press this tightly round the candle in the same manner as the first covering.

By taking two candles and shaving off one side of each, and pressing the two flattened portions together, we may obtain a double candle which gives a very large flame. The two wicks should be about one-half inch apart. If the two candles are wrapped in tin-foil, taking care that the case thus formed be prolonged under the candles, the portion of stearic acid shaved off may be melted and poured in the mould of tin-foil and the two candles will be cemented into one.

## PHOSPHORUS IN CLEVELAND IRONSTONE AND IN IRON.\*

By J. E. STEAD.

THE paper I now lay before you consists essentially of investigations made during the last three years, which may be described under the following heads, viz. :—

- 1st. The compound or compounds in which phosphoric acid exists in the Cleveland ironstone.
- 2nd. Method of eliminating phosphoric acid from iron ores.
- 3rd. The compounds in which phosphorus exists in Cleveland metal.
- 4th. The effect, physically and chemically considered, which phosphorus has on pig metal.
- 5th. Methods of removing it from pig iron.
- 6th. Phosphorus in bar iron.

The field is rather a comprehensive one, and, in order not to take up too much of your time, I shall endeavour to condense the matter into as few words as possible.

In 1781, Mayer published the results of investigations he had made, relating to a white calx which precipitated from a solution of metal in sulphuric acid. The metal was obtained from bog iron ore.

This calx, on smelting with charcoal in a crucible, yielded a very brittle and fusible button. Mayer believed it was a new element, and gave it the name Siderium.

\* The difference of diameter between the larger tube *b* and the tube *a* that enters in it, is not properly shown in fig. 2.

† Berzelius, "Use of the Blowpipe in Chemical Analysis and Mineralogical Determinations."

\* A Paper read before the Cleveland Institution of Engineers.

Bergmann shortly after came to the same conclusion, and also gave the metal the name Siderium.

Both of these investigators soon after this discovered that the calx was a phosphate of iron, and that the metal obtained from it was nothing more than a combination of phosphorus and iron, or phosphide of iron.

In 1806, Vauquelin in France clearly proved that phosphorus was always present in metal produced from ores containing phosphoric acid, and that it was reduced together with the iron oxides in the smelting process.

We have, since the investigations of these eminent chemists, had abundant evidence of the correctness of their conclusions, and our sincere desire is, that we may be able to supplement the discoveries they have made with one which would enable us practically, and at a small cost, to remove the phosphorus from the ore before being smelted, or from the metal containing it.

We now turn your attention to the composition of the Cleveland ironstone. The analyses below will give a general idea of the proportions present in the various constituents of the main Cleveland ironstone bed.

A separate analysis of each foot of stone through the entire section is given.

CLEVELAND IRONSTONE.

Stone Analysed.	Iron.	Silicious Matter.	Phosphoric Acid.	Moisture.	Loss by Calcination.	Iron in the Calcined stone.
	P.c.	Pc.	P.c.	P.c.	P.c.	P.c.
<i>Main—</i>						
9 feet						
1st foot	26.53	18.30	1.46	8.50	27.39	36.50
2nd "	29.54	10.90	1.13	9.10	29.80	42.08
3rd "	29.14	10.68	1.13	9.50	29.80	41.50
4th "	28.41	11.98	1.41	9.80	28.80	39.92
5th "	29.97	9.00	1.17	10.00	30.83	43.31
6th "	30.42	8.82	0.89	10.00	31.51	44.40
7th "	29.70	9.00	0.80	10.10	31.78	43.53
8th "	29.85	9.29	0.91	9.80	30.90	43.20
9th "	30.30	12.01	1.16	9.00	28.50	42.40
<i>Black Hard—</i>						
21 in.						
7 inches	30.56	12.90	0.44	8.50	26.80	41.75
7 "	27.87	22.20	1.12	5.50	18.00	34.00
7 "	27.26	24.70	0.81	5.00	17.00	32.85

It will be seen from these analyses that no part of the stone is free from phosphoric acid. Near the top it is highest, and in the most porous part, about 3ft. above the "Black Hard" bed, it is very much lower.

In the "Black Hard" bed I found this substance very variable in quantity, reaching as much as 3 per cent in some cases, and only 0.25 per cent in others.

1st. The compound or compounds in which phosphoric acid exists in Cleveland ironstone.

Several years ago, Mr. John Pattinson investigated this matter, and concluded, judging from the non-action of ammonium sulphide on the stone, or rather on the compound containing phosphoric acid in the stone, that no iron phosphate was present, and that the phosphoric acid must be in combination with lime. Ammonium sulphide readily decomposes, iron phosphate rendering the phosphoric acid soluble; whereas lime phosphate is not affected. I have since that time, from the results obtained by other methods of investigation, arrived at the same conclusion.

Sulphurous acid dissolves phosphate of lime much more readily than iron phosphate after they have been well calcined, and as it was found that the phosphatic compound, existing in the finely powdered calcined stone, was very readily removed by sulphurous acid, it was thought therefore that iron phosphate could not be present.

Again, when common salt is fused with iron phosphate, part of the chlorine combines with the iron, forming ferric chloride, and the sodium with the phosphoric acid, producing sodium phosphate, which is soluble in water. Lime phosphate, however, is not so decomposed, and no sodium phosphate is produced. If, therefore, calcined

Cleveland stone be fused with salt, and no sodium phosphate be produced, we should have strong grounds for believing that the compound of phosphorus existed as lime phosphate, and that iron phosphate was absent. Two experiments clearly proved this to be the result, from which fact, together with the results obtained by the other methods, we may consider all the phosphoric acid in the Cleveland stone to be in combination with lime.

It is the prevailing opinion that the remains of small phosphatic animals is the source of all the phosphorus in the ironstone. I am, however, inclined to regard this theory with distrust. First, because in some parts of the "Black Hard" bed, where no fossil remains could be detected, the phosphoric acid has been found in large quantity. Secondly, because in all cases, on analysis, the shells and fossil remains, which were taken out of the stone, were proved to contain much less phosphoric acid than the surrounding ironstone.

The following analyses of fossil wood taken from various mines in this district, I think will throw some light upon this very obscure subject.

FOSSILISED WOOD FOUND IN CLEVELAND IRONSTONE.

No. I.

Lime .. .. .	27.60	per cent
Phosphoric acid .. .. .	20.80	"
Magnesia .. .. .	1.12	"
Protoxide of iron.. .. .	10.02	"
Iron .. .. .	5.20	"
Cobalt and nickel .. .. .	1.65	"
Oxides of cobalt and nickel	3.70	"
Alumina.. .. .	8.25	"
Protoxide of manganese ..	trace	"
Sulphur.. .. .	7.56	"
Sulphuric acid .. .. .	0.60	"
Carbonic acid .. .. .	0.75	"
Silica .. .. .	0.50	"
Carbonaceous matter.. ..	9.60	"
Water .. .. .	3.00	"
	<hr/>	
	100.35	"
	<hr/>	
Lime Phosphate .. .. .	45.41	"

Several other samples gave similar results on analysis, phosphate of lime being present in large quantities in every case, as will be seen by the following analyses, viz. :—

No. II. No. III. No. IV.

Phosphate of lime	16.0	23.1	27.8	per cent.
-------------------	------	------	------	-----------

There can be no doubt about the fact that these samples were at one time parts of trees, which in their natural state would not contain more than very minute quantities of phosphoric acid; and knowing this, we ask the question: "How can this phosphate of lime have got there?" The only answer compatible with the circumstances of the case we can offer is this, that it has been in solution, and in this state passed into the substance of the wood, and been there deposited in the condition in which we find it.

Phosphate of lime is soluble in carbonic acid. It is therefore probable, considering that this acid is a solvent, or being the principal one after water which nature possesses, that the phosphate we find in the wood has at one time been dissolved in carbonic acid. I do not mean to argue from this that all the phosphate of lime in Cleveland stone has been deposited from solution in this manner, for it is quite possible that a solution of a portion of the phosphate, before deposited in some other way, has been effected, and this been re-deposited in the woody fibre.

This subject is of extreme interest to us all. As, however, our information respecting the formation of the Cleveland ironstone is not of the clearest nature, we

should not further at present discuss the matter, leaving it rather for more complete investigation in the future.

#### Methods of Removing Phosphoric Acid from Ores.

The first which demands our attention is the sulphurous acid method of Jacobi, which may briefly be described as follows, viz. :—

The porous ores are placed in large tanks, and there treated with sulphurous acid, produced by burning sulphur pyrites, and condensing the acid fumes in coke tower condensers. The phosphatic compound is by this treatment dissolved out of the ore.

After the action is completed, about 90 per cent of the phosphorus is found in solution, and is run out of the tanks in the liquor. The excess of the sulphurous acid is recovered, together with the phosphate, by simply boiling the solution. The sulphurous acid, passing off as gas, is condensed in the coke towers, and the phosphate, having in this way removed from it that which rendered it soluble, is precipitated in the insoluble state, after which it is dried and sold for manure. It is stated that the price obtained for this substance covers the expense of extracting it.

In order to ascertain if Cleveland stone could be so purified, several samples of the finely powdered calcined stone were treated with thirty times their weight of sulphurous acid, containing 10 per cent of the gas. After exposure to the action for about 24 hours, the ore was separated by filtration, and the solutions examined for phosphoric acid. The following were the results obtained, viz. :—

	Phosphoric acid in stone. Per cent.	Phosphoric acid removed. Per cent.	Phosphoric acid remaining. Per cent.
1st Sample	1·73	1·64	0·09
2nd „	1·80	1·71	0·09
3rd „	1·34	1·16	0·18
4th „	1·14	0·97	0·17

Average amount removed = 90 per cent.

The next point was to ascertain if similar results could be obtained if lumps of stone were used instead of powdered, and for this end a small lump not more than a cubic inch was treated with large excess of acid. After three days' exposure only about 15 per cent of the phosphorus was removed, and it was only after the ore had been in contact with stronger acid for about ten days that 90 per cent was dissolved out. Larger pieces required a much longer period for purification; so long, in fact, that it induced me to conclude that the solution of the phosphorus, from such lumps as we require for our furnaces, by this method is far from being a practical solution of the difficulty.

The next method for our consideration is that of Forbes, based on the action of common salt when fused upon iron phosphate.

The porous ore is first saturated with a strong solution of salt, the water afterwards removed by heat, and the ore containing salt throughout its entire mass subjected to calcination.

By this process it is stated that the phosphoric acid is rendered soluble in water, and that the ore only requires to be washed to free it from that objectionable substance.

*Experiment.*—Cleveland calcined stone in fine powder was fused for about an hour with pure salt or chloride of sodium, but no phosphoric acid was made soluble by the treatment. From what has been already stated we cannot wonder at this, for it is phosphate of lime we have to deal with, and not phosphate of iron, the former of which is not acted upon or changed by fusion with salt; this method also may be considered of no value to Cleveland.

The last method to which we turn your attention is that based on the action of carbonate of soda on phosphate of lime, when fused with it. It is well known that

when these compounds are fused together carbonate of lime and phosphate of soda are produced, and that, by treating the fused mass with water the phosphate of soda can be dissolved out. If, therefore, a sufficient quantity of carbonate of soda could be introduced into the lumps of ore by means of a saturated solution of the carbonate, we might be able by calcination to effect the above mentioned changes. An experiment made to test this proved that the quantity so introduced is insufficient, for only a trace of phosphorus was found to be removed after washing the stone.

Judging from the results of these experiments, we may conclude that Cleveland ironstone can not be freed from phosphorus by any methods as yet proposed.

We now turn to the smelting of ironstone.

When we know that phosphate of lime, heated with carbon and oxides, or metallic iron, to a very high temperature, is decomposed, the phosphorus combining with the iron, we are not at all surprised to find nearly the whole of the phosphorus, introduced in the charge at the top of the blast-furnace, concentrated in the pig metal. The greater the temperature of the furnace hearth, and the longer time the ore is exposed to this temperature in the zone of fusion, the greater is the amount of phosphorus concentrated in the metal. The slag, run from furnaces working at a high temperature, making No. 1 and 3 pig-iron, rarely contains more than 0·55 per cent phosphoric acid, and frequently not more than a trace. On the other hand, the slag from furnaces working at slow temperatures, producing rough white iron, very often contains from 0·10 per cent to 0·60 per cent.

Iron as a rule is in considerable quantity in slags containing much phosphoric acid, which fact clearly proves that reduction has been imperfect in the furnaces at the time of their production, that what failed to reduce the iron had also failed to reduce the phosphoric acid.

A great deal has been said about the power of fluor-spar when used as a flux in smelting ores containing phosphorus, in removing the phosphoric acid, or preventing its passage into the metal.

In order to ascertain if this compound of calcium and fluorine had any beneficial effect, the following experiments were made.

1. An ore calculated to yield pig metal containing 1·8 per cent. phosphorus, if all were reduced, was smelted in a crucible with 25 per cent fluor-spar. The metal produced contained 1·80 per cent. P, showing that the whole of the phosphoric acid had been reduced.

2. Two equal portions of calcined Cleveland stone were smelted in separate crucibles—one with lime in the usual way, and the other with 100 per cent. fluor-spar. The metal produced in each case was tested for phosphorus, with the following results, viz. :

Smelted with lime .. ..	1·627 per cent
„ fluor-spar .. ..	1·630 „

From which result we may conclude that fluor-spar is of no value in the smelting process as an agent for removing phosphorus.

#### Iron and Phosphorus.

By direct addition of phosphorus to iron heated in a crucible, I have obtained combinations containing between 6 and 27 per cent phosphorus. This result is different from what we might have expected, considering that our most eminent metallurgist, Dr. Percy, has stated, that iron will not take up more than 8·4 per cent. phosphorus when heated together in the manner described.

This element makes very fusible compounds with iron.

Judging from a large number of experiments, the fusion point decreases with each addition of phosphorus, until a compound, containing from 10 to 12 per cent of phosphorus is produced, which is the most fusible; after which each addition makes the compound less and less fusible.

Phosphide of iron, containing about 11 per cent phosphorus, is quite fluid at a bright red heat; whereas, when

25 per cent is present, the compound is infusible at that temperature.

All the phosphides of iron are exceedingly brittle. Those containing the largest proportion of phosphorus are the most so. The combination of 75 of iron with 25 of phosphorus is capable of being ground up like sandstone in an agate mortar to an extremely fine powder.

*The Compounds in which Phosphorus Exists in Cleveland Metal.*

When Cleveland pig-iron is melting in a puddling furnace, there appear to be, near the complete fusion point of the iron, certain parts of the metal more fusible than others. If a partially fused pig be broken, the fractured surface presents throughout glistening, apparently fluid portions, thoroughly interspersed with particles of metal which have not become fluid. Judging from the comparative fusibility of phosphide of iron, it was thought that, if separate compounds of iron and phosphorus existed in pig metal, these compounds would be more fusible than the bulk. In order to ascertain if such is the case, about 1 cwt. of Cleveland iron was poured into a mould. After it had become viscous extreme pressure was applied by means of a hydraulic ram, and the portions of metal last fluid expressed. The analyses given below indicate with what result, viz. :—

	Metal used.	Metal expressed.
Iron .. ..	93.125 per cent	90.122 per cent
Carbon .. ..	3.000 ,,	1.750 ,,
Manganese ..	0.355 ,,	0.288 ,,
Silicon .. ..	1.630 ,,	0.790 ,,
Sulphur .. ..	0.120 ,,	0.060 ,,
Phosphorus ..	1.530 ,,	6.840 ,,
Titanium .. ..	0.240 ,,	0.150 ,,
	100.000	100.000

The metal expressed may be considered to be a combination of phosphide of iron and unaltered pig metal.

Assuming that the silicon in the expressed portion represents the proportion of unaltered metal, we have—

$$\frac{100 \times 0.79}{1.63} = 48.5$$

of such metal, and  $100 - 48.5 = 51.5$  of phosphide. By calculation we find the composition of each of these parts to be as follows, viz. :—

	Unaltered Metal.	Phosphide of Iron.
Iron .. ..	45.167 per cent	44.955 per cent
Carbon .. ..	1.455 ,,	0.295 ,,
Manganese ..	0.172 ,,	0.116 ,,
Silicon .. ..	0.790 ,,	—
Sulphur .. ..	0.058 ,,	0.002 ,,
Phosphorus ..	0.742 ,,	6.098 ,,
Titanium .. ..	0.116 ,,	0.034 ,,
	48.500	51.500

Not taking into consideration the very small proportion of the elements other than phosphorus and iron present, which together amount to only 0.447 part, we have iron and phosphorus in the following proportion expressed in per cents, viz :

Iron .. ..	88.05 per cent
Phosphorus ..	11.95 ,,
	100.00

Calculated into chemical equivalents by dividing each by their respective atomic weight, we have—

$$\frac{88.05}{56} = 1.57$$

and—

$$\frac{11.95}{31} = 0.385,$$

that is, we have the equivalents in the ratio of 1.57 iron to 0.385 phosphorus, or—

$$\frac{1.57}{0.385} = 4$$

equivalents iron to 1 of phosphorus, and therefore may be written  $Fe_4P$ .

About six months after the above experiment was made, it was repeated, and, as will be seen by what follows, with almost the same result.

	Metal used.	Metal expressed.
Iron .. ..	92.36 per cent	89.70 per cent
Carbon .. ..	2.84 ,,	2.00 ,,
Manganese ..	0.28 ,,	0.24 ,,
Silicon .. ..	3.01 ,,	1.51 ,,
Phosphorus ..	1.46 ,,	6.52 ,,
Sulphur .. ..	0.05 ,,	0.03 ,,
	100.00	100.00

The expressed metal in this case contains by calculation 50 per cent of unaltered iron, and 50 per cent of phosphide, the composition of each being as stated below, viz. :—

	Unaltered Metal.	Phosphide of Iron.
Iron .. ..	46.18 per cent	43.53 per cent
Carbon .. ..	1.42 ,,	0.58 ,,
Manganese ..	0.14 ,,	0.10 ,,
Silicon .. ..	1.50 ,,	—
Sulphur .. ..	0.03 ,,	—
Phosphorus ..	0.73 ,,	5.79 ,,
	50.00	50.00

Calculated into 100 parts, this phosphide would contain viz. :—

Iron .. ..	88.26 per cent
Phosphorus ..	11.74 ,,
	100.00

This also may be considered as  $Fe_4P$ .

It is very clear from these results that phosphide of iron does exist in a separate state in pig metal intimately diffused throughout the mass.

We now turn your attention to a different method of investigation.

All who have immersed bar iron in dilute acids, such as hydrochloric or sulphuric acids, must have noticed a black residue adhering to the outside of the iron. It is this substance which must now occupy our attention.

Metal, which had been deoxidised and desilicised containing 1.6 per cent of phosphorus, was treated in fine powder to the action of hot dilute sulphuric acid. After all that was capable of being dissolved had passed into solution, a dense black residue remained, insoluble in sulphuric acid. This residue was filtered off, washed, dried, and weighed. The weight was a little over 2 per cent of metal used. On analysis it was found to consist of phosphide of iron together with a minute quantity of silica, carbonaceous matter, and titanous acid. The iron and phosphorus were present in the proportions of 3 equivalents of iron to 4 equivalents of phosphorus, and therefore may be expressed as  $Fe_3P_4$ .

A second experiment gave the same result.

Two samples of puddle bar, treated in the same manner, also left a residue of phosphide of the above-mentioned composition.

I have also found phosphides in residues from other samples as  $Fe_3P_2$ .

The proportion of phosphorus left in the insoluble phosphide varies very considerably, differing widely in different samples of iron, in some being as much as one-third, and in others only one-tenth of the total amount.

These facts I think clearly prove that there exist two or more different phosphides in iron containing phosphorus,

and that they exist in very varying proportions in different samples of iron.

The causes which produce these different compounds I have not been able to fathom. I hope, however, on further investigation to bring this matter to light.

(To be continued.)

## PROCEEDINGS OF SOCIETIES.

### MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND.

A GENERAL MEETING was held at 116, Victoria Street, S.W., on Thursday, July 5th, Mr. R. H. SCOTT, F.R.S., in the chair.

The following papers were read and discussed:—

“*On a New Manganesian Garnet from Several Localities in Scotland*,” by Prof. M. F. HEDDLE, of St. Andrews.

“*On Cotterite, a New Variety of Quartz from Ireland*,” by Prof. HARKNESS, of Cork.

“*Cu Youngite*,” by Mr. J. B. HANNAY, of Owens College, Manchester.

“*On the Artificial Production of Psilomelane*,” by Mr. J. B. HANNAY.

“*On Penwithite, a new Hydrous Manganetic Silicate from Cornwall*,” by Mr. J. H. COLLINS.

“*Notes on Cornish Minerals and Localities*,” by Mr. J. H. COLLINS.

The Annual Meeting was fixed for Wednesday, August 14th, at 2.30 p.m., to be held at Dublin.

## NOTICES OF BOOKS.

*Phosphates in Nutrition, &c.* By M. F. ANDERSON L.R.C.P. Edin., and M.R.C.S. Eng. London: Baillière Tindall, and Cox, 1878.

We welcome the appearance of this book as an additional example of the increasing interest taken by the medical profession in the application of the principles of chemistry to medicine and diet. The importance of each and all of the inorganic substances contained in the food of man is but too frequently overlooked, by even the shining lights of the medical world, most of whom are only too apt to look on chemistry as a dry and disagreeable subject to be coached up for examination and then laid aside. We could, however, cite many examples of medical men who are also chemists, and the importance of the work done by them ought to lead the rising generation of medical students and workers to regard chemistry as part and parcel of their own special science, and as necessary to the trained surgeon or physician as anatomy and physiology. Digestion, assimilation, and disorganisation are as much chemical processes as dyeing or iron smelting, and a physician or a surgeon who is not a chemist as well cannot be said to be armed at all points for the battle which he daily wages against disease and death.

Dr. Anderson's theory, as we understand it, is that certain diseases which have hitherto puzzled the medical profession are due to a lack of what the author calls tissue phosphates, *i.e.*, soluble tribasic salts in the various tissues, especially in the capillaries and the inner arterial lining, which are much richer in phosphatic salts than any of the other tissues. That the tissues may be kept in a thoroughly healthy state, the author asserts that not only is a certain amount of tribasic phosphatic salts necessary, but that they must be exhibited, whether as food or medicine, in a soluble form or in conjunction with a solvent. The efficacy of lime-juice in scurvy, for

instance, lies not so much in the phosphatic and potassic salts contained in it, but in the citric acid, which, according to Dr. Anderson, is the most powerful solvent of the insoluble phosphates that we possess, and that without producing any decomposition as in the case of the mineral acids. Dr. Anderson lays great stress on using phosphoric acid in combination with the proper basis, and decides that the administration of the element phosphorus can be of but little service, seeing that it must be oxidised in the system and united with the proper bases before it can be assimilated. For this reason the phosphorus preparations of the British Pharmacopœia are incapable of easily forming tribasic phosphates such as those formed in the tissues. From a chemical point of view, Dr. Anderson's theory seems to be fully borne out by the numerous analyses which he gives throughout the book, and his conclusions are, so far, the only possible results of his premisses; whether he is right physiologically time alone can tell.

As an example of the way in which purely chemical principles may be applied to the investigation of the causes and cure of certain diseases Dr. Anderson's book has a very high value, and we gladly recommend it to those of our readers who believe that the balance and test-tube are efficient handmaidens of the scalpel and dissecting knife.

*Aids to Chemistry.* Part II., Inorganic. The Metals by C. E. ARMAND SEMPLE, B.A., M.B., M.R.C.P. Lond. London: Baillière, Tindall, and Cox, 1878.

OF writing and publishing elementary manuals of chemistry there is literally no end. There is nothing original about Dr. Semple's book except the preface, in which he heartlessly tells us that “contributions have been freely levied on the admirable works of Miller, Fownes, Roscoe, Bernays, and especially upon the “*Chemia Coartata*” of Professor Kollmyer. On the title-page we are told that the book is for students preparing for examinations; we are afraid, however, that the student who presented himself for examination, without any knowledge of such chemically important elements as Va, Te, W, and a number of others purposely omitted by Dr. Semple, would fare somewhat badly. The work is an unusually bad specimen of cram book-making. It is nothing more than a meagre list of chemical facts loosely strung together, apparently for the purpose of being learned by heart.

## CORRESPONDENCE.

### WORKING UP NAPHTHALIN FOR USEFUL PRODUCTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxxvii., p. 258, is a paper by Mr. J. Marzell on the above subject. He quotes from a number of blue books, &c., showing what a variety of efforts has been directed to the obtaining of light-gas, oils, benzol, homologues, and anthracen, by passing naphthalin through red-hot tubes alone, or in presence of other bodies. The naphthalin has also in some instances been first treated so as to obtain a naphthalin compound or derivative, which has then been distilled. After reading this paper of Mr. Marzell's it struck me that some remarks thereon, from one who has tried all the experiments detailed, with many more besides, on the laboratory, and many of them on the practical, scale might be thought acceptable. Further, Mr. Marzell would appear to have become so deeply interested in patent specifications and specifications under provisional protection as to have forgotten to refer to or look up the memoirs or

journals of the scientific world, since he proposes for himself problems already solved, and describes results he has obtained, which seem to have given him certain false hopes to say the least.

With regard to efforts directed to obtaining light-gas from naphthalin by the action of heat upon the latter, it may just be mentioned that, on passing the latter through a long narrow tube with pieces of charcoal or pumice, and raised to an intense white heat, comparatively little decomposition takes place, and then pure hydrogen gas is evolved, and what distils over is a mixture of naphthalin with a small quantity of a mixture of the isomeric dinaphthyls, together with a brown polymeric dinaphthyl. By using lower temperatures, the above decomposition occurs, but to a much smaller extent. From the above it will readily be perceived how futile admixture of the naphthalin vapours with hydrogen must be in passing through the red-hot tube.

*Working Up for Benzol Homologues.*—The proposed process of passing naphthalin over heated peroxide of manganese I have already tried, and may just briefly say dinaphthyl is again formed in this case. Rowley's process, by first saturating with chlorine, with subsequent distillation, yielded me also, first, oils, and finally a fatty looking substance in small quantity. But how benzol was obtained by Mr. Rowley by simply dissolving this body in naphtha and then distilling, unless indeed the naphtha previously contained some benzol, I cannot comprehend.

*Working Up for Anthracen.*—With regard to Mr. Marzell's remarks under this head, I would solicit this gentleman's notice of *Proc. Lit. Phil. Soc.*, Manchester, (vol. v., series iii.), session 1870-71; or *Journ. Chem. Soc.*, 1871 (p. 1184), and succeeding numbers in 1873, 1876, and 1877.

I may mention that when the product obtained as Mr. Marzell describes is oxidised with chromic acid, absolutely no anthraquinon is obtained; and, likewise, when the picric acid test of Fritsche is applied, it fails to discover the presence of the smallest trace of anthracen. I may in conclusion now just remind Mr. Marzell that the field in which he appears to contemplate a series of researches, or is actually so engaged, has been for the last eight or nine years, and is still, occupied. Further, that a tacit understanding exists amongst chemists—I may say an international understanding—that a field of labour taken up and wrought in by any given individual, notice being from time to time given by said individual of such occupation, that this field of work shall be honourably left to the worker and not intruded upon.—I am, &c.,

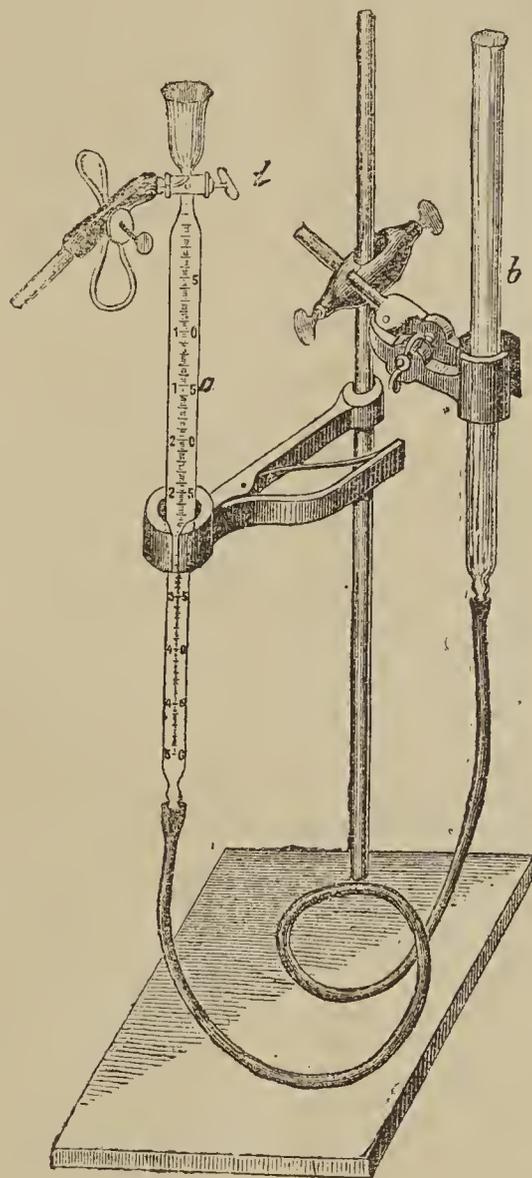
WATSON SMITH.

#### DETERMINATION OF NITROUS AND NITRIC ACIDS.

To the Editor of the Chemical News.

SIR,—Since the abstract of my paper on the determination of nitrous and nitric acids (from the *Berichte der Deutschen Chemischen Gesellschaft*), in your impression of 28th inst., will probably give to the reader a wrong idea of the purport of my paper I trust you will favour me with accepting the following more accurate abstract of the same. After having discussed a few unimportant contradictions between the results of Dr. Eder and my own, I continue by saying that all methods for the above-mentioned estimation founded on the use of oxidising reagents have certain drawbacks, where factory acids or similar impure substances are concerned, and that accordingly a method free from those drawbacks must be very welcome to chemists. As such a method I quote the mercury process invented by W. Crum, improved by Mr. John Watts, and lately recommended by Mr. Davis. It is true I mention that Mr. Davis has not given any proof of the accuracy of the method by the analysis of any

pure substances, and of such as had been mixed with known quantities of impurities; but I continue by saying that on making those test analyses myself, I have completely confirmed the accuracy of the method, and have found it not to be interfered with by the presence of arsenious acid and of organic substances. For this I have given full experimental details, and I have warmly recommended the process. The apparatus I have constructed for it is certainly very different from that of Mr. Davis's, which requires a mercurial trough and 10 lbs. of mercury, has too short a tube for any accurate measurements being possible, and is a somewhat clumsy instrument as to manipulation. My own apparatus requires no trough and less than 2 lbs. of mercury, and allows of the



same degree of accuracy as the scientific methods of gas analysis; it is equally applicable for factory work and for the most exact scientific determinations, the latter taking no more time and trouble than any rough method. As it may interest many of your readers, I beg to hand you a sketch of the apparatus, which I have proposed to call "Nitrometer," and which I have now used for some time with great success. You will observe the measuring tube *a*, holding 50 c.c., divided in  $\frac{1}{50}$ ths, provided with a funnel *c*, and a two-bore glass cock *d*, hanging in an instantaneously opening spring-clamp; an elastic tube connects *a* with the plain tube *b* of equal size, sliding up and down in another clamp. First of all *b* is placed so that its lower end is nearly at a level with *d*; mercury is poured into *b*, till it has filled *a*, and has got into *c*; *d* is turned so as to close the communication between *a* and *b*,

and so run off the excess of mercury through the lateral bore; *b* is lowered in its clamp, and 1 c.c. of the nitrous vitriol, &c., to be tested is introduced into *c*, by means of an accurate pipette. By carefully turning *d*, the acid is sucked into *a* without any air following, and *c* is rinsed out by a few c.c. of pure acid, run into *a* in the same way. *a* is now taken out of the spring-clamp, violently shaken for two minutes (no more is necessary), replaced in the clamp, and *b* adjusted, so that the levels of mercury of both tubes are equal, except that an allowance is made in *b* for the acid contained in *a*,  $\frac{1}{4}$ th of the height of the latter being either allowed for as an addition to the mercury in *b*, or else being deducted from the barometrical pressure. After the temperature has become constant ( $\frac{1}{4}$  hour suffices for factory work, 1 hour for exact analyses), the volume of gas in *a* is read off (which can be done to  $\frac{1}{20}$  c.c.) and reduced to 0° and 760 m.m. in the usual way. Each c.c. at 0° and 760 m.m. corresponds to 1.343 m.gr. NO = 1.701 m.gr. N<sub>2</sub>O<sub>3</sub> = 2.417 m.gr. N<sub>2</sub>O<sub>5</sub> = 3.805 m.gr. NO<sub>2</sub>Na, &c. Now *d* is opened, so that *a* and *c* communicate, *b* is raised, and thus first the gas then the acid are driven into *c*, from whence the acid is run away by the lateral bore of *d*; everything is now ready for a new test.—I am, &c.,

Zurich, July 1, 1871.

G. LUNGE.

## MAGNETIC FIGURES.

To the Editor of the Chemical News.

SIR,—In your last issue you published the report of a meeting of the Physical Society on Saturday June 22nd. In that report it is stated that Prof. S. P. Thompson exhibited a series of "magnetic figures illustrating electrodynamic relations." These figures are produced by fixing upon glass plates the curves obtained by the use of iron filings scattered in a magnetic field. There are probably few who deliver courses of lectures upon electricity and magnetism who have failed to make use of some such simple device for showing the nature of a magnetic field as that now dignified by the term "magnetic figures illustrating electrodynamic relations." But the very device used has also been employed. At a lecture upon the "Telephone" which was delivered at the Bristol Trade and Mining Schools in April last, I exhibited some of these figures upon the screen, and described the method of preparing the plates, which method is *exactly* similar to that now employed by Prof. Thompson. Many of these plates (perhaps a greater variety than those shown to the Physical Society), prepared in a similar manner, now lie in the Physical Cabinet at that Institution, and have been rather extensively used, both in my own and other classes.

One of Prof. Thompson's students was present at this lecture, and a full report appeared in the Bristol papers.

ERNEST H. COOK.

Ilfracombe, July 4, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 22, June 3, 1878.

Direct Fixation of Carbonic Acid, of Sulphurous Acid, and of Phthalic Anhydride upon Benzol; Synthesis of Benzoic Acid, of the Hydride of Sulpho-phenyl, and of Benzoyl-benzoic Acid.—O. Friedel and J. M. Crafts.—The syntheses which the

authors have effected have their analogues in the reactions of sodium-ethyl and of zinc-methyl, and seem difficult to understand without admitting the formation of an organo-metallic combination of aluminium by the reaction of this metal upon the hydrocarbides. On passing a current of carbonic acid, dried by traversing tubes filled with pumice moistened with sulphuric acid and with phosphoric anhydride, into benzol mixed with aluminium chloride, and kept at a heat near its boiling-point, a small quantity of hydrochloric acid is evolved. After a considerable time, which may amount to several days, the process is arrested and the mixture treated with water. The upper layer is decanted, and, after having filtered the watery stratum through a moistened filter, a small quantity of sulphuric acid is added, and the whole is moistened with ether. The ether, after being decanted and distilled, leaves a crystallisable body, which is benzoic acid.

Manufacture of Cast Manganese, and Volatility of Manganese.—P. Jordan.—The author presented to the Academy a specimen of cast-metal obtained by treating ores of manganese in the blast-furnace. Its composition is—

Manganese.. .. .	84.960
Iron .. .. .	8.550
Carbon .. .. .	5.700
Silicon.. .. .	0.660
Sulphur .. .. .	0.035
Phosphorus.. .. .	0.005

99.910

In subsequent operations the percentage of manganese has been carried as high as 87.4. The specimen laid before the Academy has been preserved for six months without having undergone any sensible alteration. There is a considerable loss of manganese in the furnace, amounting sometimes to 10 per cent, which, with certain other facts, seems to argue in favour of the volatility of this metal at elevated temperatures.

Thermo-chemical Examination of Certain Derivatives of Phenol.—W. Longuinine.—The author concludes that the heat of combination of the substitution products of phenol increases in proportion to the number of times that the residue NO<sub>2</sub> is introduced.

On Vapour Densities.—L. Troost.—The author has examined acetic and hyponitric acids, and finds that both behave like sulphurous acid, cyanogen, &c. He has also repeated his experiments on chloral hydrate, and finds his former results confirmed.

On Metallic Allotropism.—P. Schützenberger.—The facts relative to copper which the author has laid before the Academy are by no means isolated. Everything favours the view that by the electrolysis of metallic solutions under favourable conditions, which may vary for each metal, instances of this kind may be multiplied. Former experiments upon lead establish the existence of an allotropic modification of this metal characterised by an oxidability much superior to that of normal lead.

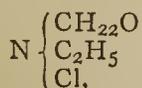
Reciprocal Combinations of the Metallic Sesquisulphates.—A. Etard.—The persulphates are capable of combining so as to form salts of the general formula M<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.N<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, and the compound thus formed can in its turn take up sulphuric acid so as to form more complicated acid compounds. The author has studied the double sulphates of the sesquioxide of iron and aluminium, of iron and chromium, of aluminium and chromium, aluminium and manganese, &c.

On Certain Compounds of Platinum.—D. Cochin.—The author has obtained a diplatino-phosphoric chloride of the formula PtCl<sub>3</sub>.2(PtCl<sub>2</sub>). He has also formed compounds of the subchlorides of platinum with aniline and tolydin analogous to the green salt of Magnus, and has combined aniline and tolydin respectively with the ethylic and methylic diphospho-platinic ether.

**Volumetric Determination of Arsenic.**—MM. A. Millot and Maguene.—The form in which arsenic, when isolated, is most often determined, is the ammoniaco-magnesian arseniate. The precipitation is rarely complete even in presence of a great excess of magnesia; and the authors have often observed that in the filtrate, after concentration and acidification, hydrosulphuric acid produces a slight yellow turbidity of arsenic sulphide. Further, the precipitate cannot be ignited, but must be weighed with its filter. They propose as a substitute the volumetric process already in use for phosphoric acid. It is known that, in a neutral or slightly acid liquid, arsenic acid is completely precipitated at the boiling-point by uranium acetate. If reagent is added drop by drop it becomes apparent when the precipitation is complete by the brown tint which a drop of the liquid takes when brought in contact with a drop of potassium ferrocyanide placed upon a porcelain plate. If the uranium solution has been standardised with a known volume of pure arsenic acid, the quantity of arsenic in the liquid is easily calculated. On account of the high equivalent of arsenic acid it is necessary to employ a solution of uranium more dilute than for phosphoric acid, 20 grms. acetate of uranium per litre being a suitable strength. Each c.c. of such a solution precipitates about 5 m.grms. of arsenic acid. The solutions of sodium acetate and of ferrocyanide are of the same strength as those employed for phosphoric acid. The ferrocyanide should have been prepared recently. The process requires that the arsenic acid should be completely separated from all the bases with which it may form compounds insoluble in weak acetic acid. This end is easily attained by decomposing, with pure fuming nitric acid, the arseniuretted hydrogen which the substances produce in Marsh's apparatus. After two hours the volatilisation of the arsenic is generally complete, as may be ascertained by igniting the gas escaping from the apparatus. The liquid which contains all the arsenic at the maximum stage of oxidation is then separated to dryness, re-dissolved, mixed with 10 c.c. of acetate of soda, and titrated with uranium. If the arsenic is mixed with antimony the latter is deposited during the evaporation, and does not interfere with the subsequent process.

**Researches on the Nitrogenous Acids derived from the Acetones.**—G. Chancel.—The author refers to a compound which he obtained in 1844, and named butyro-nitric acid. Three years later he considered it as nitro-propionic acid, but now he prefers to name it propyl-nitrous acid. The analyses of this acid and of its salts agree with the formulæ for dinitro-propane and its derivatives, as obtained by M. ter Meer.

**On Mono-chlor-ethyl-acetamide.**—T. H. Norton and J. Tcherniak.—This compound, to which the authors assign the formula—



is a very mobile liquid, neutral to test-paper, possessing an irritating odour, and being soluble in all proportions in water, alcohol, and ether. Analogous compounds are formed by the action of bromine upon ethyl-acetamid.

**On Ethylen Cyanide.**—Milan Nevolé and J. Tcherniak.—The authors have succeeded in preparing this compound,  $\text{C}_4\text{H}_4\text{N}_2$ , as a white brilliant solid, perfectly amorphous; soluble in water, alcohol, and chloroform, but sparingly soluble in carbon disulphide. It melts at  $54.5^\circ$ , and solidifies at  $53^\circ$ .

**Researches on the Peptones.**—A. Henninger.—The peptones derived from fibrin, albumen, or casein appear as white, amorphous, infusible powders, very soluble in water and in glacial acetic acid. They have a slight acid reaction, and behave like weak amido-acids. On examining the action of a great number of reagents upon the various peptones, the author has not been able to distinguish any difference in their respective behaviour.

Whilst possessing certain characters in common with the albuminoids, they differ as a class by a smaller tendency to coagulation and precipitation. They approximate remarkably to gelatin, but their hot solutions do not form a jelly on cooling. Their rotatory power varies, being most feeble in albumen pepton, and highest in casein pepton.

**Method of Separating and Determining the Stearic and Oleic Acids derived from the Saponification of Tallow.**—J. David.—This method is based on the novel fact that if acetic acid is dropped into an alcoholic solution of oleic acid a moment arrives when the oleic acid suddenly separates. Thus, if at a temperature of  $15^\circ$  1 c.c. of oleic acid is dissolved in 3 c.c. of alcohol at 95 per cent, and if into this liquor there is dropped a mixture of equal volumes of water and of glacial acetic acid, the separation of the oleic acid—which does not even begin on the addition of 2.2 c.c. of the acetic acid—is completed by 2.3 c.c.; *i.e.*, a difference of  $\frac{1}{10}$ . It is not the same with the alcoholic solution of stearic acid, which begins to precipitate on the addition of the first drop. Further, stearic acid, which is insoluble in the mixture of alcohol and acetic acid, is equally insoluble when the mixture contains oleic acid. The authors effect the separation of the two fatty acids as follows:—They mix in a flask or litre of glacial acetic acid with a litre of water. Operating at  $15^\circ$ , they pour into a small tube graduated in tenths 1 c.c. of pure oleic acid, then 3 c.c. of alcohol at 95 per cent, and finally 2.2 c.c. of the acetic acid. So far nothing ought to be precipitated, but if, on adding  $\frac{1}{10}$  c.c. of acetic acid, a turbidity appears, and if above the mixture of alcohol and acetic acid there floats 1 c.c. of oleic acid, it may be inferred that the sample is good. If not, the proportions are varied until the point of precipitation is hit within 0.1 c.c. of acetic acid. When this end is attained, alcohol and acetic acid are mixed in the proportions indicated by the preliminary trial—for instance, 300 of alcohol to 220 of acid. In the meantime they add to the alcoholic-acetic mixture 1 grm. or 2 grms. of pure stearic acid cut in fragments, and, finally, the lower end of the exit tube of the washing bottle is fitted with a small piece of sponge, so that when operating they may always have a clear liquid, free from undissolved stearic acid. When not in use both apertures of the washing bottle are kept well-stoppered, in order to prevent the evaporation of the alcohol. The analysis is then performed as follows:—0.95 (gm.?) of the fatty acid to be analysed is weighed into a thin tube-flask, fitted with a well-ground stopper. Upon it are poured 15 c.c. of the alcoholic mixture; it is repeatedly shaken up, and left for twenty-four hours in a cellar of the maximum temperature of  $15^\circ$ . The oleic acid being then entirely dissolved, the whole is thrown upon a small filter, in a funnel whose edges are ground and covered with a glass plate. The stearin remaining upon the filter is washed with the same mixture of alcohol and ether with which the filter is fitted three times in succession, thus rendering it perfectly free from oleic acid. The stearic acid is then entirely washed from the filter into a tared platinum capsule by means of a stream of cold water from a washing bottle with a very slender orifice. The capsule is then heated in the water-bath, and when the stearic acid has collected on the surface of the water, as an oily cake, it is allowed to cool. The water beneath this solid matter is decanted off, and the stearic acid is completely dried at  $100^\circ$ , or better in a vacuum. It is then weighed, and the weight, less that of the empty capsule, gives the proportion of stearic acid in 95 of the fatty acid.

Moniteur Scientifique Quesneville. Série 3, Tome viii., June, 1878.

**Dissociation of the Salts of Aniline.**—M. Goppelsroeder.—The salts of aniline, toluylidin, and naphthylamin are decomposed into acid and base so completely by water that such salts in an aqueous solution may be

advantageously titrated with a normal solution of potassa. The aqueous solution of these salts behaves like the solution of the free acid in the salts. The author announced at the same time that on passing a galvanic current through a hot and concentrated solution of a salt of aniline, he had obtained at the positive pole a pure green deposit which appeared to be emeraldin. This deposit turns black on oxidation.—*Bulletin de la Soc. Ind. de Mulhouse.*

**Discharge on Vat Blues.**—M. Oscar Scheurer.—Minium, or lead sesquioxide, if printed on cloth which is dyed blue in the vat, and then passed through cold and weak hydrochloric acid, gives very clear and well-defined whites. If the passage through the acid takes one minute, a strength of  $\frac{1}{2}$  degree B. (?), or 25 c.c. of the commercial acid to a litre of water, suffices for the production of a pure white. The cloth is then passed through boiling water to remove the lead chloride formed. If with the minium are mixed other insoluble colours, such as terra di sienna, ochre, chrome yellow, Guignet's green, &c., thickened with albumen a variety of discharge colours are obtained. But it is requisite to steam before the passage through acid in order to coagulate the albumen. The defect of this procedure is the impossibility of entirely removing the lead chloride.—*Bull. de la Soc. Ind. de Mulhouse.*

**Simultaneous Action of Ferricyanide of Potassium and certain Acetates upon Indigo.**—M. Alb. Scheurer.—If a swatch of vat-blue cloth upon which a design has been printed with potassium ferricyanide mixed with any acid is steamed, the indigo is destroyed. The destruction of the colour is directly as the power of the base whose acetate is used and inversely as the energy with which the same base retains the acetic acid at the temperature of 100°.

**Candles for the Blowpipe.**—M. Paul Casamajor.—See page 14.

**On Ashes sold for Bleaching Linen.**—M. E. Feray.—An account of the various kinds of wood-ashes, &c., sold in France as a source of alkaline lyes. The fact is mentioned that the annual cost of washing linen, &c., in France, is 1 $\frac{1}{2}$  milliards of francs.

**Researches on the Fermentation of Dextrin.**—M. Barfoed.—A solution of pure dextrin may enter into alcoholic fermentation under the influence of yeast alone, though the fermentation progresses much more slowly than with sugar. The gas disengaged consists exclusively of carbonic acid, other products of fermentation not being formed in appreciable quantity. There is no proof that the dextrin is previously transformed into glucose.

**Researches on the Aromatic Amines.**—MM. E. Noelting and F. Reverdin.—Monomethyl-orthotoluydin is a colourless oil, of a peculiar odour, boiling at 207–208° and having at 20° the sp. gr. 0.973. If oxidised by the process followed in the manufacture of methylanilin violet, it yields a fine violet-red colouring matter, whilst its isomer, monomethyl-paratoluydin, described by M. A. Thomson, yields a brown colour.

**The Blue Solution of Molybdic Acid as a Reagent.**—M. O. Maschke.—If calcium molybdate is moistened with a quantity of dilute hydrochloric acid sufficient to produce a clear solution on the application of a gentle heat, a deep blue colouration quickly appears in the liquid. In place of calcium molybdate those of ammonium, sodium, or potassium, may be used, adding so much hydrochloric acid that the liquid if poured upon a plate of polished marble may produce a visible but very slight effervescence. If after cooling a concentrated solution of sodium or calcium chloride is poured into the liquid there is formed a blue-black precipitate, not easily distinguished in the liquid, and which may be regarded as a compound of molybdic acid and molybdic oxide. It dissolves with great ease, not merely in water but also in alcohol, and produces a colouration of extraordinary in-

tensity. The author prepares the solution as follows:—3 grms. calcium molybdate, 250 c.c. of water, and enough of hydrochloric acid to effect the solution of 2 grms. of cane- or grape-sugar. When the deep blue colouration is apparent the ebullition is continued for five minutes. When the precipitate has been produced with sodium or calcium chloride, it is washed upon the filter first with the precipitant and then with a little water. As soon as the liquid begins to run through of a deep blue colour, the filter with its contents is placed in distilled water and the solution finally made up to 250 c.c. This blue solution is decolourised with extreme ease by caustic alkalies and oxidising agents, such as chlorine, nitrous acid, hydrogen peroxide, and permanganic acid. Hydrochloric acid of sp. gr. 1.24 produces in this solution a blue precipitate, the supernatant liquid being colourless. Sulphuric acid of sp. gr. 1.840 does not give a precipitate, but the colour of the liquid is altered. Nitric acid of sp. gr. 1.185 produces a rapid decolouration. Dilute solutions of ferric salts decolourise, and those of ferrous salts occasion turbidity. The author has endeavoured to employ the blue solution to detect nitrous acid in spring waters. The water under examination is mixed with a little caustic soda; after filtration, so much acetic acid is added that the liquid may have but a very feeble acid reaction. A test-tube is three-fourths filled with this liquid and about 6 to 10 drops of dilute acetic acid and 1 to 2 drops of the blue molybdic solution are added, so that, in placing the tube upon a white surface and viewing it longitudinally, only a very slight blue colouration may be perceived. Water containing only some tenths of a milligram. of nitrous acid per litre will certainly destroy the colour in an hour. The rapidity and distinctness of the reaction are remarkably increased on heating the liquid mixture gently for a short time. Solutions of potassium nitrate, containing  $\frac{1}{10}$ th of a millionth of nitrous acid per c.c., are decolourised in a few minutes after being gently heated. A strong and prolonged heat is to be avoided. Attempts made at the titration of nitrous acid by means of the blue molybdic solution, have so far given unsatisfactory results. Still if we admit that 1 mol. of permanganic acid corresponds to 5 mols. of molybdic oxide, it is easy to determine with precision the quantity of molybdic oxide contained in a liquid by titration with permanganate. It might therefore be possible to determine nitrous acid in a satisfactory manner, by causing the blue solution of molybdic acid to react for a certain time, the length of which must be experimentally determined, and then titrating back with permanganate. The blue solution is not very stable.—*Zeitschrift für Anal. Chemie.*

**Process for the Detection of Molybdic Acid.**—M. O. Maschke.—According to Schoenn traces of molybdic acid and its compounds may be discovered by the blue colouration produced on heating it with concentrated sulphuric acid in a porcelain capsule. This test is rendered exceedingly convenient, and much more certain by the following modification: a little concentrated sulphuric acid is applied to a piece of platinum foil, bent so as to form a slight depression; upon the acid is placed a little of the substance in powder, and the foil is heated till vapours escape in abundance; it is then let cool and repeatedly moistened with the breath. When after cooling only minute blue spots are visible, the sulphuric acid after being breathed upon takes an intense blue colouration. On heating the platinum foil, the blue colour vanishes, but reappears on cooling. It is completely decolourised if a considerable quantity of water is added.—*Zeitschrift für Anal. Chemie.*

**On Chromic Phosphate.**—Phosphoric acid in combination with chrome may be easily overlooked in following the method indicated in Will's tables, when chromic oxide and chromic phosphate are obtained simultaneously in solution in potassa. On boiling this solution to precipitate the chrome, the phosphate is entirely decomposed, and not a trace of phosphoric acid is precipitated with the oxide of chrome.—*Zeitschrift für Analyt. Chemie.*

July, 1878.

**Chemical Industry at the Exhibition of 1878.**—M. Adolphe Kopp.—The branches discussed in the present issue are sulphur, bisulphide of carbon, sulphuric acid, and alkali. Little appears to have been done in the last few years towards improving the manufacture of sulphuric acid. M. de Hemptinne causes the sulphurous acid derived from the combustion of pyrites to pass through two concentric chambers, so that the impurities may be deposited. The top of the chambers is occupied by a vat in which the concentration and denitrification of the acid is effected. This vat is of sheet-iron and it is lined with lead. Its bottom is traversed by 100 tubes of lead, one metre long and 50 centimetres in diameter. In each tube is suspended another more slender, the lower extremity of which is open almost like the steam-tubes in Field's boiler. This second tube opens at 10 centimetres from the bottom, and serves to feed the former with weak acid. In this manner a constant current of acid is established in the tubes, and it is concentrated to 6<sup>r</sup> B. In order to denitrify it, the vat is covered, and by means of a leaden tube the sulphuric acid which has already entered the chamber is aspirated; it is pressed by a sort of Giffard's injector through the nitrous sulphuric acid and the watery vapours derived from the evaporation. The sulphurous acid loaded with nitrous vapours returns into the chambers by another tube. The lead chamber in which the transformation is to take place with extreme rapidity is lined with sheets of lead and filled with 5200 earthen bottles fitted with holes. The nitric acid enters the chamber by means of a Welter's funnel, and weak sulphuric acid is thrown over the bottles at regular intervals. No steam enters the chamber, except the jet which is between the chimney and the Gay-Lussac towers. There is no information as to the practical value of this process. The drums and the cascade-apparatus for denitrifying the acid, as described in the works of Knapp and Wagner, have not been generally introduced into manufactories. These systems differ from Glover's tower, inasmuch as water plays the part of denitrifier as the gases enter it saturated with moisture. Probably the great waste of lead has caused these contrivances to be rejected; in fact, the weak sulphuric acid which runs down the sides is saturated with weak sulphuric acid, and is of course highly destructive to lead. The drums have been replaced by large stoneware bottles, similar to those employed for the condensation of hydrochloric acid, and filled with fragments of coke. In these denitrification is well effected, vapour of water being used, not sulphurous acid. The acid is concentrated to 48° B. Lately various interesting communications have been published concerning Glover's tower, and this apparatus, which in 1873 was only known for concentrating the acid, seems to become more generally used, not merely for this purpose but also for denitrification. On this point a brisk controversy has sprung up in the English and German journals. M. Kuhlmann having studied the action of sulphurous acid upon the binoxide of nitrogen and hyponitric acid, proved that the oxides of nitrogen are to a great extent reduced to protoxide. MM. Pelouze, Fremy, and Weber have arrived at the same conclusions. In presence of water the reaction goes still further. M. Vorster has come to the same results, and applying his laboratory experiments to the reactions which take place in Glover's tower, he argues that though the process of denitrification is complete in this apparatus, it is carried too far, nitrous oxide and even free nitrogen being formed with a loss of 40 to 70 per cent. Thus in England alone the loss would be equal to 3600 tons nitrate of soda annually. On the other hand, Dr. Lunge considers that the English manufacturers could not but have become aware of the loss attending the new process, had such really existed. But no greater quantity of nitre is decomposed than by the old process—2.14 per cent of the sulphur employed, or if without a Gay-Lussac's tower 3 per cent. He further explains the differences which have arisen between

theory and practice. It has been certainly proved that nitric oxide is easily reduced by sulphurous acid to nitrous oxide and even to nitrogen, nitrous acid less readily and nitric acid least readily of all, but only under conditions which do not occur in practice. The experimentalists above mentioned have, *e.g.*, caused the gases to react upon each other in a state of purity, whilst in Glover's tower the sulphurous acid is mixed with a large excess of air. The process of denitrification is chiefly effected in the upper part of the tower where the gases are coolest, the temperature of the acid being never above 120°—140°. There are nevertheless two cases where Glover's tower cannot be used. If the nitrous sulphuric acid coming from the Gay-Lussac towers is contaminated with impurities extracted from the coke, the temperature of the Glover's towers is not elevated enough to burn these organic particles; the acid remains brown, and this colouration disappears but slowly, until the coke has been used for several months. The Gay-Lussac towers might indeed be filled with some other substance, but such is not easy to find, on account of the low price of coke, its porosity, and its resistance to acids. If the pyrites used contain much ash, the result will be an impure acid containing much iron. The author describes next the improvements in apparatus for the concentration of chamber acid, speaking very highly of that devised by Messrs. Johnson and Matthey, of Hatton Garden, and now on view in the English section of the Exhibition. The methods proposed for the removal of arsenic present in sulphuric acid are not pronounced perfectly satisfactory, the best being that of Dupasquier, who adds barium sulphide and hyposulphite.

**Use of Soluble Glass in Bleaching Cotton.**—M. R. Meyer spreads out the cotton to be bleached, without moistening it previously, in a chest fitted with squeezers, containing a solution of silicate of soda, and placed in an iron cylinder, open above, and fitted with a double bottom. The solution consists of 1 litre silicate of soda at 20° B., and 120 litres of water. When the cotton is saturated with this liquid it is further covered with a similar quantity of the same solution, and boiled for two hours. The liquid is drawn off strongly coloured, and is replaced by boiling water, which is kept in ebullition for an hour. This operation is repeated once more when the bleaching is complete, and the cotton is drained and washed. The first washings should be made with boiling water, for, if cold or luke-warm water is employed, the dirt is re-precipitated upon the cotton. For the same reason it is proper to pass the cotton through a centrifugal machine before washing.—*Muster-zeitung.*

**Process for the Preservation of Wood.**—It is recommended to char the wood superficially, and then, while still hot, to coat it with as much hot tar as it will absorb.

**Manufacture of Violet Ultramarine.**—M. J. Zellner.—The inventor claims the four following processes:—1. He passes a dry halogen, preferably chlorine, over blue or green ultramarine heated to 300°, and obtains the halogenic derivatives of ultramarine. 2. He heats blue or green ultramarine to 160° to 180°, passing into it chlorine (or some other halogen) along with the vapour of water. There is formed what the author terms hydroxylised violet ultramarine, along with chloride of sodium, which is eliminated by washing; 34 kilos. of chlorine are required for 100 kilos. of ultramarine. 3. Blue or green ultramarine is heated with a mixture of such salts as ammonium nitrate or chloride, or with any mixture giving off watery vapour and a halogen on the application of heat. There is formed violet hydroxylised ultramarine or, in presence of ammoniacal salts, "amidic ultramarine." 4. The conversion of ultramarine into violet ultramarine may be likewise effected more or less completely by submitting blue or green ultramarine at 160° or 180° to the action of an acid, an oxidiser, of water, or a mixture furnishing these three bodies.—*Muster-zeitung.*

**Falsification of the Extract of Logwood.**—Formerly this extract was adulterated with indifferent substances, so that the value of a sample could be ascertained by simply dyeing a swatch. Now the extract is sophisticated with colouring matters of less value, such as sumac, chestnut wood, gall-nuts, &c. [There is a mistake here: the cheapest gall-nuts cost twice the price of the dearest logwood.—*Ed. CHEM. NEWS.*] The following method may be recommended for detecting this new fraud. Exhaust 1 decigramme of the sample dried at 110° in the gramme of absolute ether, and weigh the residue after evaporation of the ethereal extract; treat the portion left undissolved by ether with alcohol, and compare the weights of these two extracts with those given by a normal extract of logwood. The extract of chestnut-wood being insoluble in ether, but soluble in alcohol, it is evident that a sophisticated extract will contain a larger proportion of matter insoluble in alcohol than a genuine sample. It may also be useful to make quantitative dyeing experiments with the portions respectively soluble in alcohol and ether.—*Journal de Fabricants de Papier.*

**Manufacture and use of Chlorophyll.**—MM. Secourt and Guillemare take the leaves of spinach, nettles, &c., and macerate them in water. The whole is then boiled with an equal weight of soda-lye at 12.5° Baumé, and the liquid thus obtained is precipitated with alum. The lake thus yielded is washed and pressed and is then mixed with an equal weight of a soluble phosphate, an alkaline citrate, or, a bitartrate, and then diluted with water down to 2° to 5° Baumé. This solution retains its colour and may be advantageously used for giving a green to preserved vegetables, &c.—*Chemisches Industrie-Blatt.*

**Nitro Alizarin.**—M. Caro has patented several processes for the preparation of the alizarin-orange resulting from the action of nitric acid upon alizarin. The alizarin is spread out in a thin layer upon the floor of closed chambers, and is submitted to the action of vapours of nitric acid. Another method is to dissolve the alizarin in ether, glacial acetic acid, petroleum, or nitro-benzol, and to pass a current of nitrous acid through the solution; 20 parts of the solvent are employed to 1 part of alizarin, and the current of nitrous acid is kept up until it ceases to be absorbed. The colouring matter is collected either by distilling off the solvent or by precipitation with an aqueous solution of potassa and subsequent precipitation of the salt formed with an acid. When glacial acetic acid is used as a solvent, nitric acid of sp. gr. 1.38 must be added. Sulphuric acid of sp. gr. 1.840 may likewise be used as a solvent.

**Suppression of Dysentery.**—Dr. Dounon.—From observations made in Cochin China, it appears that dysentery is due to certain animalculæ, *Anguillula stercoralis* and *dyssenterica*, *Anklystoma dyssenterica*, &c., introduced into the intestinal canal by means of polluted waters. The disease may be obviated by never partaking of water unless it has been previously purified by alum, or, better still, by boiling. The treatment with alum has been successfully used by the natives of Annam from time immemorial, and during six years has completely preserved the French troops in Cochin China from this dreadful scourge.

**Physico-Chemical Researches on the Different Allotropic States of Hydrogen.**—Dr. Donato Tommasi.—The author examines so-called electrolytic, electrified, and occluded hydrogen, and concludes that this element has no allotropic modifications.

**On Black in Dyeing.**—M. Moyret.—The author maintains that there is no true black in dyeing, the so-called blacks being merely dark colours. Nevertheless, the dyers of the Gobelins, when they declare that blue is a light black, are wrong as far as the colours of the present day are concerned.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*

No. 52, April, 1878.

Report presented by M. Bérard on behalf of the Committee of Chemical Arts on a Method for the Analysis of Alkaline Carbonates and Analogous Industrial Products.—MM. Delachanal and Mermet.—The process consists in oxidising the total sulphur present by means of potassium hypobromite and determining it as sulphuric acid. The carbon bisulphide in a second portion of the sample is then expelled, and the remaining sulphur oxidised and determined as before.

**Determination of the Illuminating Power and of the Purity of the Coal-Gas of Paris.**—M. F. Le Blanc.—This paper cannot be usefully abstracted without a reproduction of the accompanying diagrams.

No. 53, May, 1878.

Report presented by M. Davanne on behalf of the Committee of the Fine Arts on the Photographic Preparation known as the Dry Bromide of Silver Emulsion.—M. Chardon.—M. Chardon is declared to have succeeded in producing a simple and certain dry photographic process admirably adapted for use during scientific expeditions in barbarous countries. The so-called dry emulsion is a compound of collodion, containing in its pores a suitable quantity of the bromide of silver. This substance, if placed in bottles and preserved from exposure to the light, retains its properties for an indefinite time, even at very elevated temperatures. When it is required to employ the emulsion, about four grms. are dissolved in 100 c.c. of a mixture of equal parts of ether and of absolute alcohol; after agitation and twenty-four hours' contact the liquid is filtered and the plates are covered and then dried without any further preparation. When dry they are fit for use, and retain their properties for some months. The development of the impression may be effected either forthwith or a long time afterwards. Thus proofs taken at Aden have been developed at Paris.

**Presence of Oxygen in Metallic Silver.**—M. Dumas.—Taken from the *Comptes Rendus*, and already noticed.

**Composition of Tin-Foil specially designed for Chocolate Manufactories.**—MM. Charles Kopp and G. Engel.—In these tin-foils lead was found in mere traces as compared with the so-called tin which is brought in contact with articles of food in England in the shape of tinned iron. One sample, however, contained antimony to the extent of 6.111 per cent along with 0.889 per cent of arsenic!

**Experiments on the Formation of Artificial Ultramarine.**—M. J. F. Plicque.—Taken from the *Comptes Rendus*, and already noticed.

*Bulletin de la Société Chimique de Paris,*

No. 8, April 20, 1878.

**Oxidation of Ethylen.**—M. Berthelot.

**Persulphuric Acid.**—M. Berthelot.

**New Observations on the Chemical Reactions of the Effluve and on Persulphuric Acid.**—M. Berthelot.

**Formation of Oxygenated Water, Ozone, and Persulphuric Acid during Electrolysis.**—M. Berthelot.

**New Observations on the part played by Pressure in Chemical Phenomena.**—M. Berthelot. — These papers have all been already noticed.

**Rotatory Power of Meta-styrolen.**—M. Berthelot.—The author remarks that if he insists upon the fact that styrolen is possessed of a rotatory power, it is because a theory recently proposed to explain the rotatory power of organic compounds, that of so-called "asymmetric car-

bon," regards the existence of this property as impossible in a carbide so simple as styrolen. This theory is, therefore, incompatible with experience.

**Certain Reactions of Borax and of Boric Acid in presence of Mannite.**—M. D. Klein.—A mixture of solutions of mannite and of alkaline or alkaline-earthly bborates, though presenting an acid reaction under certain circumstances, becomes alkaline when diluted with water.

No. 10, May 20, 1878.

**Researches on Anthraflavon and Anthraxanthic Acid.**—M. A. Rosenstiehl. (Second part.)—The author concludes that anthraflavon is a mixture of two isomers of alizarin, to each of which corresponds an isomer of purpurin. The author has not specially studied—*a* anthraflavon, but merely the trioxy-anthraquinon derived from it, and which has been identified with isopurpurin. Anthraflavon *β* has been identified with the anthraflavic acid of MM. Schunck and Roemer, and compared with the anthraxanthic acid of MM. Ulrich and von Perger. The two latter are secondary products of the manufacture of alizarin, that is to say, derivatives of anthracen. Oxyanthraflavon *β*, oxyanthraxanthin, and flavopurpurin are identical, and the author proposes to retain from them the name flavopurpurin. The ten bodies reviewed in the author's memoir may be reduced to five. Anthraflavon *a* (meta-benz-bioxyanthraquinon of Schunck and Roemer) isoanthraflavic acid; isopurpurin (anthrapurpurin of Perkin, Schunck, and Roemer); anthraflavon *β* and flavopurpurin. Four of these compounds are secondary products of the manufacture of alizarin, and are consequently obtained from anthracen; four of them are also procurable from oxybenzoic acid.

**Aromatic Nitrosamines.**—M. Otto Witt.—Not suitable for abstraction.

**Remarks on the Analysis of Crude Tartars.**—M. A. Scheurer-Kestner.—The tartaric acid in tartars is present as bitartrate of potassa and neutral tartrate of lime, the former of which is the principal constituent. It is generally determined by means of a standard solution of soda or potassa. Sometimes, instead, the product derived from the calcination of the tartar is titrated. Ignition transforms the titrate into carbonate, but in this case there is danger of titrating simultaneously the carbonate of lime, and of thus committing an error if it is not rectified by a special determination of the tartrate of lime. But if the tartar contains calcium sulphate, its value may be lowered by the action of the potassium carbonate upon the plaster. If the tartars are free from calcareous salts, the titration of the ignited residue gives results perfectly exact. It is not always the same with the direct titration of the acidity by means of a standard alkali. Certain tartars, and especially certain dregs of wines, contain acid organic products distinct from tartaric acid. The calcium tartrate yielding a double quantity of alkaline substance for the same proportion of tartaric acid compared with that yielded by the cream of tartar, it would be a grave error to titrate the entire product of calcination with standard acid. In this case it is proper to treat the ignited product with water till all the soluble salts are dissolved, and to titrate the solution thus obtained. This method leaves nothing to be wished if the tartar is free from plaster; in the contrary case there are formed during the solution potassium sulphate and calcium carbonate. If tartars contain plaster, it is almost impossible to determine with accuracy the relative quantities of potassium bitartrate and calcium tartrate. It is practicable only in the absence of organic acids other than tartaric. In this case, the bitartrate may be determined by the use of a standard alkaline liquid; the whole of the tartaric acid in the sample may then be determined as calcium tartrate, and the original proportion of the two salts may be found by calculation. Exact and concordant results may be obtained by the following process: The sample in question is dissolved in hydrochloric acid.

The solution is filtered, mixed with calcium chloride and precipitated by caustic soda, but to avoid the possible precipitation of calcium hydrate the saturation is completed with ammonia. Instead of caustic soda ammonia may also be used for the precipitation of calcium tartrate, but in this case the quantity of hydrochloric acid employed must be limited, calcium tartrate being slightly soluble in ammonium hydrochlorate. The precipitate obtained is collected on a filter, washed, ignited, and determined by means of standard solutions.

**Decomposition of Alcohol by Zinc Chloride at High Temperatures.**—W. H. Greene.—The products obtained are hydrogen, hydrochloric acid, ethyl hydride, ether, water, aldehyd, and certain oily products, probably polymers of ethylen,

**New Mode of Formation of Ethylic Oxide.**—W. H. Greene.—On heating sodic oxide to 180° with ethyl iodide, a notable quantity of ethyl oxide is obtained.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 4, May 23, 1878.

**Presence of Oxygen in the Sun.**—Prof. Draper has identified in the solar spectrum no fewer than thirty of the best known rays of oxygen.

**Annatto.**—According to M. C. Etti, there exists in annatto a third tinctorial principle, a soft, brownish-red colouring matter, which has not yet been examined.

**"Gum-ammoniac."**—The gum-resin obtained from Morocco under this name, if heated in contact with potassa, yields resorcin, and a small quantity of an acid precipitable by plumbic acetate, and taking a red colour in contact with iron. Its composition is given as C<sub>10</sub>H<sub>10</sub>O<sub>6</sub>, isomeric with hemipinic acid. The substances met with in commerce under the name of "gum-ammoniac" differ respectively in their chemical properties.—*Dr. Goldschmidt.*

No. 5, May 30, 1878.

It is announced that the coal-deposits of China are at last to be worked on a large scale, and that a railway from the mines to the sea is about to be constructed.

M. du Moncel, in reply to a letter from M. Navez, points out that a current so feeble as that of a single Daniell element, after traversing millions of kilometres of telegraphic wire can scarcely have sufficient energy to cause a plate of iron like that of the telephone to vibrate mechanically by its attraction.

*Reimann's Färber Zeitung,*  
No. 22, 1878.

This issue contains a proposal to purify the waste waters from dye, print, and bleach works by allowing them to collect in tanks, where the various impurities may react upon each other. A process substantially the same has been successfully used in England ten years ago.

*Chemiker Zeitung.*  
No. 22. May 29, 1878.

**Polish Guano Deposits.**—Exaggerated reports have been spread concerning the value of the so-called guano discovered in certain caverns between Olkusz and Ojcow. In most of these caves the deposit is not merely poor in nitrogen (0.3 per cent.), but also in phosphoric acid (2.35 to 8.65 per cent.) The bed in the Jerzmanowska cavern, near Ojcow, is the only one which appears worth working. It is poor in nitrogen,—0.4 to 0.6 per cent,—but contains, on an average, 20 per cent phosphoric acid, accompanied, however, with 10—15 per cent carbonate of lime, and about 2.2 ferric oxide and alumina. The contents of the cavern are valued at £25,000.

**Vitality of Bacteria.**—Concerning the recent statement of A. Frisch, that bacteria survived a temperature of

=83°5', Dr. E. Schumacher mentions that in his experiments they were not destroyed at -113°75'.

**Distinction of Colours by Artificial Light.**—The light of Swedish safety-matches is sufficiently white for recognising the difference between greens and pale blues.

**Cleansing Glass Vessels.**—For quickly and perfectly cleansing glass vessels, especially if soiled with fatty matters Walz recommends the application of a concentrated solution of potassium permanganate, mixed with a few drops of hydrochloric acid.

**Sugars Tinted with Ultramarine.**—If such sugars are heated along with the juices of fruits, the ultramarine is decomposed with evolution of sulphuretted hydrogen.

**Detection of Alcohol in Presence of Methylic Spirit (Wood Naphtha).**—The liquid to be tested is distilled with sulphuric acid, the distillate mixed with potassium permanganate and sulphuric acid, any turbidity being removed by means of sodium hyposulphite, and a very dilute solution of magenta is added drop by drop. If alcohol was present, the red colour of the magenta is changed to a violet, by the acetaldehyd which is formed.—*Zeitschrift f. Anal. Chemie.*

**Separation of Nickel and Iron.**—The process depends on the insolubility of ferric phosphate in acetic acid, in presence of sodium phosphate in excess, whilst nickelous phosphate is soluble. The hot solution of the two metals containing free acetic acid is mixed with sodium phosphate, the ferric precipitate is removed by filtration; from the filtrate phosphate of nickel is thrown down by the addition of potassa, the precipitate is dissolved in sulphuric acid, the solution is rendered alkaline, and the nickel precipitated by the galvanic current. The process is only applicable where the nickel does not exceed 3 per cent.—*Zeitschrift f. Anal. Chemie.*

## MISCELLANEOUS.

**University of London.**—The following is a list of the candidates who have passed the recent D.Sc. Examinations:—Branch IV., Inorganic Chemistry: P. P. Bedson, Owens College; J. K. Crow, Owens College. Branch V., Organic Chemistry: R. H. Jude, Christ's College, Camb. Branch VIII., Physical Optics, Heat, Acoustics (treated experimentally): S. P. Thompson, B.A., private study. Branch XIV., Geology: C. Callaway, M.A., private study; R. D. Roberts, Clare College, Camb.

**Edison's Instrument for Measuring the Heat of Heavenly Bodies—Improvements in the Telephone.**—Mr. Edison was recently visited, at his home in Menlo Park, by Profs. Brackett and Young, of Princeton College, and Prof. Barker, of the University of Pennsylvania, who were desirous of examining his instrument for measuring heat. Mr. Edison has made several experiments with this apparatus, and has succeeded in measuring the fifty-thousandth part of a degree of heat. Prof. Young and Prof. Brackett will go to Colorado to observe the solar eclipse, and the usefulness of this instrument for measuring the heat of the heavenly bodies will then be tested for the first time. Mr. Edison has also been working diligently at his telephone. He has lately perfected the "receiver" of his telephone so that words spoken at a distance of 100 feet from the instrument have been distinctly heard 30 rods away. He recently placed a telephone containing the improved "receiver" in his laboratory, and connected it in the usual manner with another one in his house, which is more than 30 rods distant. The instrument in the laboratory was placed at the end of the room, and Mr. Edison retired to the other end, and his words—spoken in an ordinary conversational tone—were distinctly heard in the other telephone at his residence. One difficulty met with in the experiment was that the other sounds in the laboratory were also trans-

mitted through the instruments, but they did not destroy the sound of the inventor's voice. The resistance thus overcome by the sound was equal to that encountered in traversing 100 miles of wire when the words are spoken directly into the "receiver."—*New York Daily Tribune.*

## NOTES AND QUERIES.

**Sulphate of Iodo-Quinine.**—Would some reader kindly describe the method of preparing above for use as artificial tourmalines?—C. J. LEAPER.

**Molybdate of Ammonia.**—Would some reader kindly describe Eggertz's method of preparing a solution of the above in nitric acid as a test for phosphoric acid?—C. J. LEAPER.

**Liquid Lighter than Water, &c.**—Can any of your correspondents name me a substance with the following properties, viz:—Liquid, lighter than water, not volatile, and insoluble in water and in bisulphide of carbon?—E. R.

## THE QUARTERLY JOURNAL OF SCIENCE.

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

Now ready, No. LIX., July, 1878, price 5s.

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Notices of Scientific Works, Scientific Notes, &c.

London: 3, Horse-Shoe Court, Ludgate Hill, E.C.

## MANCHESTER CORPORATION GAS-WORKS.

### AMMONIACAL LIQUOR.

**The Gas Committee of the Corporation of Manchester** are prepared to RECEIVE TENDERS for the PURCHASE of the AMMONIACAL LIQUOR to be produced at their Gaythorn and Rochdale Road Works during a period of one or more years, commencing from the 1st day of January, 1880. In addition to tenders for the purchase of the liquor in its crude state, the Committee will also be prepared to consider tenders for its disposal, either by manufacture into sulphate of ammonia at the above-mentioned works on their behalf, or in any other manner. The Committee reserve to themselves the option of accepting the offer the terms of which they deem most advantageous. They do not bind themselves to accept the highest or any tender. Sealed tenders, addressed to the Chairman of the Gas Committee, Town Hall, and endorsed "Tender for Ammoniacal Liquor," must be delivered at these offices on or before Tuesday, the 1st day of October next.—Forms of tender and further particulars can be obtained on application to Mr. George B. Jackson, at the Gas Offices.—By order of the Gas Committee,

JOSEPH HERON, Town Clerk.

Town Hall, Manchester, 31st May, 1878.

**MANCHESTER CORPORATION GAS-WORKS.**—AMMONIACAL LIQUOR.—The TIME for RECEIVING TENDERS has been EXTENDED from the 1st of August to the 1st of October next.—By order of the Gas Committee,

JOSEPH HERON, Town Clerk.

Town Hall, Manchester, 5th July, 1878.

**WILLIAM AND WILLIAM T. FIELD,**  
**MANUFACTURERS** of the Celebrated  
STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, i.e., Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c., &c. Prices and samples on Application.

### TESTIMONIAL.

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years, during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

**TOLL END BRICK-WORKS,**  
**TIPTON, STAFFORDSHIRE.**

THE CHEMICAL NEWS.

VOL. XXXVIII. No. 973.

A SINGING TELEPHONE.

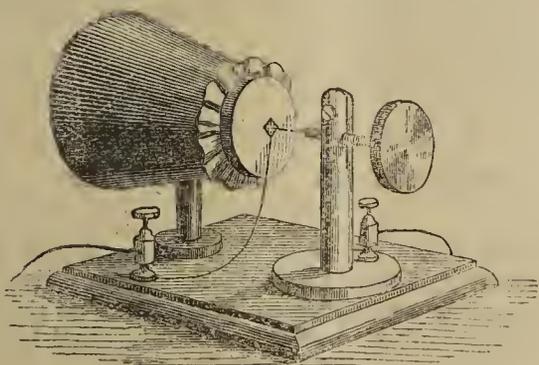
By HENRY MORTON, Ph.D.,

President of the Stevens Institute of Technology, Hoboken, N.J.

IN connection with the very general interest in the telephone, and the demand for some instrument which might serve as a means of illustration for lectures before large audiences, I was recently led to make some experiments in the direction of developing a singing telephone, simple and inexpensive in its construction, and yet capable of producing musical sounds loud enough to fill the largest lecture halls. In carrying out this object I was assisted by the following gentlemen, graduates of or students in the Stevens Institute of Technology:—Mr. Wm. E. Geyer, Mr. Brown Ayres, and Mr. Henry A. Beckmeyer.

Without attempting to give the various experiments and modifications, I will simply describe the instrument as it was finally perfected, and has been manufactured since by Messrs. Geo. Wale and Co., Philosophical Instrument Makers, of this place.

The transmitting apparatus consists of a hollow truncated cone, whose smaller end is closed by a diaphragm of metal, paper, or thin sheet rubber, and of a platinum



pointed screw, so supported as to make contact with the centre of this diaphragm. The centre of the diaphragm is provided with a plate of platinum connected if necessary by a wire with a binding-post.

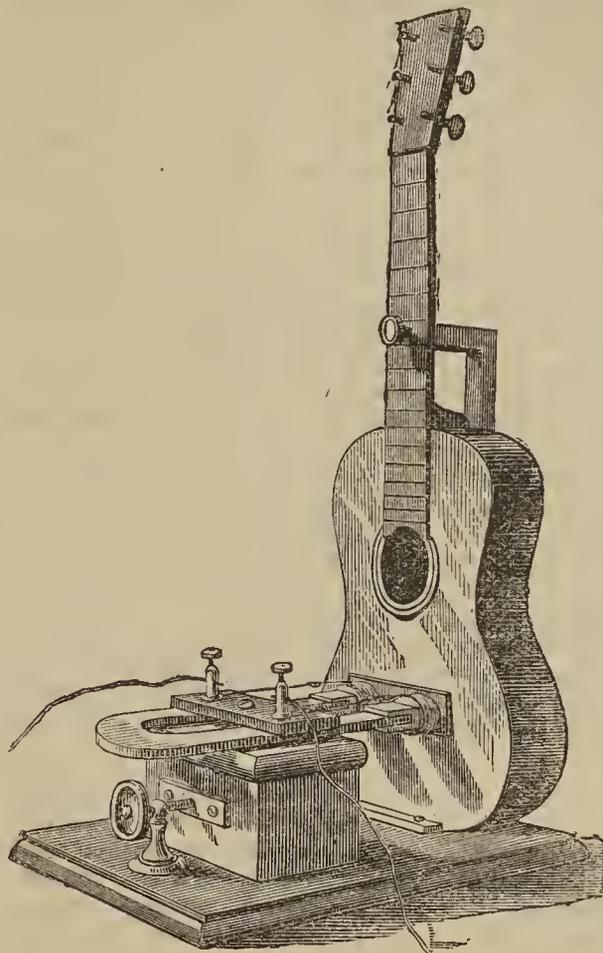
On singing into the open end of the cone the vibrations caused in the diaphragm occasion corresponding ruptures in the circuit at the point of contact of the central platinum plate with the platinum pointed screw. The best effect is obtained by closing part of the cone with the hand and singing into the remaining opening with the mouth closely applied. The contact of the screw and plate should also be as strong as can be obtained on trial without loss of effect.

The receiving apparatus, shown in the accompanying figure, consists of a powerful steel horseshoe-magnet supported horizontally on a sliding block provided with an adjusting screw. The poles of this magnet are provided with soft iron caps terminating in pins or cylindrical poles, on which are placed flat spools of very fine wire. These spools have each a resistance of about 100 ohms. Opposite to these poles is firmly supported a guitar, whose springs have been removed, and to whose bridge had been attached a plate of soft iron acting as an armature to the magnet.

When in use the magnet is so adjusted by means of the screw at the rear that its soft iron pins or poles are very close to the armature of the guitar. A battery of six to twelve Leclanché cells being placed in circuit, and a performer singing into the cone of the transmitter, the fluctua-

tions in the attraction of the armature by the magnet will then cause the guitar to emit musical sounds of remarkable intensity. One of these instruments was lately used by Dr. Geo. F. Barker (of the University of Pennsylvania) in a lecture delivered by him in the Opera House at Philadelphia, and its sound, clear and flute-like, was heard even out into the street, though this is a building seating over three thousand persons.

If the current interrupted by the transmitter is made to pass through the primary of an induction-coil, and the secondary current of the same is then carried to the receiver at the distant place, two small cells of a Grove battery will produce the most intense sounds, and the current



may be caused to traverse the bodies of several persons, and will yet, without occasioning any painful shock, produce music in the guitar loud enough to be heard in every part of the largest auditorium.

A very convenient battery for use with these instruments has been made by Messrs. Geo. Wale and Co. from glass specimen tubes  $\frac{3}{4}$  inch in diameter and 4 inches high, into which are introduced in a convenient manner strips of carbon and zinc. The exciting fluid may be dilute sulphuric acid, or a solution of Glauber salt, or of sal-ammoniac.

Nitro-derivatives of Alizarin.—Samuel Grawitz.—The property of alizarin of yielding nitro-derivatives is a fact which the author believes he was the first to point out in his patent for the production of artificial purpurin. One and the same alizarin can furnish two distinct amide-derivatives, by the reduction of the nitro-derivative, the one soluble in alkalies, and the other insoluble. If alizarin is the phthalic ether of oxyphenol or its isomer, it is natural that all the facts in the history of the nitro- and amido-derivatives of phenol should recur among the nitro- and amido-derivatives of alizarin. The author pointed out two years ago an oxidation-derivative of alizarin yielding blue lakes.—*Bulletin de la Soc. Chimique de Paris.*

ON THE  
COMPOSITION OF THE RIVERS PARANA AND  
URUGUAY.

By JOHN J. J. KYLE, Buenos Ayres.

FOR some years I have had occasion to analyse the water supplied to the City of Buenos Ayres, and in the year 1872 was employed to examine the water of the Rio de la Plata and of the River Parana, its principal tributary. The object of the latter investigation was to determine the most suitable locality whence to draw the increased supply, which forms part of the City of Buenos Ayres Improvement Scheme, now being carried out under the direction of the eminent engineer, Mr. J. F. Bateman, F.R.S. I have very recently had an opportunity of analysing the water of the other great river, the Uruguay, which, together with the Parana, supplies the enormous volume of water, estimated at 700,000 cubic feet per second of time, which the Rio de la Plata pours into the Atlantic Ocean.

I have not been able to find any reference to the composition of these great South American Rivers in any of the standard works on chemistry, and for this reason I take the present opportunity of communicating a few particulars, which appear to be of some interest.

The Rio de la Plata, or River Plate, is in reality the estuary of the Rivers Parana and Uruguay; is characterised by its muddy appearance, and always contains in suspension a considerable amount of "colloid" clay. This suspended clay is almost exclusively derived from the immense territory drained by the River Parana. The Uruguay is a river remarkable for its transparency and freedom from suspended matters. The following table shows the proportion and composition of the residue yielded by 1000 c.c. of each of the three waters—the River Plate, at about five miles above the city of Buenos Ayres; the Parana, at about five miles above its termination in the Plate; and the Uruguay, in the middle of its stream in front of the town of Salto in the Republic of Uruguay.

	River Plate. Grm.	River Parana. Grm.	River Uruguay. Grm.
Sodic oxide .. .. .	0'0212	0'0189	0'0020
Potassic oxide.. .. .	0'0034	0'0046	0'0015
Calcic oxide .. .. .	0'0078	0'0095	0'0055
Magnesian oxide .. .. .	0'0050	0'0043	0'0019
Ferric oxide .. .. .	0'0040	0'0030	—
Aluminic oxide .. .. .	0'0060	0'0030	—
Silicic acid (SiO <sub>2</sub> ) .. .. .	0'0193	0'0194	0'0185
Sulphuric acid (SO <sub>3</sub> ) .. .. .	0'0058	0'0079	0'0013
Carbonic acid (CO <sub>2</sub> ) .. .. .	0'0116	0'0122	0'0071
Chlorine .. .. .	0'0114	0'0149	0'000247
Nitric acid (N <sub>2</sub> O <sub>5</sub> ) .. .. .	—	—	0'0019
Organic matters .. .. .	0'0100?	0'0106?	traces
	0'1055	0'1083	0'039947
Determined directly .. .. .	0'1000	0'1000	0'039500

The three waters were examined by Wanklyn's process, and yielded per litre:—

	River Plate. M.grms.	River Parana. M.grms.	River Uruguay. M.grms.
Free ammonia.. .. .	0'07	0'16	0'07
Albuminoid ammonia .. .. .	0'24	0'24	0'10
Hardness (1°=0'01 gm. per litre of CaCO <sub>3</sub> ) .. .. .	4'00°	4'50°	2'25°

The minute quantities of nitric acid were not determined in the Plate and Parana waters; in the Uruguay water it was estimated by Thorpe's reduction method. Part of the silica and all the alumina belong to the clay which, as already stated, is suspended in the first two

waters, and remains in this condition for many weeks. The water of both the Plate and Parana always yields, by Wanklyn's ammonia process, a very large amount of albuminoid ammonia, derived chiefly, I believe, from vegetable organic matters partly in solution and partly adherent to the suspended clay. In spite of this and its opaline, sometimes even muddy, appearance, the Plate water is highly esteemed as a drinking-water.

Beyond this the composition of these two rivers does not call for any further observations. The water of the River Uruguay is, however, in some respects very remarkable. It is probably one of the purest river waters in the world, containing rather less than 4 parts of solid matter per 100,000. It is almost free from chlorides: the determination of chlorine, made with every possible care, gave rather less than one-fourth of a milligram. per litre, and this, be it remembered, at a distance of say 500 miles from its source.

Still more noteworthy, in my opinion, is the fact that about 46 per cent of the total solid matter consists of soluble silica, not suspended as in the other two rivers. A small proportion exists probably as alkaline silicate, but the greater part is undoubtedly present as hydrated silicic acid. In this circumstance may be found an explanation of the petrifying properties attributed to the water of the Uruguay. On one occasion a cart-wheel was fished up from its bed completely converted into stone. A considerable export trade in agates is carried on by the inhabitants on the Uruguayan shores of this great river, and the stones from the Uruguay are, I believe, those most esteemed by European lapidaries. The free silicic acid dissolved by this river among the mountains of Santa Catherina, in Brazil, is probably the raw material out of which are elaborated the agate mortars so invaluable to every analytical chemist.

National College, Buenos Ayres, June, 1878.

COMPOSITION OF POTATOES.

AT a meeting of the Scientific Committee, Royal Horticultural Society, South Kensington, March 5, 1878, Dr. Gilbert made some very interesting remarks on this subject. He said that Mr. Lawes and himself had been for two years experimenting on the effects of different manures on the potato, and they had obtained a variation in the amount of produce from something over three tons without manure to nearly nine tons with the highest manure. Samples of the different crops had been analysed in the usual way, and a great difference in the composition of the tubers was found. There was a difference of several units per cent in the amount of dry or solid matter; there was about one and a third time as much mineral matter in some as in others; and there was nearly twice as much nitrogen in some as in others.

It occurred to them that it would be interesting also to examine the tubers somewhat in the way adopted in the case of some root crops, such as sugar-beet; that is, to express and determine the composition of the juice.

It was found that by far the largest proportion of both the mineral matter and the nitrogen of the tuber existed in the clear filtered juice; and there was as striking a variation in the percentage of these in the juice as in the whole tubers, depending on the character of the manure and on the amount of crop. It was remarkable, too, that some of the largest crops, which, judging from the withered condition of the tops, must be considered fairly ripe, nevertheless contained a juice relatively very rich in nitrogen.

His special object in referring to these experiments was, however, to call the attention of the Committee to some results which they had obtained with diseased potatoes. Already the Rev. J. H. Jellett\* had examined the juice, or

\* *Proceedings of the Royal Irish Academy, May 22, 1876.*

rather the extract, of sound potatoes, of the apparently sound part of diseased potatoes, and of the discoloured part of diseased potatoes. He had found a considerable development of sugar in the white part of the diseased tubers. He also determined the amount of nitrogen in the dry matter of similar specimens, and found it to be greater in that of the apparently sound part of diseased potatoes than in that of sound potatoes, and also greater in the diseased part, but not so great as in the apparently sound part.

At Rothamsted they had experimented rather differently. They had determined the nitrogen and the mineral matter in the sound whole tubers and in the diseased whole tubers; in the juice of the sound potatoes, in that of the white part of the diseased potatoes, and in that of the black part of the diseased potatoes. They had also determined them in the washed or exhausted solid matter or "mark" of the white part and of the black part of diseased tubers.

In accordance with Prof. Jellett's results they found a higher percentage of nitrogen in the dry substance of the diseased than of the sound potatoes; but, calculating the quantity upon the fresh tubers, they did not find evidence that there was an actually greater amount of nitrogen in the diseased potatoes.

The most interesting point in their results was, however, that whilst the juice of the white portion of the diseased potatoes contained approximately the same amount of nitrogen as that of corresponding sound potatoes, the juice of the diseased portion contained very much less; in fact, only about one-half or two-thirds as much. On the other hand, the washed or exhausted "mark" of the white portion contained a very small amount of nitrogen, whilst that of the black or diseased portion contained very much more, in some cases four or five times as much as the "mark" of the white portion. It was also found that the amount of mineral matter was much higher in the juice of the white than in that of the diseased portion, but much lower in the "mark" of the white than in that of the discoloured portion. It was obvious from these facts that the juice had suffered exhaustion of much of both its nitrogen and its mineral matter in the development of the fungus. The sugar, itself the result of diseased action, probably also contributed to the same end.

## PHOSPHORUS IN CLEVELAND IRONSTONE AND IN IRON.\*

By J. E. STEAD.

(Continued from p. 18.)

### *The Effect, Physically and Chemically Considered, which Phosphorus has on Pig Metal.*

#### *Physical Properties.*

FROM what has been already stated, it must be clear that phosphorus makes pig metal brittle, and this is a fact so well known that I need not further discuss the question.

Silicon, we all know, when present in Cleveland pig to the extent of about 5 per cent, causes it to crystallise on cooling, so as to present when cold, on the fractured surface, a glazed appearance.

The result of a large number of analyses has proved that this iron cannot contain more than 5 per cent of silicon without having this peculiar texture. It is different, however, with metal containing little or no phosphorus. Bessemer pig-iron is often produced, containing above 5 per cent silicon, and yet has shown no glazed appearance or fracture. The sample placed before you, containing nearly 7 per cent, is an instance.

It seems from this, that, as a considerable quantity of

iron is in combination with phosphorus in Cleveland iron, there is less iron remaining capable of taking up silicon than is the case where no phosphorus is present; consequently less silicon will be required to give to the smaller proportion of iron the conditions necessary for the production of glazed iron.

#### *Chemical Properties.*

When sulphur is added to fluid metal—which, under ordinary circumstances, would assume a grey fracture when cooled and broken—the sulphurised iron when cold will present a mottled or white fracture. In other words, sulphur prevents the separation of carbon as graphite.

In order to ascertain if phosphorus has a similar action, the following experiments were made. Four moulds in sand, each of the same size, were made. On the bottom of two of these, small sticks of phosphorus were placed, after which all the moulds were filled with molten Cleveland iron.

A considerable amount of phosphorus was vapourised and burnt at the top of the moulds in which it was placed.

After cooling, the castings were broken. Both of the samples containing excess of phosphorus exhibited closer fractured surfaces than those to which it was not added, but they had no mottled appearance. On testing for phosphorus and combined carbon the following results were obtained:—

	Metal without phosphorus added.				
Combined carbon ..	0'60	per cent	..	0'61	per cent
Phosphorus.. ..	1'46	"	..	1'46	"
	Metal to which phosphorus was added.				
Combined carbon ..	0'73	per cent	..	0'73	per cent
Phosphorus.. ..	1'71	"	..	1'70	"

From these results it will be seen that 0'13 per cent of carbon has been prevented from assuming the graphoidal state by the action of 0'25 per cent of phosphorus. It might be objected that the volatilisation of a portion of the phosphorus introduced into the moulds would chill the metal and cause it to set more quickly, and that this might account for the difference in the proportions of combined carbon, but it is a fact that the samples containing the most phosphorus were the last to assume the solid state, so that the objection must cease. The effect of phosphorus compared with sulphur is, however, very small, and would not affect materially the quality of the iron or pig in this direction if increased in considerable quantity.

#### *Methods of Removing Phosphorus from Pig Metal.*

I have made considerable research in this direction, but shall not be able to give all the results in the present paper as time will not permit. I shall therefore confine myself to some features of the common method of purification by oxide of iron.

The action of oxide of iron is well known, but it has frequently been supposed that oxide of iron, without the aid of mechanical power, has very little action, and that the work a puddler gives to the metal has some important action in removing phosphorus independent of the oxide of iron.

By the results obtained from numerous experiments, it has been clearly proved, that mechanical power, whether it be in the force of the refining blast, the motion of the puddler's bar, or the revolving of the rotary puddling machine, is simply the means by which the molten iron is brought into intimate contact with the fluid or semi-fluid oxide of iron. The removal of phosphorus depends entirely on the action of these, and mechanical force is no more concerned in the chemical action between cinder and phosphide of iron than the men who convey the ore to blast-furnaces have to do with the reactions which take place within. The action is due to fluid or semi-fluid oxide of iron.

By the results which follow it will be seen that, where

\* A Paper read before the Cleveland Institution of Engineers.

the puddling process is conducted at a very low temperature, or when the cinder is run out of the furnace before the phosphorus is removed, the puddled bar produced is high in phosphorus. On the other hand, when a high temperature is maintained a very excellent quality of bar is produced.

The reason for these facts must be clear. In the first instance the temperature is not high enough to liquefy the necessary amount of cinder required for the purification of the metal, and, as a consequence, there is left an impure iron. Again, when the cinder is removed from the semi-purified iron, the purifying agent being taken away, the removal of phosphorus is retarded and a phosphuretted iron is produced. The following results show that what has been stated is correct, viz.:

## No. 1.

Cleveland iron puddled in an ordinary furnace. Conditions—normal:

	Metal charged to furnace.	Metal just before boil.	Puddled bar iron.
Phosphorus	1.54 per cent	0.73 per cent	0.306 per cent

## No. 2.

Puddled at very low temperature:

	Metal.	Puddled bar.
Phosphorus	.. .. 1.54	0.52 per cent

## No. 3.

(Bleeding.) Cinder run out before boiling:

	Metal	Metal just before boiling.	Puddled bars.
Phosphorus	1.54 per cent	0.65 per cent	0.448 per cent

On the other hand, when the temperature is very great, an abundant supply of oxide of iron is melted, and this acting on every part of the iron presented to it by mechanical means the metal is thoroughly purified.

This will be seen by the result of an experiment made in the same furnace in which the former experiments were carried out.

*Metal Puddled at a High Temperature.*

	Metal.	Metal just before boiling.	Bar iron.
Phosphorus	1.54 per cent	0.18 per cent	0.09 per cent
Phosphoric acid in cinder,	4.2 per cent.		

The following results were obtained from an analysis of iron made in a Danks furnace at the works of Messrs. Hopkins, Gilkes, and Co., who have kindly permitted me to lay them before you in this paper. The temperature of furnace was high.

	Metal.	Metal just before boiling.	Bar iron.
Phosphorus	1.80 per cent	0.21 per cent	0.17 per cent
Phosphoric acid in cinder,	10 per cent.		

The following experiments, made by the direction of Mr. Edward Williams, also show the powerful action of fluid oxide of iron.

Fluid Cleveland iron was poured into crucibles containing cinder, also in a fluid state. The crucibles with contents, after having been carefully covered, were violently shaken for about a quarter of a minute. After this treatment the metal, still in a fluid state, was poured out from each of the vessels into moulds, and allowed to set.

On analysis the refined iron was found to contain, viz.:

	I.	II.	III.
Carbon	.. 1.80 per cent	2.40 per cent	3.00 per cent
Silicon	.. 0.04 "	trace	trace
Phosphorus	0.13 "	0.13 "	0.04 "

The cinder used in No. 1 and 2 experiments consisted

of mill tap, for No. 3 a mixture of mill scale with 20 per cent of sand.

It is clear that the agitation to which the metal was subjected was simply a means of exposing every particle of its mass to the action of fluid oxide of iron, and we have no hesitation in saying that could we so subdivide, say, a ton of Cleveland metal, in such a way as to expose every molecule of its mass to the action of rich oxide of iron in a fluid state, the removal of the phosphorus would be effected instantly.

So far we have only considered the changes which take place between oxide of iron and metal, at the highest temperatures attainable in puddling furnaces. We now pass on to consider the reactions, which are effected at excessively high temperatures.

Iron, compared relatively with oxygen, has a much greater attraction for phosphorus at high than at low temperatures; whereas at low temperatures oxygen has the greater attraction. A striking instance of this will be seen from the following results obtained in a Bessemer converter.

A charge of 6 tons was overblown for about 15 minutes. A large amount of oxide of iron was produced in consequence. In fact, throughout the entire mass, where the air came in contact with the iron, rich oxides of iron must have been formed, which, I naturally thought at the time would remove all the phosphorus from the iron present to the extent of about 0.10 per cent. It was, however, found that such was not the case, as will be seen by the analysis below, viz.:

Protoxide of iron	.. ..	47.68 per cent
Peroxide of iron	.. ..	6.87 "
Protoxide of manganese	.. ..	3.47 "
Lime	.. ..	0.52 "
Magnesia	.. ..	1.05 "
Silica	.. ..	39.00 "
Sulphur	.. ..	0.09 "
Phosphoric acid	.. ..	nil "
Alumina	.. ..	1.30 "
		99.98 "
Metallic iron	.. ..	41.89 "

The phosphorus was evidently so strongly attracted by the iron that even oxide of iron failed to remove it.

In order to ascertain if this cinder would remove phosphorus from iron at a lower temperature, lumps of it were stirred about in fluid Cleveland iron. The metal was then poured out, and an analysis made for phosphorus. The metal result showed that 50 per cent had been removed, clearly proving that its incompetency to remove the phosphorus in the Bessemer converter was due to the excessively high temperature.

*Iron Heated with Phosphoric Acid.*

Pure iron at red heat has no power to decompose phosphoric acid, but, if heated to its fusion point, the acid is rapidly decomposed. An experiment, in which pure iron was fused in a crucible with phosphorus pentoxide, P<sub>2</sub>O<sub>5</sub>, gave a very fusible button of phosphide of iron, containing, viz.:

Iron	.. ..	85
Phosphorus	.. ..	15
		100

The result clearly shows that phosphoric acid is decomposed by iron, phosphide and oxide of iron being produced.

The next point was to ascertain whether or not pure iron would decompose phosphoric acid when in combination with iron oxide. For this end pure iron was fused with puddlers' tap cinder, containing above 4 per cent of phosphoric acid. The button produced contained = 2.12 per cent. The experiment was repeated with the

same results. The buttons in both cases lost in weight about 20 per cent during the treatment, clearly proving the absence of reducing agents, such as carbon or carbonic oxide. Pure iron was next fused with phosphate of iron. The metal, after fusion, contained 2.68 per cent of phosphorus.

Cleveland pig-iron in fine powder was mixed with pure oxide of iron, and exposed to a very high temperature, so as to fuse the spongy iron produced. The metal before and after the treatment contained, viz. :—

	Before.	After.
Carbon .. ..	3.50 per cent	trace
Silicon .. ..	2.80 ,,	trace
Phosphorus ..	1.50 ,,	1.28 per cent

It must be clear that, during fusion, the phosphorus would be removed at first when the temperature was not excessive, and that it had been reduced again from the cinder when the iron became extremely hot, by the reducing action of the iron itself.

On testing the cinders from these experiments, they were all found to be nearly saturated with silica, which had been dissolved from the sides of the silicious crucibles. We therefore must consider these results to be due to the combined action of phosphate of iron and silica on pure iron, and not to that of phosphate of iron *per se*.

We know that silica displaces phosphoric acid from its compounds, when fused with them; and it is probable that the silica, which passed into the cinder, liberated the phosphoric acid, which, in its free state, would be decomposed by iron.

As it is a difficult matter to find any crucibles made of a substance which has no action on oxide of iron or is unaffected by the oxide, the following experiment was made :—One end of a piece of pure wire was coated with phosphate of iron. The other end was supported by hand, and by means of an oxyhydrogen jet the end coated with phosphate was fused completely. By this method the two substances were fused together without the aid of a direct support. A considerable amount of the iron was burnt away, but the minute globule of iron not weighing more than 0.10 gramme, on analysis, distinctly showed the presence of phosphorus.

We now turn to the consideration of the nature of the action between oxide and phosphide of iron.

In order to ascertain whether this is a physical action (in which the oxide or cinder simply washes out the phosphide) or a chemical one (by which the phosphorus is oxidised by the oxygen of the oxide, the following experiment was made.

Two grammes of phosphide of iron were fused under a thick layer of iron oxide, consisting chiefly of protoxide, for one hour. Now, if the action be a purely physical one, in which the phosphide is bodily removed, and retained in the slag or cinder as such, our button after fusion should weigh less than before. The weight, however, was greater, which fact at once leads us to decide that the action is not physical but chemical.

The button weighed 2.3 grammes or 15 per cent greater than before. They had the following-mentioned composition, viz. :

	Metal before	Metal after.
Iron .. ..	1.768 %	2.162 %
Phosphorus ..	0.232	0.138
	2.000	2.300

It will at once be seen that there has been a loss of 0.232—0.138 = 0.094 grammes of phosphorus, and a gain of 2.162 — 1.768 = 0.394 gramme of iron. That is to say, 0.094 of phosphorus has taken the oxygen from 0.394 parts of iron, existing as oxide in the cinder, to produce phosphoric acid. Each unit of phosphorus has precipitated 4.2 units of iron, calculating from theory expressed by the chemical expression



One of phosphorus should be equal to 4.5 parts of iron, which is very near that obtained by experiment.

#### Phosphorus in Bar Iron.

This subject I cannot treat at length in this paper, as I have already exceeded the time at my disposal.

All bar iron made from phosphatic pig-iron contains phosphorus in two conditions, one in combination with the iron itself, producing, if in large quantity, "cold-shortness;" the other in cinder, wrapped up between the particles of iron, exists as phosphoric acid and has no injurious effect on the bar.

It has long been a difficulty with chemists to estimate these quantities, so as to be able to state what proportion of the phosphorus, in any sample they may test, is combined with the iron. I have given a considerable amount of attention to this matter, and, I believe, with success. Without describing the method adopted, which would be of little interest to the members of this Institute, I shall give the results obtained by its use.

The amount of phosphorus found in puddled bar made in Cleveland is well known to be between 0.30 and 0.40 per cent, or from 20 to 25 per cent of that in the pig-iron.

The proportion existing as phosphoric acid in the cinder varies between 0.05 and 0.15 per cent, just as the proportion of cinder varies which is not squeezed out of the bar.

Assuming that 2, 3, 4, and 5 per cent of cinder containing 2.5 per cent of phosphorus is left respectively in four different bars, it will be clear that we should have, respectively 0.05 per cent, 0.075 per cent, 0.10 per cent, and 0.125 per cent phosphorus, not in an injurious state of combination with the iron, which is capable of being simply squeezed out by the rolls after piling, heating, and rolling. This is shown to take place from the following results obtained by twice piling and rolling No. 2 ordinary bar iron made from Cleveland pig.

After the second rolling, the No. 4 bar produced was excellent fibrous iron and very soft, whereas, before the treatment it was in great part crystalline and hard. These samples of Nos. 2, 3, and 4 bars were with the following results :—

	Phosphorus combined with iron.	Phosphorus in cinder enclosed.	Phosphorus total.
No. 2 ..	0.243 %	0.087 %	0.33 %
,, 3 ..	0.130	0.110	0.24
,, 4 ..	0.071	0.149	0.22

From this result we see that a considerable amount of phosphorus is removed by simply heating and rolling iron containing it; we also see that it is oxidised and removed from the iron, which of course accounts for the great improvement in the quality of the bar.

Before concluding, by the kind permission of Messrs. Hopkins, Gilkes, and Co., I have pleasure in laying before you three analyses of finished bars made from Cleveland iron, puddled in the Danks furnaces at the Tees Side Iron Works, which prove that our iron, although containing rather more phosphorus than we care for, is capable of being almost freed from it.

	I.	II.	III.
Carbon .. ..	0.080 %	0.110 %	0.160 %
Silicon .. ..	0.092	0.046	0.040
Sulphur .. ..	0.012	0.016	0.012
Phosphorus ..	0.110	0.060	0.073

#### Phosphorus.

	Combined with iron.	In cinder.	Total.
1 ..	0.057 %	0.063 %	0.110 %
2 ..	0.023	0.037	0.069
3 ..	0.034	0.039	0.073

Without making any comparisons, I think we all must agree that better iron than this it would be difficult to find.

(To be continued).

## PROCEEDINGS OF SOCIETIES.

EDINBURGH UNIVERSITY CHEMICAL SOCIETY.

Tenth Meeting, May 29, 1878.

JOHN GIBSON, Ph.D., F.R.S.E., in the Chair.

A PAPER was read by Mr. GEORGE MACGOWAN, F.R.S.E., on "The Action of the Chlorides of Iodine on Ethylen and Acetylen." The following were the chief points in the paper:—(1) The formation (in theoretical quantity) of chloride and chlor-iodide of ethylen, on passing the latter slowly over pure iodine-trichloride at 0° C. (2) The formation of the new compound acetylen chlor-iodide (C<sub>2</sub>H<sub>2</sub>ICl) by passing acetylen through a solution of iodine mono-chloride in ether at 0° C. (3) The author failed to obtain any acetylen cyanogen compounds.

## CORRESPONDENCE.

## ABSORPTION OF SUGAR BY BONE-CHAR.

To the Editor of the Chemical News.

SIR,—In addition to the authorities quoted in a former communication upon the absorption of sugar by bone-char I cite the following:—

An article in the *Sugar Cane*, Jan. 1, 1872, entitled "The Analysis of Sugar and Molasses." The author says, in speaking of filtration over cool, "the first filtered portion must be rejected, because the density is altered."

In the *Zeitschrift für Zucker-industrie*, 1872, p. 259, is an article by E. Sostmann, upon the determination of sugar in bone-char that has been used. He says, "Es fast unmöglich is durch reines heisses Wasser Allen Zucker aus der Kohle auszussüssen," and goes on to give his method of treatment with a solution of caustic alkali.

Wurtz, "Dict. de Chimie," art. "Sucre," says, in speaking of the decolourisation of a solution of molasses, "Les so premiers centimètres cubes filtrés, sont écartés, leur titre étant faussé, par l'action initiale du noir."

In "Muspratt-Stohman's Chemistry," 3rd edition (German), a list of authorities is cited—under v. Knochenkole—upon the absorption power of bone-char for sugar. Scheibler and Walberg are quoted as having closely investigated the subject.

Scheibler found that 5.5 grms. of bone-char added to a 50 c.c. solution of 13.024 grms. of sugar made the results on an average 0.4 per cent too low.

Walberg's work and tables of absorption are very striking.

Payen, "Precis de Chimie Industrielle," English translation, p. 876, says, The use of the charcoal is to be avoided as much as possible, because it absorbs a portion of the sugar as well as colouring matters.

In "Watts's Dictionary, vol. 1., p. 742, after speaking of the power possessed by bone-char of absorbing organic substances, this caution is given:—"It is important to bear this in mind [viz., the absorbing power of sugar] in analysing liquids which have been decolourised by animal charcoal, as many of the substances originally contained in the solution may have been carried down by the charcoal."

The same work, "Watts's Dict.," under v. Sugar, gives directions for rejecting the first fourth of the liquid which runs over the cool.

I have quoted above such books only as happened to be at hand in my laboratory, and there appears to be an almost absolute consensus of authorities on this point.

Although further research would seem to be a waste of

time, still, to make assurance more sure, I made the following experiments.

A.—A sample of cane sugar was polarised in a Ventzke instrument with a good field and delicate tints, so that two observers could generally agree to 1-10 of a degree—

P = 99.50

The above solution—which had simply been filtered through paper—was run over a little fine dry char thrown on a dry filter.

P, first running = 99.00

P, second ,, = 99.20

P, third ,, = 99.40

The solution was exhausted before enough had been run over to get a solution which would test 99.50.

B.—A half weight of nearly pure sugar for the Ventzke instrument was weighed, dissolved in 100 c.c. of distilled water, and the solution tested—

P = 49.80.

A little perfectly dry char was introduced into the solution, the flask corked, and another test made at the end of twenty minutes—

P = 48.40, or a loss of 1.40 per cent.

C.—A sample of centrifugal sugar was tested—

P = 95.30.

A little of this solution was run over a small amount of dry fine char and immediately tested—

P = 95.00.

D.—About 50 c.c. of the original solution was shaken up in a flask with a little char for ten minutes. The solution was then re-tested—

P = 94.60.

Another portion which had remained longer in the char was tested—

P = 94.50.

E.—The char used in the above experiments was the fine dry char in daily use in my laboratory, but for fear it might be open to criticism I prepared some myself by drying fine sifting four and a half hours at 180° C., and bottling it immediately. With this new lot the following trials were made, viz.:

F.—A sugar solution was polarised by myself and my assistant. Our readings are given as A and B.

	A.	B.	Average.
P .. .. .	80.70	80.80	80.75

30 c.c. of this solution were introduced into a dry flask with 7 c.c. of the new char. At the end of thirty minutes the solution was filtered and re-tested.

	A.	B.	Average.
P .. .. .	80.20	80.20	80.20

Here was a loss of  $\frac{1}{2}$  per cent.

Half the original solution (which had been kept in a stoppered flask) was now filtered through a dry filter, so that it might have the same exposure to the air, &c., as the char-treated solution, which was now run again over the char on the filter, both filtrations going on simultaneously. The solutions were then re-tested—

	A	B.	Average.
Original solution P =	80.70	80.70	80.70
Char treated ,, P =	80.10	80.10	80.10

Here was a loss of 6-10ths per cent.

G.—A sugar solution polarising 88.40 was run once over the new char and then tested.

P = 87.60.

Here was a loss of 8-10ths per cent.

H.—A sugar solution polarising 96.50 was shaken up with a little of the new lot of char, and re-tested at the end of one hour.

P = 95.90.

Here was a loss of 6-10ths per cent.

Some other tests were made which simply amounted to a repetition of the above work.

From the printed authorities, from what I believe is the general rule, viz., to reject one-third of the solution, and from my own experiments detailed above, it seems to me safe to say that anyone who prepares his sugar solutions by putting char *into* them will get results not merely lower than his neighbours, but absolutely too low.—I am, &c.,

J. M. MERRICK.

Laboratory, 59, Broad Street,  
Boston, U.S.A., June 25, 1878.

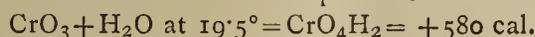
## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 23, June 10, 1878.

**Cubes or Prisms of M. Rohart for the Destruction of the Phylloxera.**—E. Chevreul.—It is possible to find the proportion of sulphuret of carbon contained in M. Rohart's preparation by introducing a given weight of the substance well dried and finely divided into a small retort, which is heated in the water-bath. The product is collected in a tubulated receiver, to which is adapted a long straight tube drawn out at the extremity.

**Thermic Researches on the Chromates.**—F. Morges.—The heat of combination of anhydrous chromic acid with water has been in the first place determined:—



This result is far below that for sulphuric anhydride, for which the mean of the numbers found by M. Berthelot and M. Thomsen is 20850 cal. This difference is explained if we remember that anhydrous chromic acid crystallises from its aqueous solution. The regular curve which represents the thermic phenomena of the hydration of chromic acid presents at  $4\text{H}_2\text{O}$  a maximum ordinate which seems to indicate the existence of a hydrate of chromic acid.

**Artificial Production of Natron or Natural Carbonate of Soda by the Action of Carbonate of Magnesia upon Chloride of Sodium.**—The natural production of natron was ascribed by Berthollet to the action of carbonate of lime on common salt. But this reaction has never been demonstrated experimentally. It is known that calcium chloride, nitrate, and sulphate are decomposable by the bi- and sesqui-carbonates of soda as well as by the neutral carbonate. But even at ordinary temperatures the chloride of sodium is decomposed by the bicarbonate of magnesia, with the production of bicarbonate or sesqui-carbonate of soda. The author's results explain the simultaneous occurrence of natron, and of the large quantity of magnesian chloride found in solution in salt lakes.

**Influence of the Physical Condition of Gallium upon its Electro-chemical Part.**—J. Regnault.—The author has some years ago shown that according as a metal in alloying itself with mercury absorbs or liberates heat, it rises or falls in the scale of positive affinities. Zinc, e.g., which in becoming amalgamated absorbs heat, is nearer to potassium than pure zinc, whilst cadmium, which, in uniting with mercury liberates heat, is further from potassium. The analysis of the thermic conditions accompanying the double phenomenon of fusion and of combination between these simple similar bodies, led the author to admit that the disposable chemical work which they possess is a function, not merely of the specific nature of their atoms, but also of the sum of the calories,

which maintain them in a given physical state. To prove this view experimentally he endeavoured to form a hydro-electric couple, in which a liquid metal should be negative with relation to the same metal in the solid state. He has succeeded in constructing such a galvanic element with liquid and solid gallium connected by a stratum of a neutral aqueous solution of gallium sulphate. The liquid metal plays the part of zinc, and the solid that of copper.

**On Starch.**—MM. Musculus and Gruber.—The following distinct compounds have been obtained from starch under the influence of diastase or of dilute boiling sulphuric acid:—Soluble starch, erythro-dextrin, achroo-dextrin  $\alpha$ , achroo-dextrin  $\beta$ , achroo-dextrin  $\gamma$ , maltose, and glucose.

**Action of Caustic Potassa upon Quercite.**—L. Prunier.—Aqueous potassa has very little action upon quercite, even at  $100^\circ$ , but about  $200^\circ$  to  $250^\circ$  a profound decomposition sets in. Among the products of decomposition are quinon, quinhydrin, pyrogallic, oxalic, and malonic acids.

**Action of Fluoride of Boron upon Certain Classes of Organic Compounds.**—F. Landolph.—The author proposes as a general law that boric fluoride combines in definite proportions, equivalent for equivalent with the aldehyds, the acetons, and the carbonyls.

**Researches on the Peptons.**—A. Henniger.—The author concludes that the peptons result from the fixation of water upon the albuminoids.

No. 24, June 17, 1878.

**Production of Organic Sulphuretted Compounds Possessing Insecticide Properties.**—MM. de la Loyère and Muntz.—A question of priority.

**Researches on the Sub-nitrate of Bismuth.**—Alf. Riche.—The author has examined a number of commercial samples of this salt, and with a single exception has found a maximum of 1-10th per cent of lead.

**Physiological Part of the Hypophosphites.**—MM. Paquelin and Joly.—The authors infer from their researches that the hypo-phosphites, like the pyro-phosphates, are mere diuretics, and leave the system as they entered it without having undergone any transformation.

**Colouring Matter of Wines.**—Arm. Gautier.—The catechins (and their analogues, the quercetins), the tannins, and the vegetable colouring-matters are closely connected together. It is possible to pass from the first to the last, as M. Gautier has ascertained by the limited oxidation of the catechins of gambir. The author endeavours to demonstrate these views as regards the colouring matters of wine, which are not identical as has been supposed. Each kind of grape produces one or more special colouring-matters, the totality of which forms a family of bodies, analogous but not identical, belonging to the aromatic series, playing the part of acids, partly in combination in the form of ferrous salts and appearing to result from the oxidation of the corresponding tannins.

No. 25, June 24, 1878.

**Depolarisation of Electrodes by Solutions.**—M. Lippmann.—The depolarising power of certain salts has long been known. The first constant current battery constructed in 1829 by M. Becquerel depends on the use of copper sulphate, whilst zinc and cadmium sulphates have been utilised by MM. Du Bois-Reymond and J. Regnault for the construction of impolarisable electrodes and of constant elements. This property, however, has not been studied. The author's experiments reveal an essential condition of the phenomenon. In order that an electrode may be depolarised it must be formed of the metal which is contained in the solution. Thus, copper is the only metal which is depolarised in copper sulphate, whilst gold, silver, and platinum are polarised in this solution. On the other hand, copper is polarised in zinc and cobalt sulphates, &c. A salt depolarises only its own metal. This

principle may be applied to the detection of a metal in a solution. Taking for example copper, if a wire of this metal be plunged in a solution under examination, and taken as the negative electrode of a feeble current, it will not be polarised if the liquid contains 1-5000 of copper sulphate. The presence of copper may thus be detected in a mixture of metallic salts. With a silver wire silver may be detected in like manner.

**New Dielectric Constant.**—M. Neyreneuf.—On continuing the comparison of different isolating substances employed as the dielectric plates of a condenser, the author has established that for glasses of the same nature that the ratio  $\frac{e}{n}$  of the thickness to the number of sparks corresponding to a given quantity of electricity was constant. He has almost determined the value of this ratio for the varieties of glass met with in commerce. For substances much more isolating—such as ebonite, caoutchouc, and paraffin—the above ratio, which may be called the condensing constant, goes on increasing in a marked manner with the thickness. Consequently, only results obtained with plates differing respectively little in thickness are comparable.

**An Experiment in Magnetism connected with the Telephone.**—J. Luvini.—The author infers from his experiments that the changes produced by magnetising action in a magnetic mass are entirely molecular, and that M. Th. du Moncel, in ascribing the sounds produced in the telephone to the molecular vibrations of which M. de Rive speaks in his "Memoirs" of 1846, is completely in the right.

**The Telephone.**—M. des Portes.—The author describes a number of experiments made with the telephone, tending to show—as M. Th. du Moncel remarks—that vibrations determined in a magnet by the effect of a shock have for their result the determination of undulatory displacements of the magnetic particles.

**Electro-magnets.**—E. Bisson.—The author has changed the manner, rolling the wire upon the coils of electro-magnets: at the end of each range he connects the wire in a straight line to the point of departure, in order to recommence the rolling from the same side as in the preceding ranges, and finds an advantage of one-third.

**Organised Dust held in Suspension in the Atmosphere.**—P. Miquel.—The author finds in his experiments that the number of organic cellules collected varies from 500 to 120,000 per cubic metre of air passed through his apparatus, not including bacteroid particles. Hence it is certain that the atmosphere contains at least a hundred times as many germs as was announced by Drs. Maddox and Cunningham. The author thinks that with more perfect apparatus the number he has obtained might be much exceeded. He finds that the number of microbes in the air is small in winter, augments rapidly in spring, remains almost stationary in winter, and decreases in autumn. Rain always occasions the recrudescence of these microbes.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*  
No. 7, 1878.

**On Naumann's Method of Determining Molecular Weights.**—Hermann Kopp.—Not suitable for useful abstraction.

**On Nitroso-compounds of the Fatty Series: No. II.**—V. Meyer and J. Züblin.—Three distinct bodies can be obtained at pleasure from methyl-acetic ether and nitrous acid, namely, nitroso-methyl-aceton, nitroso-propionic ether, nitroso-propionic acid.

**Formation of Naphthalin and Methyl-violet.**—H. Brunner and R. Brandenburg.—In their investigations on the formation of aniline colours by means of bromine, the first results of which were communicated last year (*Berichte*, x., p. 1845), the authors found that the yield of

colour was essentially affected by the duration of the process. If equal molecules of dimethyl-aniline and bromine had been heated not above 120° for some hours a beautiful blue-violet colouring matter is produced, the analysis of which shows 4 mols. of hydrobromic acid to 1 of tetramethyl-rosanilin. On further examination it appeared that one of the atoms of bromine is introduced into the base by substitution, whilst the three others form a trihydro-bromate with the bromised tetra-methyl-rosaniline. This colouring matter the authors consider as a monobrom-tetra-methyl-rosanilin-trihydrobromate. This compound is only formed on cautious working; if the operation is conducted too rapidly, and if the temperature rises above 120°, more reddish shades, poorer in bromine, are formed; the yield of colour is greater, and the proportion of by-products is smaller. Among these products naphthalin was recognised.

**Urethan-benzoic Acid.**—C. Wachendorff.—If urethan-benzoic acid is heated a few degrees above its melting-point, alcohol and carbonic acid are separated, and the residue congeals again, amidst brisk escape of gases to a brittle mass, from which two substances have been isolated, urea-benzoic acid and urethan-benzoic ethyl-ether.

**Fittica's Oxy-para-toluylic Acid.**—E. v. Gerichten and W. Rössler.—Fittica's experiments were repeated in the expectation that nitro-toluylic acid would yield oxy-toluylic acid, as in fact took place.

**Occurrence of Tricarballic Acid in the Juice of Beet-root.**—E. O. von Lippmann.—The author obtained this acid from a small quantity of a sediment formed in the evaporation apparatus of a sugar manufactory.

**On Aurin.**—R. S. Dale and C. Schorlemmer.—On the prolonged exposure of aurin to heat along with ammonia a base is obtained which has all the properties of rosanilin. As the formula proposed by the authors,  $C_{20}H_{14}O_3$  (?) cannot be harmonised with Hofmann's formula for rosanilin,  $C_{20}H_{19}N_3$ , they endeavoured to prepare a larger quantity of pure aurin in order to convert it into the base in question. The analysis of aurin prepared from pure phenol as well as of that obtained by the purification of the commercial substance give numbers which agree with the formula  $C_{19}H_{14}O_3$ . In the meantime they received a communication from E. and O. Fischer showing that the rosanilin prepared from paratoluydin has the formula  $C_{19}H_{17}N_3$ . They consider the rosanilin obtained from Messrs. Dale and Schorlemmer as identical with their own.

**Asparagic Acid and Tyrosin from the Sprouts of Pumpkins.**—E. Schulze and J. Barbieri.—The nature of this paper appears sufficiently from the title.

**The Flame-reaction of Boracic Acid as a Lecture Experiment.**—H. Gilm.—An equally-coloured splendid green flame is obtained by passing the vapours of boracic ether through a narrow tube into a wider vertical tube of glass, and burning it at the upper aperture, mixed with air.

**On Hydroquinon-phthalein.**—A. G. Ekstrand.—The author, heating 1 mol. anhydrous phthalic acid with 2 mols. hydroquinon, and from two to three times the weight of stannic chloride, to 120° to 130° for twelve to fourteen hours, obtained a yield of 70 per cent hydroquinon-phthalein. It is coloured a deep violet by alkaline solutions, but on boiling or even on long standing it turns a dirty brown. In sulphuric and hydrochloric acid it dissolves with a red colour. D'acetyl-phthalein is obtained by heating phthalein for two or three hours with anhydrous acetic acid.

**Action of a Copper-zinc Element upon Alkaline Oxy-salts.**—J. H. Gladstone and A. Tribe.—The electrolysis of potassium nitrate and chlorate is here investigated. The general results are that the positive constituent unites with the zinc, whilst the negative is set free among the copper crystals, where it enters into new combinations forming caustic potash and water. The hydrogen does not pass through the solution and is

probably not oxidised at once, but is first condensed by the finely divided negative metal. The zinc compound formed and the alkali decompose each other mutually with formation of the original salt and of zinc hydrate, a molecule of hydrogen being thus available in every cycle.

Decomposition of the Tarry Oil of Lignite at a Red Heat.—C. Liebermann and O. Burg.—Lignite tar on distillation yields a mixture of hydrocarbons closely resembling those of coal-tar, containing 4 per cent of benzol and toluol, and 0.9 per cent of crude anthracen. Much gas is formed, especially from the portions boiling at the highest temperatures. Commercial petroleum suffered a very heavy loss by the formation of gas; it yields considerable quantities of benzol, but scarcely any anthracen. Technically speaking the authors' experiments point to the possibility of utilising the "gas-oil" of paraffin works—now produced in quantity and almost worthless—for the preparation of benzol, toluol, and anthracen.

Action of Trichlorolactic Acid upon Urea.—C. O. Cech.—A preliminary notice.

Formation of Tertiary Amine Bases During the Synthesis of Organic Acids.—Ernst Schmidt.—During the synthetic preparation of a considerable quantity of isobutyl-formic acid, the author, on evaporating the alcohol employed with hydrochloric acid, obtained a large quantity of a salt, which proved to be almost pure tri-isobutylamin.

On Tri-isobutylamin.—Rudolph Sachtleben.—An examination of the salt mentioned in the previous paper.

Chlorine-Derivatives of Naphthalin.—E. Fischer.—On treating naphthalin with chlorine gas in the cold, or with potassium chlorate and hydrochloric acid, there is formed a mixture of addition- and substitution-products. The author has undertaken to isolate and to examine all those substances formed at common temperatures by either of these methods of treatment.

Behaviour of the Products Obtained by Treating Brucin with Nitric Acid and Reducing Agents.—R. Röhre.—If 1 part of brucin is treated with 25 parts of nitric acid of sp. gr. 1.4, and if the red solution is allowed to stand till it has become yellow, and is then mixed with stannous chloride in excess, the well-known deep violet colouration is produced, which soon passes into a dark red. On prolonged standing the liquid slowly becomes colourless, and well-formed violet crystals are deposited on the sides of the vessel. These crystals are soluble in water and mineral acids with a fine violet colour, with the exception of nitric acid, in which they form a yellow solution. In potassa they dissolve with a greenish yellow colour, which, on the addition of an acid, becomes violet. In alcohol they are sparingly soluble, and insoluble in ether, benzol, chloroform, petroleum ether, carbon disulphide, and amylic alcohol. The crystals contain no tin.

Compounds of Organic Bases with Mercuric Chloride.—Otto Klein.—The author is investigating the compounds formed by mercuric chloride with the bases of the aromatic series, and especially how far the basic character of a compound can be weakened without its losing the power of combining with mercuric chloride. Two tolydins (ortho and para), diphenylamin, dimethylanilin, and naphthylamin yield crystalline compounds, whilst acetanilid in the cold shews no reaction.

Researches on the Ketons of the Aromatic Series (Second communication).—W. Stædel.—The compounds here described are the derivatives of benzophenon and diphenylmethan, as also dioxy-diphenyl-keton.

On Mono-chlor-acetylen.—O. Wallach and O. Bischof.—An examination of  $\beta$ -bichlor-acrylic acid, which, when its baric or calcic salt is heated with an aqueous solution of baryta in an apparatus with an ascending condenser, gave rise to a somewhat violent explosion, due to the development of mono-chlor-acetylen.

Regularities in the Boiling-Points of the Chlorinised Ethans.—W. Stædel.—A useful abstraction of this paper would require the insertion of the author's illustrative tables.

Certain Derivatives of Tetra-chlor-ether.—E. Paterno.—A claim of priority as against J. Busch (*Berichte*, v., p. 445).

Acid Imid-chlorides and Amidins.—O. Wallach and A. Gossmann.—The authors point out a formation of secondary amines which may be of importance for the preparation of some of them, and which even points the way for obtaining aromatic tertiary amines, hitherto so difficult of production.

On Aromatic Nitrosamins (Third communication).—Otto N. Witt.—An account of mono-dinitro-diphenyl-nitrosamin.

On Ortho-azo-benzoic Acid.—A. Claus and F. Mallmann.—Pure ortho-nitro-benzoic acid dissolves in potassa with an intense yellow colour, and if sodium amalgam is added to such solutions the colour becomes darker. If the addition of amalgam is continued so that a brisk evolution of hydrogen takes place, and if the mixture is well cooled the pale yellow colour returns. On the addition of acids reactions ensue, which vary greatly according to the circumstances. Thus if the warm solution immediately after the action of the amalgam is mixed with concentrated hydrochloric acid brown or green solutions are obtained, which on boiling turn red- or blue-violet, and on cooling and standing deposit precipitates of a similar colour.

On Azo-phthalic Acid.—A. Claus and O. May.—A preliminary notice.

Azo-benzol-sulphonic Acids.—A. Claus and O. May.—An examination of  $\alpha$ -azo-benzol-sulphonic acid, prepared from  $\alpha$ (meta)-nitrobenzol-sulphonic acid.

Conversion of the Nitriles into Imids.—A. Pinner and F. Klein.—Researches into the action of sulphuric acid upon the nitriles.

Oxy-toluyaldehyds and the Accessory Oxy-toluylic Acids Obtainable by the Chloroform Reaction from the three Isomeric Cresols.—F. Tiemann and C. Schotten.—This paper does not admit of useful abstraction.

Certain Derivatives of Para-homo-salicyl-aldehyd.—C. Schotten.—A notice of para-homo-saligenin,  $C_8H_{10}O_2$ , of methyl-para-homo-salicyl-aldehyd, acet-para-homo-salicyl-aldehyd, acetic acid-acet-para-homo-salicyl-aldehyd, the homologues of cumarin and cumaric acid, ortho-nitro-para-homo-salicyl-aldehyd, and ortho-nitro-ortho-homo-para-oxy-benzaldehyd.

Reduction of the Aldehyd-oxy-benzoic Acids to Alcoholic Acids.—C. L. Reimer.—The author has converted the three aldehyd-oxy-benzoic acids into the corresponding alcohol acids by means of sodium amalgam.

Action of Chloroform upon  $\alpha$  and  $\beta$  Oxy-phthalic Acid in Alkaline Solution.—C. L. Reimer.—Not suitable for abstraction.

Ethyl-ethers of Pyrogallic Acid and the Cedriret of the Ethyl Series.—A. W. Hofmann.—The author having already recognised cedriret as a derivative of the dimethyl-ether of pyrogallic acid has investigated the homologous cedrirets. He has digested pyrogallic acid, caustic potassa, and potassium ethyl-sulphate, with a large excess of absolute alcohol for twenty-five to thirty hours in soda-water bottles, at a temperature of 100°, and has obtained various novel compounds, especially ethyl-cedriret,  $C_{20}H_{24}O_6$ .

Decomposition of the Oil of Lignite-tar at a Red Heat.—M. Salzmann and H. Wichelhaus.—The authors announce that they too are engaged with this subject, and that they obtained the best yield of nitrobenzol from the fraction boiling between 200° and 300° of an oil obtained from Hübner, of Zeitz.

*Reimann's Fürber Zeitung,*  
No. 23, 1878.

This issue contains a notice of the tinctorial chemicals displayed at the Paris Exhibition. M. Poirrier exhibits violet de Paris, eosin, lutecienne, &c., in splendid specimens. M. J. Casthelaz, in addition to the ordinary coal-tar dyes, shows aureosin and rubeosinic acid. Bédés, of Clichy, exhibits hexanitro-diphenylamin, diphenylamin, acetanilid, acetoluid, and toluidin in large white nacreous crystals.

L. Thomas, of Javel, exhibits a plate of gallium, of about 6 inches square. Tessié du Motay displays tussah-silk bleached with hydrogen peroxide obtained from baric peroxide.

In order to distinguish artificial alizarin from extract of madder, Goppelsroeder sublimes the specimen and examines it with the microscope. All artificial alizarins contain, in addition to the long orange acicular crystals of alizarin, light yellow crystalline scales of anthraquinon. Or the specimen of dye is extracted with a concentrated solution of alum, the hot filtrate is allowed to cool and filtered again after the bulk of the alizarin has been deposited. Extract of madder shows the well-known fluorescence of purpurin which is wanting in artificial alizarin.

No. 24, 1878.

The account of the tinctorial department of the Paris Exhibition is continued in this issue. Among the most noteworthy objects is a collection of dichroic silkyarns, dyed with fluorescein and displaying the beautiful fluorescence of this colour.

In order to determine the value of tin crystals, Goppelsroeder and Drechsel mix the hot solution with a known quantity of potassium chromate in solution. The stannous salt is thus converted into stannic, and it is merely necessary to determine how much chromic acid remains unreduced in the liquid in order to calculate how much stannous chloride was originally present. Chlorine is, therefore, liberated by the addition of hydrochloric acid, and conducted into a solution of potassium iodide, and the iodine liberated is finally titrated with sodium hyposulphite. To this process Dr. Reimann objects that commercial tin crystals invariably contain a certain proportion of stannic salt, which, if treated as above described must escape valuation.

*[Rivista Scientifico-Popolare di Statistica, Economia,  
Agricoltura, Industria, e Varieta.*  
Anno v., No. 2.

The Diaphanometer of Savalle.—This is an instrument for judging of the purity of commercial samples of alcohol by means of their degree of transparency and colouration after being mixed with a certain reagent, which, however, is not named or described.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 8, June 20, 1878.

The ventilation of the Rotunda of the Palace of the Trocadero is completely successful. The supply of air is after the rate of 40 cubic metres per hour for each person.

At Tarbes, in the Hautes Pyrénées, bundles of straw attached to broom-handles are placed upon the roofs of the houses by way of lightning-rods, and are said to have proved completely successful.

Records of earthquakes have been regularly kept in Japan since the year 400 B.C. Severe shocks have generally been preceded by a rise of temperature and great atmospheric perturbations. On an average there have been ten severe earthquakes each century.

It is announced that at the forthcoming national fête, to be celebrated at Paris, two hundred electric lights will burn during the whole of the night at different points of the city, in addition to those which now regularly illu-

minate the Place de l'Opéra, the Place de la Concorde, the triumphal arch de l'Etoile, and the front of the Legislative Palace.

At a meeting of the Société d'Encouragement, the Count du Moncel, on behalf of M. Regnier, exhibited improved points for the electric light. They are covered with a slender layer of nickel, which preserves them and concentrates the electric action towards the point.

Experimental Researches on Colour Blindness.—J. Delbœuf and W. Spring.—It is to be regretted that the authors speak of this affection as "Daltonism," and of those suffering from it as "Daltonians."

It is proposed to erect a monument at Rome in memory of the late astronomer Secchi.

*Chemiker Zeitung.*

No. 24, June 13, 1878.

According to G. C. Wittstein, ground cryolite is occasionally sold under the deceptive name of "enamel soda."

According to the *Archiv. der Pharmacie*, genuine wine-vinegars, if mixed with an equal volume of a solution of potassium dichromate and boiled for about half a minute, turn a dark red—a change which occurs with no other vinegar. Wine-vinegars also give a plentiful precipitate with plumbic acetate.

*Bulletin de la Societe Chimique de Paris,*  
No. 11, June 5, 1878.

Action of Chlorine upon Hydrobromic Ether.—H. Lescoeur.—Hydrochloric acid is liberated, and certain chloro-bromated compounds are formed, several of which the author has examined.

Researches on the Action of Dry Oxalic Acid upon the Primary, Secondary, and Tertiary Alcohols.—A. Cahours and E. Demarcay.—Already noticed.

On Certain Compounds of Lanthanum and Didymium.—P. T. Clève.—A critique on the paper of MM. Frerichs and Smith.—*Liebig's Annalen*, clxii., p. 334.

On Certain Derivatives of Dichlorated Naphthalin  $\eta$ .—P. T. Clève.—The author examines the nitro-dichloro- $\eta$  compound, the dichloro- $\eta$ -naphthylamin compound, and trichloro-naphthalin.

On Aniline-Black which does not turn Green.—S. Grawitz.—The author's processes for dyeing these blacks consist in causing oxidising salts or metallic acids to act upon an acid solution of aniline in presence of the tissues to be dyed. These become green, growing deeper and deeper, and finally black when the oxidation has reached a sufficient term, the bath remaining perfectly clear. He considers that in the formation of these blacks the metal plays a part totally different from what it fulfils in Light-foot's process. In this latter the metal merely decomposes the chloric acid, which does not produce black, into lower stages of oxidation, which have that effect. In the Grawitz black, in spite of the acidity of the liquid, the metallic oxides obtained from the salts or acids employed are fixed upon the fibre in a true combination with the black, more intimate than in lakes, and very probably in a state of true substitution. One or more molecules of hydrogen are replaced by one or more molecules of the metal, which gives a special stability to the products of the ulterior oxidation by reason of the stability of the metallic oxides and of their affinity for oxygen. The author considers that his theory is fully proved by the following experiment, in which two stages can be traced, in the former of which the metallic acid has an oxidising act on, but in the latter a metallising effect:—Let a black be fixed with chromic acid acidulated with sulphuric acid. As soon as the tissue printed with a black capable of turning green has been worked for some minutes in a boiling bath containing a certain quantity of this mixture, the chromic acid is rapidly reduced, and the yellow liquor

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JUNE, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Ni- trates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Sulphuric An- hydride.	Hardness on Clark's Scale		
	Saline. Grs.	Organic. Grs.								Before Boiling. Degs.	After Boiling. Degs.	
<i>Thames Water Companies.</i>												
Grand Junction .. .. Clear	0'000	0'009	0'135	0'101	20'80	8'730	0'432	0'94	1'430	14'3	2'80	
West Middlesex .. .. Clear	0'000	0'008	0'114	0'073	19'10	8'010	0'828	0'94	1'430	13'2	2'80	
Southwark and Vauxhall Clear	0'001	0'010	0'114	0'098	19'30	8'780	0'432	0'94	1'480	14'3	2'80	
Chelsea .. .. . Clear	0'001	0'009	0'099	0'090	19'80	8'120	0'396	0'94	1'500	14'3	2'80	
Lambeth .. .. . Clear	0'001	0'011	0'144	0'098	20'70	8'670	0'432	1'01	1'700	14'8	3'30	
<i>Other Companies.</i>												
Kent .. .. . Clear	0'000	0'002	0'444	0'003	28'50	11'250	0'648	1'59	3'430	20'6	5'10	
New River .. .. . Clear	0'000	0'006	0'144	0'045	19'90	8'840	0'468	1'01	0'800	14'8	3'30	
East London .. .. . Clear	0'000	0'006	0'114	0'056	20'40	8'620	0'820	1'15	1'730	14'3	3'30	

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B

turns green. The reagents have therefore exhausted their oxidising power, but the black still turns green on exposure to sulphurous acid. The amount of the reagents may be indefinitely increased, and the black may be rendered grey, or even destroyed, without affecting its property of turning green. But if, on the other hand, the tissue is worked in the bath with the original dose of chromic and sulphuric acids for half an hour or longer, the green liquor becomes a violet-red, the black is fixed and is no longer capable of becoming green, and all the chromic oxide derived from the reduction of the chromic acid has disappeared from the liquid, and is found deposited upon the black portions of the cloth. [Has it been analytically proved that no chromic oxide remains in the liquid? To what is the violet-red colour due?]

On Brown Alizarin.—M. Prud'homme.—This new product, if fixed with potassium ferricyanide or chromic acetate, gives light shades varying from a mode to a grey. The heavy shades seem difficult to obtain. With alkaline reducing agents brown alizarin gives a red liquor, which, on exposure to the air, becomes covered with a blue scum. The dye seems identical with that which may be obtained by an alkaline reduction of nitro-alizarin. If a solution of nitro-alizarin in caustic soda is heated for a long time in presence of a stannous salt, or of the hydrosulphite of soda, the colour becomes successively violet, blue, red, and is covered with a blue scum. The new colour may be useful along with the red and blue alizarins, in substitution for dyes which require to be fixed with albumen.—*Bul. de la Soc. Ind. de Mulhouse.*

MISCELLANEOUS.

South London School of Pharmacy.—On Saturday, July 13, the presentation of the Medals and Certificates to the successful candidates at the last school examinations for the session held between July 4 and 8, took place at this institution, when the Secretary announced the awards as follows:—Senior Chemistry: Medal, Mr. Phillips; Certificate, Mr. Stonham. Junior Chemistry: Medal, Mr. Lumby; Certificate, Mr. Humfrey. Botany: Medal, Mr. Humfrey; Certificate, Mr. Lovely. Materia Medica: Medal, Mr. Powell; Certificate, Mr. Humfrey. Pharmacy: Medal, Mr. Lovely; Certificate, Mr. Lumby.

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JOSEPH HERON, Town Clerk.

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MANCHESTER CORPORATION GAS-WORKS.—AMMONIACAL LIQUOR.—The TIME for RECEIVING TENDERS has been EXTENDED from the 1st of August to the 1st of October next.—By order of the Gas Committee,

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Town Hall, Manchester, 5th July, 1878.

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 974.

ON THE  
PRODUCTION OF MAGNESIUM NITRIDE BY  
SMOTHERED COMBUSTION OF MAGNESIUM  
IN AIR.

By J. W. MALLET,

THE existence of a nitride of magnesium was first noticed by Deville and Caron,\* in connection with the purification of the metal by distillation.

Briegleb and Geuther† afterwards obtained this compound by passing ammonia or nitrogen over strongly heated magnesium. The amorphous mass produced, of greenish-yellow colour, had approximately the composition  $Mg_3N_2$ . I have lately observed the formation of the same substance in large quantity in the simple combustion of magnesium with limited access of air.

Using the burning of a piece of magnesium ribbon, as it so often has been used, to illustrate to students the fact that the metal gains in weight by oxidation, I held the coiled-up ribbon pretty well down in a porcelain crucible to diminish the loss of magnesia in fume carried up by the heated air, and finally dropped a part of the metal, still burning, into the bottom of the crucible.

Washing the vessel out afterwards, I noticed that water at once produced effervescence and a distinct smell of ammonia.

On repeating the experiment with a larger piece of the ribbon, placed at once at the bottom of the crucible, the same result was obtained, and with far greater distinctness when magnesium filings were used, the residue in this latter case having a well marked greenish yellow colour, and giving off abundance of ammonia on addition of water or a solution of a caustic alkali. When but a few drops of liquid are added, the heat evolved is so great as sometimes to ignite a portion of the mass, and much of the powder is scattered by the escaping ammonia and vapour of water.

The porcelain being attacked, and a dark brown film of silicon formed upon it, I wished to ascertain whether this element had anything to do with the absorption of the atmospheric nitrogen, and therefore substituted an iron crucible, but without changing the result. The magnesium used was itself examined, and found free from silicon.

The chief part of the metal burned is, of course, converted into oxide, with the production of a temperature high enough to induce the remainder, when the supply of oxygen is limited, to unite with nitrogen. The amount of nitride formed varies with the manner in which the combustion is managed. I have found the best result to be obtained when the crucible, of usual Berlin porcelain shape, is filled to about one-third its depth with the filings, and heated gently over a lamp, the filings ignited at the top by a red-hot iron wire, and from time to time, but not continuously, gently stirred with the wire. A peculiar orange glow, unlike the brilliant light of the magnesium burning with free supply of air, and a slight apparent clotting together of the filings, indicate the formation of the nitride.

To determine approximately how far nitrogen may thus be taken up, I in several instances weighed the metal, and, cooling the crucible rapidly by standing it upon an iron block, transferred its contents to a small flask, in which was a test-tube of water or a solution of potassium hydrate.

Attaching a set of absorption-bulbs with a measured volume of normal sulphuric acid, I very gradually tilted the flask so as to bring the alkaline liquid in contact with the powder, and, after action in the cold was over, heated to the boiling-point, and drew air through the apparatus with an aspirator. The unsaturated acid in the bulbs was determined with a normal alkaline solution.

The three experiments showing the largest absorption of nitrogen gave the following results. A little magnesium was lost in the fumes, but that, doubtless, altogether in the form of oxide:—

	Mg used. Grms.	NH <sub>3</sub> obtained. Grms.	Equiv. Mg <sub>3</sub> N <sub>2</sub> . Grms.	Equiv. Mg converted Mg. into nitride per Grms. 100 pts. used.
No. 1.	2.635	0.292	0.859	0.618 23.5
No. 2.	2.204	0.286	0.841	0.606 27.5
No. 3.	3.117	0.365	1.074	0.773 24.8

This mode of treating magnesium furnishes a simple and effective lecture-table illustration of the formation of a metallic nitride, and of some of the reactions presented by bodies of this class.

University of Virginia, April, 1877.

PHOSPHORUS IN IRON ORE AND IN IRON.\*  
PART II.

By J. E. STEAD, Middlesbrough.

(Concluded from p. 31.)

I ENDEAVOURED in the first part of this paper to lay before you, in a very condensed form, investigations made with the aim of removing phosphorus from iron ores and from the crude products of our blast-furnaces.

It is intended this evening to describe some of the changes which take place when air is blown through phosphoretted metal; also to consider the value of manganese oxides, chlorine, bromine, iodine, and hydrogen, as agents for removing phosphorus, leaving the question of ore purifications as a yet unsolved problem, and one which to our mind will not be readily solved to the satisfaction of the practical iron manufacturer.

I have first, then, to turn your attention to the action of air. When metal containing manganese, silicon, carbon, and phosphorus is acted upon when in a fluid state by a stream of air, we have every reason to believe that all the elements present—probably with the exception of carbon—are oxidised in the ratio in which they exist in the metal and that a very basic cinder is at first produced, which, by calculation, would have the following composition, in the case of Cleveland iron being used, viz. —

Cleveland Pig-Iron.		Cinder produced by Action of Oxygen.	
	Per cent.		Per cent.
Iron .. .. .	92.65	Protoxide of iron ..	93.4
Carbon .. .. .	3.25	,, manganese ..	0.5
Manganese .. ..	0.50	Silica .. .. .	3.4
Silicon .. .. .	2.00	Phosphoric acid ..	2.7
Sulphur .. .. .	0.10		
Phosphorus .. ..	1.50		
	100.00		100.0

It has been found, however, that it is impossible to obtain by direct experiment cinder of this composition, for, almost instantly after its formation, as we might reasonably expect, the manganese, silicon, and phosphorus, still present in the fluid mass, are oxidised by the oxygen of the protoxide of iron, from which the iron is reduced, which, leaving the cinder, returns to the bath and is replaced by the oxides of manganese, silicon, and phos-

\* *Comptes Rendus*, xlv., 394.

† *Ann. d. Chem. u. Pharm.*, cxxiii., 228

\* Read before the Cleveland Institution of Engineers, December 10, 1877.

phorus. In consequence of the rapidity with which these reactions take place, the cinder, which we have been able to draw off from the metal, is always more or less saturated with silica, phosphoric acid, and oxide of manganese. The following analysis of cinder was made on that which was produced by blowing on the surface of molten Cleveland iron. It was collected by placing the end of a cold bar about half an inch in front of the air jet, on the surface of the metal. The molten oxides were blown forward, and solidified on coming in contact with the cold iron, to which they adhered. The bar with cinder was afterwards removed, and the cinder examined, the results of which are below, viz. :—

	Per cent.
Protoxide of iron .. .. .	64.91
Peroxide of iron .. .. .	12.68
Protoxide of manganese, &c. .. .. .	2.30
Silica .. .. .	14.71
Phosphoric acid .. .. .	5.40
	100.00

In a Bessemer converter, when the temperature is low enough, there can be no doubt that a portion of the phosphorus is at first removed; that the iron, manganese, silicon, and phosphorus are burnt just in the proportion in which they are present; and that the rich iron oxide at first produced will remove a second portion of phosphorus, on being mixed up with the still impure metal. Such, however, is the violent agitation to which the metal is subjected that the cinder and iron are continually in intimate contact, and, as a consequence, the cinder is very rapidly saturated with silica and phosphoric acid. The power of silicon to reduce oxide of iron is very great; in fact, by simply heating to a high temperature, in a crucible, silicious pig metal and a limited amount of mill cinder or oxide of iron, about 80 per cent of the oxide will be reduced to the metallic state, and a super-saturated silicious slag will remain on the surface of the metal.

In the Bessemer converter, then, after the saturation point has been reached, when the silica and phosphoric acid have both in combination with them the proper chemical proportion of oxide of iron, the still unoxidised silicon in the metal will continue to reduce the oxide in the cinder, and will replace it with silica. It is clear, when this has been attained, viz., the removal of a base and the substitution of an acid, in a compound already saturated with acid (silica), that silica must be in excess, and that, as this acid is much more powerful than phosphoric acid, it will take away the oxide of iron at first in combination with it, by which reaction free silica or silicic acid and iron phosphates become free phosphoric acid and iron silicate.

The silica from the bottom and sides of the converting vessel is during "the process" rapidly worn away, and this passing into the cinder will also take part in the reactions.

Having now arrived at the point at which the phosphoric acid is expelled from its combination with iron oxide, and remains in the free state dissolved in the cinder, we must endeavour to explain what action manganese and silicon, as they exist in fluid iron, have upon free phosphoric acid.

Manganese has, like silicon at low temperatures, a very powerful attraction for oxygen, and it was thought to be not at all improbable that this element would have a greater attraction for oxygen than phosphorus, and that oxide of phosphorus or phosphoric acid and manganese, when brought together, would be followed by the manganese attracting from the phosphorus the oxygen in combination with it, by which action oxide of manganese and free phosphorus would be produced.

In order to ascertain if this change actually takes place, puddlers' tap-cinder super-saturated with silica, which was added to it in order that the phosphoric acid might

be liberated or expelled from its union with the oxides in the cinder, was poured, when in a fluid state, upon melted spiegeleisen, containing a large amount of manganese.

After the mixture was thoroughly shaken up, so as to expose the spiegel in every part to the phosphoric cinder, the metal was run off and allowed to set. An analysis of the spiegel, before and after treatment, gave the following result, viz. :—

	Before.	After.
Carbon .. .. .	4.65 per cent.	4.63 per cent.
Manganese .. .. .	21.50 "	18.05 "
Silicon .. .. .	0.85 "	0.93 "
Phosphorus .. .. .	0.06 "	0.72 "
Phosphoric acid reduced =	1.51 = 0.66 per cent	
P = manganese oxidised =	3.45 per cent.	

Judging from these results, it is clear that the theory, that manganese is capable of reducing free phosphoric acid at a temperature comparatively low, is correct.

When pig-iron after fusion is brought into contact with fluid oxide of iron, the silicon and phosphorus are removed simultaneously, from which fact certain investigators have concluded that their attraction for oxygen, at comparatively low temperatures, is about equal. This is, however, not the case, for when silicious fluid metal is poured upon phosphoric acid, a portion of that substance is decomposed, free phosphorus and silica being produced. The following are the results obtained from an experiment conducted as described :—

	Metal.	
	Before treatment.	After treatment.
Phosphorus .. .. .	1.11 per cent.	1.50 per cent.
Silicon .. .. .	5.95 "	5.37 "
Phosphorus reduced from phosphoric acid =	0.39 per cent.	
Silicon oxidised by phosphoric acid =	0.58 per cent.	

In a second experiment the phosphoric acid in fluid puddlers' tap-cinder was liberated by the addition of silica, and to this pig-iron containing silicon was added. After shaking the vessel containing the mixture for a short period, the metal was poured off, allowed to set, and carefully analysed. The results obtained were as follows, viz. :—

	Metal.	
	Before treatment.	After treatment.
Silicon .. .. .	1.25 per cent.	0.75 per cent.
Phosphorus .. .. .	1.00 "	1.33 "

We may, therefore, conclude that the attraction of silicon for oxygen is greater than the attraction of phosphorus for that element, and that, when free phosphoric acid is exposed to the action of silicon, as it exists in fluid metal at low temperature, oxygen is drawn or attracted from the phosphorus, which is thus liberated, the silicon combining with the oxygen to form silica or silicon dioxide.

We must now turn our attention to the action of fluid carburetted iron at low temperature on free phosphoric acid.

The results of an experiment in which fluid iron containing little or no silicon and manganese was poured upon solid phosphoric acid, placed at the bottom of a red-hot crucible, clearly showed that the acid had suffered decomposition. The metal before and after treatment had the composition as given below, viz. :—

	Before.	After.
Carbon .. .. .	3.40 per cent.	3.20 per cent.
Silicon .. .. .	0.08 "	0.08 "
Phosphorus .. .. .	0.04 "	0.30 "

We see, then, from these experiments, what would occur in the Bessemer converter, when the phosphoric acid in the cinder—continually produced during the first

part of the process, when the temperature is not extreme—is expelled from its combination with oxide of iron, by the absorption of silica. For as manganese, silicon, and carbon, as they exist in fluid iron, readily reduce free phosphoric acid, we should naturally expect the whole of it at first removed would be returned to the bath, and that the cinder would contain little or no phosphoric acid. The following is an analysis of such a cinder, taken from a converter, in which Cleveland iron was being blown, confirming the absence of any quantity of phosphoric acid:—

Silica .. .. .	65 per cent.
Iron .. .. .	15 "
Phosphoric acid .. .. .	trace.

As there has been reference, time after time, in the foregoing remarks, to the point at which oxide of iron becomes saturated with silica, and as the question is of a very important nature, several experiments were made with the aim of solving it.

In order to do this, cinder, containing little more than a trace of phosphoric acid, was mixed with variable proportions of sand, and these, after fusion, were agitated with fluid iron containing phosphorus. The metal in each case was tested after the treatment for phosphorus, and if no diminution was detected it was concluded that in the cinder employed there was absent any free oxide of iron. The results were as follows, viz.:—

	No. 1.	No. 2.	No. 3.	No. 4.
	Per cent.	Per cent.	Per cent.	Per cent.
Protoxide of iron ..	73·90	64·50	55·50	47·68
Peroxide of iron ..	11·60	10·60	8·50	6·87
Silica .. .. .	10·50	20·40	31·00	40·00
Alumina, lime, &c. ..	4·00	4·50	5·00	5·45
	<u>100·00</u>	<u>100·00</u>	<u>100·00</u>	<u>100·00</u>
Metallic iron .. ..	65·60	57·60	49·12	41·89
Ratio of iron to silica	1 to 0·16	0·35	0·63	0·95
Phosphorus in metal—				
Before treatment ..	1·51	1·51	1·48	1·48
After treatment ..	0·13	0·04	0·25	0·75
	No. 5.	No. 6.	No. 7.	No. 8.
Protoxide of iron ..	42·13	43·41	38·57	29·57
Peroxide of iron ..	10·71	8·13	7·86	5·00
Silica .. .. .	44·00	46·00	51·00	62·50
Alumina, &c. .. ..	3·16	2·46	2·57	2·93
	<u>100·00</u>	<u>100·00</u>	<u>100·00</u>	<u>100·00</u>
Metallic iron .. ..	40·27	38·34	35·50	26·50
Ratio of iron to silica	1 to 1·06	1·20	1·44	2·36
Phosphorus in metal—				
Before treatment ..	0·91	0·91	0·91	0·91
After treatment ..	0·89	0·90	0·91	0·91

We see, then, that when the ratio of iron and silica in the cinder is as 1 to 1·06, the compound is incapable of oxidising phosphorus from fluid iron containing it.

This ratio is almost exactly the same as that of the chemical equivalents of iron and silica, viz., as 56 to 60. We may therefore conclude that one equivalent of silica saturates or neutralises one equivalent of iron in the state of oxide, or, expressed in more intelligible language, that one part of iron is saturated with 1·07 parts silica. In No. 1 experiment the results are apt to mislead without a little explanation. It will be seen that there has not been so much phosphorus removed as in No. 2, in which the cinder was not so pure as in the first case. This, however, was due to the very sluggish nature of the cinder, which prevented the intimate admixture with the metal when the contents of the vessel containing them was agitated—a state of things which did not exist in the second experiment.

I have now to turn your attention to a fact of great theoretical interest, and that is, that it is, within certain limits of temperature, impossible to drive off from cinder its phosphoric acid by the addition of silica.

We know very well that silica is a much stronger acid than the phosphoric, and that it will liberate the latter from its combination with bases; and we were prepared to find that, when an excess of silica was added to puddling cinder, and the mixture fused at a moderately high temperature, the liberated acid would be volatilised, for free phosphoric acid, heated by itself, passes off as vapour at a temperature a little above redness.

The result obtained, when experimenting in the manner described, proved that no phosphoric is volatilised even when the temperature is raised to the melting-point of steel. The results obtained were as follows, viz.:—

*Analyses of Cinder after Fusion.*

	No. 1.	No. 2.	No. 3.
	Per cent.	Per cent.	Per cent.
Protoxide of iron .. ..	41·91	37·55	32·14
Peroxide of iron .. ..	6·30	4·50	3·86
Silica .. .. .	42·20	49·00	56·00
Phosphoric acid .. ..	5·18	4·50	3·73
Lime, &c... .. .	4·41	4·45	4·27
	<u>100·00</u>	<u>100·00</u>	<u>100·00</u>
Metallic iron .. .. .	37·00	32·35	27·70
Ratio of iron to silica ..	1 to 1·14	1 to 1·51	1 to 2·03
Ratio of iron to phosphoric acid—			
Before fusion .. .. .	1 to 0·140	1 to 0·140	1 to 0·140
After fusion .. .. .	1 to 0·140	1 to 0·139	1 to 0·139

We are taught from these results what great tenacity the cinder has for phosphoric acid, and they also are confirmatory of the theory that the whole of the phosphorus, removed in the various processes in which oxide of iron is used for purifying iron, is retained by the cinder, and that none is vapourised and carried up the stack with the waste products of combustion from the furnace grate.

I have now to turn to the value of manganese oxides as agents for purifying iron from phosphorus.

As ores containing manganese are frequently employed for fettling puddling furnaces, I considered the question to be of sufficient importance to demand investigation, and I have therefore turned my attention to the matter, and now hope to be able to satisfactorily explain them.

There are several compounds of manganese and oxygen, the principal of which are the protoxide and the peroxide, the latter of which contains twice as much oxygen as the former.

When the peroxide is heated by itself to a temperature above dull redness, one-third of its oxygen is drawn off, and if mixed with substances capable of readily absorbing oxygen, and heated to a sufficiently high degree, half of it is separated, and protoxide of manganese remains. The protoxide, however, retains its oxygen with much greater tenacity, and it is only at very elevated temperatures decomposed in presence of *reducing agents*. Judging from these facts alone we naturally concluded that protoxides of manganese would be without any direct action on the phosphorus existing in fluid iron, and the result of experiment fully confirmed the theoretical deduction. As, however, this oxide has a much greater attraction for silica than iron oxide, it is highly probable that it plays a part of secondary importance in the cinders of the purifying processes, by taking up the silica, which would otherwise be saturated by oxide of iron, and would thus leave the latter free to act upon the metal.

In this respect, however, as the equivalents of manganese and iron are about equal, manganese cannot be held to be of more value than iron.

Peroxide of manganese, when forced under the surface of molten iron, parts with half its oxygen, which, acting upon the oxidisable impurities in the metal, removes

them. The following results prove this to be the case, viz. :—

	Before treatment.	After treatment.
Carbon .. ..	3.30 per cent.	3.10 per cent.
Silicon .. ..	1.51 ,,	0.20 ,,
Manganese .. ..	0.54 ,,	0.11 ,,
Phosphorus .. ..	0.90 ,,	0.50 ,,

When oxide of iron acts upon phosphorus, for each part of that element oxidised 4.5 parts of pure iron are reduced from the oxide. When manganese peroxide acts upon phosphorus the oxidation is effected by free oxygen, and therefore there is no gain in weight by the separation of metal.

The oxygen available in 7 lbs. of manganese peroxide will oxidise 1 lb. of phosphorus; whereas that, in 5.8 lbs. of protoxide of iron, there is the same amount of oxygen, but as the 2.3 lbs. of phosphoric acid produced would require about three times its weight of oxide to carry it off, the total amount would be  $5.8 + (2.3 \times 3) = 12.7$  lbs. This would yield  $4\frac{1}{2}$  lbs. of pure iron, which, at say three times the value of the original oxide, would more than cover its cost.

We see, therefore, that peroxide of manganese is of much less value than iron oxides.

The next subject for our consideration is the value of fluor-spar as an agent for removing phosphorus.

This substance, as all interested in the subject know, has been very prominently brought before the public as possessing, when in combination with oxides of iron, the power of removing phosphorus in the puddling process from crude iron. Unfortunately, however, I have not had an opportunity of investigating its action as thoroughly as could be wished. When, however, phosphide of iron is fused with fluor-spar, Dr. Percy states no action whatever takes place, and I have found on experiment a similar result.

In order to find what action a mixture of fluid oxide of iron and fluor-spar has upon Cleveland iron, two-thirds of mill-tap and one-third spar were fused and thoroughly mixed up with molten iron. The iron before and after treatment was tested, with the following results, viz. :—

	Before treatment.	After treatment.
Carbon .. ..	3.30 per cent.	3.10 per cent.
Silicon .. ..	1.50 ,,	trace
Phosphorus .. ..	1.48 ,,	0.16 ,,

Now, although the greater part of the phosphorus was removed in this case, it will be seen by former experiments that better results have been obtained from the use of mixtures of oxide of iron and sand.

The results, however, from its use in a puddling furnace may be very different, and I hope shortly to be able more thoroughly to investigate its action.

I now turn to chlorine, bromine, and iodine for consideration as purifiers of metal.

All these elements form definite compounds with phosphorus: but they are all decomposed when brought into contact with red-hot iron, the phosphorus leaving the compounds to combine with the iron. Experiments in which these elements were mixed with molten Cleveland iron gave negative results.

Judging from this fact we should consider that there would be no advantage derived from their use.

We next treat of hydrogen, considered as an agent for removing phosphorus.

Hydrogen, like chlorine, can be obtained in combination with phosphorus, in which state it exists as a colourless gas, but also, like chlorine, it has less attraction for it than iron. Iron wire will burn in phosphoretted hydrogen gas, the combustion being kept up by the rapid combination of the phosphorus and iron.

If, therefore, iron will draw phosphorus from hydrogen, it is clearly impossible for hydrogen under similar conditions to attract it from iron. We therefore consider hydrogen, in all its combinations, to be incapable of re-

moving phosphorus from iron. Water has been advocated as an agent for removing phosphorus, it being held that the hydrogen would combine with it, and pass off as phosphoretted hydrogen gas. This question was solved practically by pouring molten Cleveland iron into water, and carefully analysing the gases evolved, and also the metal before and after the treatment. The following were the results obtained, viz. :—

Pig metal.	Before.	After.
Phosphorus ..	1.48 per cent.	1.48 per cent.

*Analysis of Gases evolved from Molten Cleveland Iron in Water.*

Hydrogen .. ..	79.69 per cent.
Carbonic oxide .. ..	12.48 ,,
Marsh gas .. ..	4.87 ,,
Sulphuretted hydrogen ..	1.74 ,,
Carbonic acid .. ..	1.22 ,,
Phosphoretted hydrogen ..	none
-----	
100.00	

A considerable amount of sulphur was removed, the greater part of which was absorbed in the water. The metal lost half its sulphur by the operation.

And now, in concluding this paper, I would remark that, so far as our present knowledge goes, there is nothing to surpass in point of cost and efficiency the process of purifying by means of oxide of iron.

The process of adding fluid Cleveland iron to fluid oxides, first patented and made public by Mr. John Gjers, of this town, is now receiving thorough investigation by Mr. I. L. Bell, and I strongly believe it will become of great commercial value to this district eventually. The principal point of interest and importance in Mr. Bell's investigation is the discovery of the fact that, by acting upon fluid iron at low temperature with molten cinder, the carbon is not oxidised to any material extent, and that, in consequence, after the phosphorus is removed, the metal will remain sufficiently fluid to admit of being poured out liquid from the furnace, and removed in that state to a Siemens furnace or Bessemer converter for conversion into steel.

When the purification is conducted at higher temperatures, although the phosphorus may be as perfectly removed, there is also oxidised a considerable amount of carbon, and the purified metal will solidify at much lower temperature than that containing a larger proportion of that element.

Attention was drawn in the first part of this paper to a laboratory experiment in which fluid metal and cinder were violently shaken together in a crucible for about a quarter of a minute, by which treatment the metal was almost perfectly freed from phosphorus. From this it was maintained that if a mass of impure metal could, by practical means, be sufficiently subdivided, and exposed in that state to fluid oxide, the phosphorus would be removed in an incredibly short space of time. Whether or not there exists any machine capable of producing such an intimate mixture, and, if not, whether such a machine can be produced, are questions which should demand the most serious consideration of our Cleveland engineers. The question is now essentially a mechanical one, and the future prosperity of Cleveland depends on its practical and satisfactory solution.

I myself am very sanguine that the time is not far distant when Cleveland ironstone will yield steel which will rank as high as that made from the pure ores of Spain and Cumberland.

**Application of the Microphone in Surgery.**—The microphone has been successfully employed in the detection of urinary calculi, and it may probably serve also to indicate the position of the fragments of projectiles.—*Les Mondes.*

NOTES FROM THE PARIS EXHIBITION.

THE METALLURGY OF PLATINUM.

WE have been favoured by some notes on the magnificent exhibits of Johnson, Matthey, and Co., of platinum and rare metallic preparations, at the Paris Universal Exhibition, 1878.

From these notes we learn that from the year 1800 to 1809 a relative of a present member of this eminent firm was employed in working upon platinum, and discovered the process for its treatment and consolidation, which, generally known as the process of Wollaston, has been until late years in use here, and up to the present time on the Continent. The first apparatus of platinum ever made for the concentration of sulphuric acid was completed in December, 1809, and was supplied to some works now existing near London. The weight of platinum used in this apparatus was 423 ounces.

The work of this firm in connection with this valuable metal may be summed up under the following heads:—

*The Metallurgy of Platinum.*—The separation and production in a state of purity of the metals, rare and precious, of which the native ore chiefly consists, viz.:—Platinum, ruthenium, iridium, rhodium, osmium, palladium, large quantities of which are now in the Exhibition in a state of great purity.

*The Fusion of Platinum* by the process first commercially brought to notice by MM. H. St. Claire Deville and Debray in about the year 1856. By the fusion of pure sponge platinum (instead of its simple compression, uniting it by forging under the old system, which must always produce metal more or less porous) it is obtained in a condition of the most perfect compactness, strength, and durability, and of increased resistance to the action of acid. Messrs. Johnson, Matthey, and Co. melt ingots of pure platinum of any weight up to 10,000 ounces.

*The Patent Autogenous Soldering* (i.e., the joining together of platinum by means of the oxy-hydrogen blow-pipe).—Experiments with a view to carry out this process were begun in the year 1859, perfected in 1860, and have since been adopted by the firm for all important work. The boilers, &c., shown in the London Exhibition of 1861 were all manufactured upon this system. It is manifestly more advantageous that the whole should be equally durable and uniformly of the same metal, without the inequalities and disadvantages which do and must always exist with gold soldering. The absolute perfection and superiority of this process over the old method have been proved by the results of working more than 160 concentrating boilers, of capacities varying from 20 to 180 gallons. By the old system of working up a still from one piece of metal (which is, however, only practicable with small sizes), that portion of the apparatus which requires most strength, the bottom and lower portion of the sides, is necessarily the thinnest, whereas the dome and upper portion of the sides, where least strength is necessary, becomes the thickest, thus causing an absolutely useless and detrimental waste of metal. When under the old system gold-soldered joints are used for the larger-sized vessels, this evil is only partially mitigated, whilst the use of gold involves extra and useless cost to the purchaser, who has to pay not only for the gold employed at three times the price of platinum, but also for the double thickness of that metal where unnecessary, without in the smallest degree adding to the durability or effective working of the apparatus. The new system is therefore based upon true metallurgical principles, the whole of the apparatus being rendered more perfect and solid than by the old process, with the great advantage of the thickness of metal being regulated in accordance with the relative wear and tear of its various parts.

*Apparatus for the Concentration of Sulphuric Acid.*—The first sulphuric acid still made in 1809 was of a deep

circular form, and was worked under a leaden chamber. Since that time boilers and pans of different sizes, some entirely of platinum, and some with leaden hoods, were in use up to the year 1855, the principle being to have a deep layer of acid, digested for a considerable time. In 1855 Messrs. Johnson, Matthey, and Co. showed in the Paris Exhibition a still constructed upon the principle of running through in a continuous stream a shallow layer of acid of about two inches in depth, the drawing for which had been prepared by the eminent chemical engineer, Mr. W. Petrie. In 1862 they again exhibited an improved apparatus on the same general principles, but with an arrangement by which the acid was drawn from a compartment in the centre of the vessel, by a tube connected through its side with the cooler.

A writer in a German contemporary remarks that this process of working with corrugated rectangular boilers has had astonishingly favourable results. The flat layer of acid sliding on the corrugated surface is forced, by the effect of the partitions placed in the vase a little above the bottom, and produces thus a continual concentration at 66° full, which in the other known systems does not take place in the great generality. By the employment of this new system there is said to be an economy of 50 per cent in the first saving of platinum, of 70 per cent in the cost of attendance and general labour, and 48 per cent in the consumption of fuel.

*Alloys of Platinum.*—The preparation of the alloys of platinum of this firm, especially of the alloy with 10 per cent of iridium, demand special attention. They show a metre rule in course of construction by the system of "planing" instead of the method of drawing through plates, being the most effectual for obtaining mathematical exactness of shape and perfect purity. They also show a finished kilo. standard weight, of the density 21.52.

The following also deserve attention from visitors to the Exhibition:—Platinum and Gold Pyrometer to determine the degree of heat in the boiler.—Laboratory Alembic for making hydrofluoric acid, &c.—Platinum Assay Apparatus.—Square and Round Platinum Serpentine of extraordinary workmanship, shown as specimens of the perfection of autogenous soldering.—Platinum Tube, 500 centimetres long, in one piece, diameter 0.05 m.m.—Palladium Tube and Ingot.—Pure Palladium Mass, weight 65½ kilos., value 260,000 frs. (£10,400), extracted from about 125,000,000 frs. worth of native platinum and gold.—Pure Palladium Disc, in which nearly a thousand times its volume of hydrogen gas has been occluded. This volume of gas would be represented by a column nearly 2000 m.m. high, and 100 m.m. diameter. Original diameter of flat disc of metal, 100 m.m.; diameter after the charging of gas, 102.5 m.m.; the concavity having been caused simply by the absorption of gas; original thickness, 2 m.m.; thickness afterwards, 2.2 m.m.; original weight, 187.3775 grms.; weight afterwards, 188.2882 grms.—Platiniferous metals, viz., pure ruthenium, 2 kilos. (compressed ingot), value 40,000 frs.; pure rhodium, 2 kilos. (melted ingot); pure osmium, 2 kilos.; pure iridium, 2 kilos. (melted); pure palladium, 2 kilos. (forged ingot).—Fine Wires of the metals, gold platinum, palladium, silver, copper, iron, aluminium, each of 0.001 in. = 0.025 m.m. diam., 1 kilometre of each, weighing as under—

Gold .. .. .	18.66	grms.
Platinum .. .. .	20.0	„
Silver .. .. .	10.16	„
Copper .. .. .	8.50	„
Palladium .. .. .	15.50	„
Aluminium .. .. .	3.0	„
Iron .. .. .	7.0	„

The Rare Metallic Preparations exhibited include osmic acid, hypo-ruthenic acid, platinocyanide of magnesium, sodio chloride of rhodium, &c.

## PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL  
SOCIETY.

Annual General Meeting, April 30, 1878.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

THE following gentlemen were elected Officers of the Society and Members of the Council for the ensuing year:—

*President*—James Prescott Joule, D.C.L., LL.D., F.R.S., F.C.S.

*Vice-Presidents*—E. W. Binney, F.R.S., F.G.S.; E. Schunck, Ph.D., F.R.S., F.C.S.; R. A. Smith, Ph.D., F.R.S., F.C.S.; H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

*Secretaries*—J. Baxendell, F.R.A.S.; O. Reynolds, M.A., F.R.S.

*Treasurer*—C. Bailey, F.L.S.

*Librarian*—F. Nicholson, F.Z.S.

*Other Members of the Council*—Rev. W. Gaskell, M.A.; R. D. Darbishire, B.A., F.G.S.; W. B. Dawkins, M.A., F.R.S., F.G.S.; B. Stewart, LL.D., F.R.S.; C. Schorlemmer, F.R.S.; W. E. Axon, M.R.S.L., F.S.S.

"The Distribution of Ammonia," by Dr. R. ANGUS SMITH, F.R.S., &c.

If organic matter is everywhere, ammonia is everywhere possible, and if that matter is decomposing, ammonia is everywhere. This is the general statement which this paper illustrates. It is now many years since it was observed by me that organic matter could be found on surfaces exposed to exhalations from human beings; but it is not till now that the full significance of the fact has shone on me, and the practical results that may be drawn from it in hygiene and meteorology. These results are the great extension of the idea that ammonia may be an index of decayed matter; the idea itself has been used partly and to a large extent, as illustrated in my "Air and Rain." The facts now to be given enable us to claim for it a still more important place. The application seems to fit well the conditions already examined, and by this means currents from foul places have been readily found. This does not apply to the substances which may be called germs, whether it be possible to see them or not, because these are not bodies which have passed into the ammoniacal stage, although some of them may be passing; those, for example, which are purely chemical and exert what we may call *idiolytic* action. This word may serve to mark this peculiar action, which was left by Liebig unnamed; he used the vague term invented by Berzelius, namely, catalytic. I have elsewhere recognised the two classes of germs, instead of any disputed one, without naming them.

It is now many years since Liebig first surprised me by saying that iron ores and aluminous earths were capable of taking up ammonia, and if they were breathed upon we were able even to smell that substance. He, much about the same time, made numerous experiments in order to find the ammonia of the atmosphere, and to measure its amount in rain. The result for science was great, and Professor Way continued the enquiry for the Royal Agricultural Society. Dr. Gilbert, F.R.S., amongst his many labours in the department of agricultural science, has made this enquiry into ammonia of rain in still later times, but I shall not at present quote his results, as this paper does not intend to go fully into the subject, but rather to indicate its magnitude and importance. The first paper I ever read to this Society was on the ammonia found in peat: I was unable then to see the extent of the subject.

I shall give parts of the fuller paper without the long tables of results.

Ammonia must ever be one of the most interesting of

chemical compounds. It comes from all living organisms, and is equally necessary to build them up. To do this it must be wherever plants or animals grow or decay. As it is volatile, some of it is launched into the air on its escape from combination, and in the air it is always found. As it is soluble in water it is found wherever we find water on the surface of the earth or in the air, and probably in all natural waters, even the deepest and most purified. As a part of the atmosphere it touches all substances and can be found on many; it is in reality universally on the surface of the earth, in the presence of men and animals, perhaps attached more or less to all objects, but especially to all found within human habitations, and we might also add, with equal certainty, the habitations of all animals.

If you pick up a stone in a city, and wash off the matter on the surface, you will find the water to contain ammonia. If you wash a chair or a table or anything in a room, you will find ammonia in the washing; and if you wash your hands you will find the same: and your paper, your pen, your table-cloth, and clothes, all show ammonia, and even the glass cover to an ornament has retained some on its surface. You will find it not to be a permanent part of the glass, because you require only to wash with pure water once or twice, and you will obtain a washing which contains no ammonia. It is only superficial.

This ammonia on the surface is partly the result of the decomposition of organic matter continually taking place and adhering to everything in dwellings. The presence of organic matter is easily accounted for, but it is less easily detected than ammonia. It is probable that the chief cause of the presence of ammonia on surfaces in houses and near habitations is the direct decomposition of organic matter on the spot. If so, its presence, being more readily observed than organic matter itself, may be taken as a test, and the amount will be a measure of impurity. A room that has a smell indicating recent residence will, in a certain time, have its objects covered with organic matter, and this will be indicated by ammonia on the surface of objects. After some preliminary trials, seeing this remarkable constancy of comparative results and the beautiful gradations of amount, it occurred to me that the same substance must be found on all objects around us, whether in a town or not: I therefore went a mile from the outskirts of Manchester, and examined the objects on the way. Stones that not twenty hours before had been washed by rain showed ammonia. It is true that the rain of Manchester contains it also, but considering that only a thin layer would be evaporated from these stones it was remarkable that they indicated the existence of any. The surface of wood was examined—pallings, railings, branches of trees, grass (not very green at the time), all showed ammonia in no very small quantities. It seemed as if the whole visible surface around had ammonia. I went into the house and examined the surfaces in rooms empty and inhabited, tables, chairs, ornaments, plates, glasses, and drawing-room ornaments. A (Parian) porcelain statuette, under a glass, showed some ammonia; a candlestick of the same material (but uncovered) showed much more; the back of a chair showed ammonia, when rubbed with a common duster, very little. It seemed clear that ammonia stuck to everything.

If, then, ammonia were everywhere, the conclusion seemed to be that it was not at all necessary to do as I had been doing, namely, wash the air so laboriously; it would be quite sufficient to suspend a piece of glass, and allow the ammonia to settle upon it. For this purpose small flasks were hung in various parts of the laboratory, and they were examined daily. The flasks would hold about 6 ounces of liquid, but they were empty, and the outer surface was washed with pure water by means of a spray bottle; it was done rapidly, and not above 20 c.c. (two-thirds of an ounce) of water was used. This was tested for ammonia at once with the Nessler solution. The second washing produced no appearance of ammonia, done immediately. Ammonia could be observed after an

hour and a half's exposure at any rate, but I do not know the shortest period. The results of the washings were as follows; they are the average of 34 experiments for some, and 17 for others; in all 238 experiments:—

	Height from floor.	Ammonia.	Height from floor.	Ammonia.
	Ft. In.	M.gms.	Ft. In.	M.gms.
Front laboratory	7 3	0'013	4 2	0'019
Second landing	6 0	0'032		
Balance room ..	5 1	0'015	0 8	0'009
First landing ..	4 10	0'007		
Back laboratory	4 5	0'010	0 6	0'010
Entrance lobby	6 5	0'007		
Office .. ..	4 7	0'003		
Back yard ..	4 8	0'036	0 7	0'042
Back closet ..	2 3	0'105		
Midden .. ..	—	0'572		

The first three belonging to the working laboratory are not very regular, as we might suppose, but they never rise very high, nor do they sink to the lowest. The rest, except the second, keep a remarkable similarity, and the differences are very great. In the second there is a disturbance caused by sweeping the floors. On the other days it was requested that everything should be kept still. This of course brings in a practical difficulty, and limits the use of the test to cases where care can be used and thoughtful observation, since there are many ways by which dust may be made to interfere, even although the act of sweeping should not take place. The house experiments gave similar gradations.

The result seems to be that a piece of glass, of a definite size, hung up in any place, will receive deposits of ammonia, or substances containing ammonia, in a short time; and by washing the ammonia off with pure water, and testing it with a Nessler solution, it may be seen whether there is too much or not. It is the simplest test for ammonia yet found. Its discoverer deserves great thanks. It must not be forgotten that we may have ammonia in very different conditions; it may be pure, or it may be connected with organic matter. This mode of enquiry is better suited as a negative test to show that ammonia is absent, than to show what is present. When ammonia is present there may be decomposing matter; when absent there is not. I am hoping to make this a ready popular test for air—a test for sewer-gases,\* for over-crowding, for cleanliness of habitations, and even of furniture, as well as for smoke and all the sources of ammonia. Of course it must be used with consideration and the conclusions must not be drawn by an ignorant person.

How far it may be used as a test of climate is a matter to be considered also.

After this I made another series of trials with air, Nesslerising the washings at once, and not after laborious distillings, as in former cases: the results are very valuable, showing that we obtain comparative quantities equally in this way.

The amount of ammonia obtained in this ready way does not give exactly the same results as the more laborious methods which I have used, but it may be taken as the most convenient. It must be observed that the amount rises exactly where you might expect more organic matter to exist. The lowest is from Prince's Road, outside the town, and almost a half a mile from the extreme of the Manchester houses. The next is obtained from an empty yard behind my laboratory, but it is still pure because there was wind and rain; and anyone who observes how unusually pleasant it is to breathe air even of a smoky town during wind and rain will not be surprised. I have not yet, however, had the purest air. I shall require to make a campaign on the moors, hills, and seas before I can give numbers for this. I have not even obtained the best given on land at a distance from manufactures. All this will be done in time.†

\* For sewage also to a larger extent than it has yet been used.

† Since the paper was read I examined trees and stones at Skelmorlie and Wemyss Bay, finding very little ammonia.

In my office the amount is larger than outside, but the air is not so bad as it is in front, and not so good as sometimes in the front where it is open. From the back of the laboratory during fog the ammonia was much higher, but during one day it was excessive, and a special examination of it was made in several streets. The highest amount was obtained at the front of the Cathedral, about mid-day, on the 8th of February, 1878, when the amount was 1'25, or 14½ times more than it had been found in Prince's Road, showing a considerable range:—

	M.grms. of Ammonia per cubic metre of air.
Prince's Road .. ..	0'086
Open yard during rain .. ..	0'119 and 0'102
Front of laboratory .. ..	0'167 ordinary
Office .. .. .	0'167
Front and back during fog ..	0'476
Close shut up room .. ..	0'413
Closet outside .. .. .	0'800 to 0'900
Densest part of fog .. .. .	1'25

## CORRESPONDENCE.

### TELEPHONIC REPEATER.

To the Editor of the Chemical News.

SIR,—Allow me to state that the telephonic repeater described by Messrs. Houston and Thomson in your issue of June 21st was invented by me over a year ago, and one of the many forms devised by me was published in the *Journal of the Telegraph*, July 15, 1877, and also in the *Telegraphic Journal*, of London, about the same date.—I am, &c.,

T. A. EDISON.

Menlo Park, N.J., July 8, 1878.

### BLOWPIPE CANDLES.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxviii., p. 14) is an article by an American writer on blowpipe candles, in which no mention whatever is made of the blowpipe candles described by me at pp. 45, 48, "Pyrology." May I ask Mr. Casamajor, through your columns, if he has ever seen or heard of that book?—I am, &c.,

W. A. ROSS.

London, July, 18, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 1, July 1, 1878.

On Sulphuric Saponification.—E. Fremy.—The author describes his former researches on the decomposition of neutral fatty bodies by treatment with sulphuric acid, and adverts to the extensive industrial application of his discoveries.

System of Telephone without Electro-magnetic Organs based upon the Principle of the Microphone.—Th. du Moncel.—Hitherto the microphone has only been regarded as a telephonic transmitter, there being scarcely any suspicion that it might constitute a receiver

destined to reproduce to the ear the sounds transmitted by an apparatus of the same kind. A microphone suitably arranged speaks distinctly, though less strongly than the telephone, and the ordinary microphone itself can reproduce to the ear the sounds resulting from mechanical vibrations produced upon the board supporting the apparatus. Thus scratchings upon the board, the trepidations and sounds occasioned by a musical-box placed upon the microphone are distinctly heard. The mercurial telephone of A. Breguet requires no electro-magnetic apparatus, and emits sounds by the vibrations resulting from the oscillations of the mercurial column. But in the apparatus in question the effects produced are much more extraordinary as the vibration destined to produce them can only result from variations in the intensity of a current closed by the intervention of imperfect contacts, and to hear the sounds it is sufficient to place the ear against the stand upon which the charcoals are mounted.

**Thermic Researches on the Chromates.**—M. Morges.—It results from the author's experiments that the electrolytic decomposition of the chromates is not comparable to that of the alkaline sulphates. The quantity of heat which remains confined, according to the researches of M. Favre, ought to be 28,000 calories; but it does not exceed 12,500. The chromates, from a thermic point of view, seem more analogous to the carbonates, for which the confined heat does not exceed 21,000 calories.

**Single Liquid Battery becoming Depolarised by the Action of the Atmosphere.**—M. Pulvermacher.—In this battery the atmospheric air is employed as a natural depolarising agent, without the use of any artificial chemical oxidising agent, and gives a relative constancy to the element. The exciting liquid (dilute sulphuric acid, caustic potassa, or sal-ammoniac) is placed in a porous cylindrical vessel; the positive metal is formed of a rod of amalgamated zinc immersed in the liquid, and the negative element is formed of fine silver or platinum wire coiled round the cylinder. The spirals of silver wire are too remote from each other for the production of capillary action, and the wire is at an infinity of points in contact with the liquid exuding from the porous vessel. The rapidity of depolarisation is such that, on closing the circuit (resistance of 10 ohms) during ten minutes, the electromotoric force diminishes by about 16 per cent, and returns to its original value in three minutes after opening the circuit.

**On Trichloric Acetal.**—H. Byasson.—Trichlor-acetal is a transparent mobile liquid, of a peculiar odour, staining paper like the fatty bodies. It boils at 197°; its sp. gr. = 1.288. It is sparingly soluble in water, but miscible in all proportions with alcohol, glycerin, common and acetic ether, chloroform, benzol, and the formenic carbides. Hydrochloric acid is present among the products of its combustion.

**On Ethoxyacetonitrile.**—T. H. Norton and J. Tcherniak.—This compound is a colourless, very mobile liquid, of a peculiar but agreeable odour and burning taste. It is sparingly soluble in water, but miscible with alcohol and ether in all proportions. It boils at 132° to 133° under a pressure of 758.5 m.m. Its sp. gr. at 20° = 0.9093. Alcoholic potassa decomposes it at the boiling-point with disengagement of ammonia.

**New Method of the Formation of Ethylic Glycolate.**—T. H. Morton and J. Tcherniak.—Glycolide is sealed up in tubes with an equivalent quantity of absolute alcohol, and heated for several hours to 200°; the operation is complete when the glycolide has entirely disappeared. The contents of the tubes are diluted with water, and carbonate of potassium is added, enough to separate all the ether which floats upon the surface of the saline solution. It is dried and distilled. The yield is almost theoretic.

**Action of the Hydrochlorates of the Amines upon Glycerin.**—J. Persoz.—In view of a question of priority

which may possibly arise the author refers to a sealed paper deposited at the Academy in February, 1876, containing an account of his first observations.

**Anærobiosis of Micro-organisms.**—M. Gunning.—The author has previously recommended ferrous ferrocyanide as an extremely sensitive reagent for oxygen, and has by this means shown that the apparatus and media in general use for the culture of micro-organisms cannot be freed from oxygen by the methods usually recommended for this purpose. These observations throw a legitimate doubt upon the experiments serving as the basis of the doctrine of anærobiosis, and he has therefore repeated these experiments with the necessary precautions. He has made use of glass vessels sealed at the lamp, in which the largest possible quantities of putrescible matter were placed in contact with minimal quantities of oxygen. Urine, blood, meat-broth, yeast-water, &c., in a recent state were infected with bacteria taken from similar substances in full putrefaction. The vessels were then sealed and exposed to a temperature of 38° to 40°. Putrefaction was at once set up, but was definitely arrested in every case after a longer or shorter time—often very short—but always sensibly proportionate to the quantity of oxygen supposed to be present. The author attributes the cessation of putrefaction solely to the death of the bacteria caused by the absence of free oxygen. If the vessels containing putrescible matters terminate on one side in tubes fitted with a plug of wadding or coiled round several times, the point being drawn out to a fine point and sealed at the lamp, we may, at any desired moment, by breaking the point, expose anew the putrescible matters to the contact of atmospheric air, deprived, however, of germs. If the substances have been allowed to reach the state of complete inertia air no longer produces the least phenomenon of putrefaction, or of appreciable alteration. Blood, however, forms an exception, as it undergoes an alteration similar to that described by Pasteur in his "Études sur la Bière," p. 49, effected without the aid of organisms. This experiment seems to prove not merely that the bacteria as well as their germs are dead, but that the organic matters are not capable of spontaneously producing others. These experiments furnish the most conclusive proofs against spontaneous generation.

**Emissive Power and the Different Kinds of Heat which Certain Bodies Emit at the Temperature of 100°.**—Prof. Villari.—There is for each body a thickness possessing a maximum emissive power. This thickness varies with the substances, being from 3.45 m.m. for powdered rock salt to 0.03 m.m. for Indian ink. The thickness varies also with the aggregation of the matter; thus, for lamp-black deposited directly it is 0.200 m.m., whilst it does not exceed 0.069 m.m. if the lamp-black has been previously stirred up with sulphide of carbon. As the same laws extend to the absorbent power of bodies, thermoscopes, in order to produce their maximum effect, should be covered with a layer of lamp-black 0.2 m.m. in thickness. Different bodies have different thermic and thermo-chroic emissive powers—that is to say, if the heat emitted at 100° by each of them were visible they would all appear differently coloured with different intensities.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 9, June 27, 1878.

A quarry of lithographic limestone has been discovered in Algeria, at 8 kilos. distance from the port of Oran. The quality is declared equal to that of the stone from the old quarries of Munich, now exhausted.

The annual meeting of the French Association for the Advancement of Science will take place in Paris.

**Experiments on Capillarity.**—M. Röntgen.—According to Wilhelmy the density of a liquid is augmented by the contact of a solid body immersed in the liquid. The

author has repeated these experiments, and has weighed successively in a liquid a solid mass and the same mass broken into fragments, when the surface is augmented, and according to theory the weight of the body ought also to increase. The results of experiments made upon gypsum immersed in alcohol or in oil of turpentine and upon glass in alcohol are negative.—*Poggendorff's Annalen*.

**Quantitative Spectral Analysis.**—M. Vierordt.—In 1871 the author proposed to divide in two the slit of the spectroscop; the plates of one of the portions of the slit being set in motion by micrometric screws, which rendered it possible to equalise the spectrum of a light viewed directly through the narrow portion, and the spectrum of the light after its passage through an absorbent transmitted by the other portion. The intensity of the light, within the limits of experiment, is proportional to the width of the slit. At present he substitutes for this arrangement two others; in one the four plates of the slit are separately movable; in the other two of the plates are regulated by a screw, and move in opposite directions; the two others are separately movable. The errors of measurement are very trifling, and may be corrected by means of tables appended to the memoir.—*Poggendorff's Annalen*.

**Differences of the Affinities of Chlorine, Bromine, and Iodine.**—M. Kühlmann.—The author measures the quantities of heat evolved in the reaction  $M + R + xHO$ . M is a metal, R may be chlorine, bromine, or iodine, and  $x$  a very high number. He shows that if bromine and iodine are substituted for chlorine in aqueous solutions of hydracids or of haloid salts the differences of affinities as measured by the quantities of heat liberated are multiples of the number 5.350. The ratio of the differences of the affinities of chlorine to bromine or of chlorine to iodine is 2 to 5. This number recurs, though less distinctly, in other reactions. It is the simple proportion of  $\frac{7}{5}$  and  $\frac{5}{3}$  with the numbers 18.725 and 13.375, which, according to Thomsen are often met with in analogous experiments.—*Poggendorff's Annalen*.

**Quantitative Spectral Analysis.**—M. Hüfner.—The two halves of the slit of the spectroscop are illuminated by two pencils of rays, one of which traverses the absorbent, whilst the other can be darkened at pleasure. As source of light a petroleum lamp is employed placed in the focus of a lens; half of the pencil of rays falls at the angle of polarisation upon a mirror, which throws it back upon a parallel mirror not tinned, placed before the upper portion of the slit; a Nicol's prism fixed before the eye-piece serves to decrease the polarised pencil without acting upon the other. Before the lower part of the slit is fixed a double prism formed of a prism of transparent glass and one of smoked glass. It is rendered equal with the Nicol's prism, and the absorption corresponding with a given rotation is deduced once for all. This instrument gives chemical indications as precise as can be desired.—*Journal für Prakt. Chemie*.

**Researches upon Fluorescence.**—M. Brauner.—Solar rays are caused to fall upon two rectangular prisms of crown glass cemented together by their hypotenuse surfaces; on turning this system all the refrangible rays may be eliminated, e.g., as far as D. This light is concentrated by a lens upon the substance to be examined, and it is viewed through a system of two rectangular prisms of flint glass, cemented together by their hypotenuses, between which essential oil of cassia has been placed. The rotation of this system causes all the red rays to disappear, for instance, as far as D. White paper thus observed appears dark, but eosin and naphthalin red appear green, which confirms the results of Lommel. This arrangement of prisms gives more light than the ordinary spectroscop.—*Wiener Anzeiger*.

No. 10, July 4, 1878.

The Guinard prize of 10,000 francs has been awarded to Prof. Melsens, of Brussels, for his researches on the

use of potassium iodide in combatting saturnine and mercurial affections.

Chemiker Zeitung.  
No. 23. June 6, 1878.

**Chemical Industry at the Paris Exhibition.**—Dr. C. Deite.—The author complains of the admission of many small articles, which must certainly rank as chemical products, but which mark no advance in science, especially inks, blacking, and varnishes. In the French department there are about twenty exhibitors of blacking. Dr. Deite rejoices that the German Government refused to take part in the Exhibition, as a contrary conduct on their part would merely have tended *in majorem gloriam* of France. Next to the French department the English is the most important in point of space, and as it—thanks to the political constellations—enjoys relatively the largest space for all objects exhibited it is the easiest to overlook. Nowhere do chemical preparations present themselves to the eye of the beholder with such elegance as in the English department. "The American display is unexpectedly unimportant. This agrees ill with the prophecies so often uttered by the enthusiasts of protective duties that the chemical industry of America would soon prove a serious competitor for us in Europe."

**Preparation of Tungstic Acid.**—Dr. G. Thenius.—The author takes 50 parts of finely pulverised wolframite, and digests it in a flask upon the sand-bath with 2 parts of pure concentrated hydrochloric acid and one part of pure concentrated nitric acid, shaking it from time to time. It is then diluted with an equal quantity of distilled water and filtered, and the residue once more digested with aqua regia. It is filtered again, the residue washed upon the filter with distilled water, and digested with ammonia until the tungstic acid is completely dissolved. The whole is then thrown upon a filter, upon which a mixture of silicic and niobic acids remains. The filtrate after standing for twenty-four hours deposits a yellowish white precipitate. This is removed by filtration, and the filtrate evaporated to crystallisation. The crystals of ammonium tungstate thus obtained are heated in a flat porcelain capsule till the ammonia is expelled. The yield from 50 parts of the mineral proved to be 21 parts of tungstic acid.

Berichte der Deutschen Chemischen Gesellschaft,  
No. 8, 1878.

**Investigations on the Absolute Boiling-point.**—A. Ladenburg.—The author treats, first, lecture experiments, remarking that, although the researches of Cagniard Latour, Drion, Wolf, Mendelejeff, and Andrews are of great importance for a correct understanding of the relations between the state of vapour and that of liquidity, they seem scarcely to be noticed by chemists. As it has now become very desirable to introduce the main propositions of the kinetic theory of gases into lectures on general chemistry, it will be necessary to treat the relations between pressure and volume in gases and vapours more thoroughly. The law of Mariotte, or rather of Boyle, will not be sufficient; the signification of the isotherms will have to be explained, as also the interesting experiments of Andrews, which necessarily involves a consideration of the phenomena of the critical point or the absolute boiling-point. He then figures and describes an apparatus for the observation of the phenomena in question. The author then passes to a consideration of the methods for the determination of the absolute boiling-point.

**Nature of the Silicon Compounds Occurring in Plants.**—W. Lange.—The author has undertaken to prove what definite silicon compound occurs in the sap of a plant (*Equisetum hiemale*), and secondly of what

kind are the compounds peculiar to the cellulose, probably of all mature vegetable tissues which appear as an irremovable constituent of the ash. The silicic acid in the juice of the *Equisetum* is chiefly combined with magnesia, but the proportions which vary indicate a mixture of a silicate with free base. As regards the second question the author concludes that the constituents of the ash must be present in the texture of the plant in a state almost insoluble.

**Derivatives of the Phenylen-diamins.**—E. Wundt. —The author has obtained methenyl-ortho-phenylen-diamin by heating ortho-phenylen-diamin with formic acid, and is now engaged in preparing the ethyl compounds of the derivatives of ortho-phenylen-diamin by heating it with iodethyl.

**Aldehyd Derivatives of Amins and Ureas.**—Hugo Schiff.—An examination of the compounds formed by glyoxal and aniline; by glyoxal and meta-toluylen-diamin; glyoxal and benzidin; benzidin and acetaldehyd, valer-aldehyd, cœnanthol, furfurol, benzaldehyd, and silicyl-aldehyd; benzidin with anhydrous phthalic acid, urea, the mustard oils, and cœnanthol.

**Remarks on the Previous Treatise.**—A. Ladenburg. —A question of priority.

**On Methylen-methylamin.**—J. Romeny.—A preliminary notice. If trimethylamin is passed through a tube at dull redness in a current of hydrogen, a volatile base condenses in a refrigerated receiver.

**Constitution of the Hydrocarbon Formed from Triphenyl-methan-chloride by the Abscission of HCl.**—W. Hemilian.—A hypothetical paper.

**On a Base, C<sub>19</sub>H<sub>18</sub>N<sub>2</sub>.**—H. Böttinger.—Benzalchloride and ammonia in an alcoholic solution at common temperatures act upon each other very gradually. If the mixed solutions are heated to 100° in sealed tubes rapid decomposition sets in, sal-ammoniac and the oil of bitter almonds being formed. A very strong reaction ensues if a small quantity of zinc powder is thrown into the mixture, and the whole shaken up, the temperature being raised 45°. The base C<sub>19</sub>H<sub>18</sub>N<sub>2</sub>, described by the author on p. 276 of the *Berichte* is not a perfectly pure body. It was prepared by heating benzalchloride with aniline in sealed tubes, with or without zinc powder. Along with the base there are formed resinous bodies, which render purification more difficult. Recent experiments have shown that this base forms with benzol a double compound, sparingly soluble in benzol. The base, if heated with mercuric chloride in sealed tubes to 100°, or, with caution, in open tubes, yields a peculiar compound. The immediate product of the reaction is freed from excess of mercuric chloride by means of water, when a dark shining paste is formed. If treated with alcohol it dissolves, partially forming a reddish blue liquid, which dyes silk blue. The dried residue of the solution has a beautiful cupreous lustre, but has hitherto not been perfectly freed from mercury. Check experiments were conducted with the aniline and mercuric chloride employed, when a coloured fluid was obtained, but of far less intensity and tinctorial power. The author has also examined the products obtained by the action of benzalchloride upon dimethylanilin, orthotoluydin, and paratoluydin.

**On a Mono-brom-pyromucic Acid.**—The authors caused a molecule of brom to act upon pyromucic ether, and obtained an addition product, which, on treatment with alcoholic potassa, gives up hydrobromic acid, whilst the ether group is saponified, and an acid is obtained of the formula C<sub>4</sub>H<sub>2</sub>BrO · COOH.

**Certain New Double Compounds of Picramid.**—K. H. Mertens.—The author having obtained a large quantity of picramid, prepared from dimethylanilin by methods to be made known on some future occasion, confirms the observations of Pisani, Liebermann, &c., on its properties and melting-point. It crystallises in yellow transparent prisms with a fine violet reflection.

The melting-point is exactly 188°. If very cautiously heated beyond its melting-point in small quantities, it sublimes in long, pale yellow, plumose laminæ, with a greenish lustre. If re-crystallised from its pure yellow solution in alcohol the crystals melt at 108·5°. From a small quantity of benzol picramid crystallises in long sharply-pointed needles, but if the concentrated solution is left to itself for some time or allowed to evaporate spontaneously there are formed broad, transparent, pale yellow prisms, which, if taken out of the liquid and laid upon blotting-paper, effloresce in a few minutes and crumble down to a yellow powder. Analysis shows that there is here formation of a double compound, analogous to benzol-picric acid. Picramid combines also with toluol, forming brownish transparent needles, analogous in composition to the former compound, and consisting therefore of equal molecules of picramid and toluol. Picramid-anilin forms thick, black, shining, well-developed prisms, or very long needles with a deep purple reflection. If powdered the colour is a blood red. The author has also examined picramid-paratoluydin.

**Reduction of Ellagic Acid by Zinc Powder.**—L. Barth and G. Goldschmiedt.—Rembold had previously distilled ellagic acid with zinc powder, and obtained a hydrocarbon, which he named ellagen and to which he ascribed the formula C<sub>14</sub>H<sub>10</sub>. The authors have ascertained that it is identical with Berthelot's "fluoren," and have obtained and examined certain of its derivatives.

**Decomposition Products of a Gum Ammonia from Morocco Obtained by the Action of Melting Potassa.**—Guido Goldschmiedt.—The gum-resin in question is obtained from an umbelliferous plant (*Ferula tingitana*?) From its decomposition the authors obtained resorcin and a substance taking a splendid red colouration with ferric chloride, and probably identical with the compound obtained by Hlasiwetz and Barth on oxidising benzoin and gamboge with caustic potassa.

**Action of Bromine upon Disulphophenolic Acid.**—M. v. Schmidt.—The author has obtained the acid C<sub>6</sub>H<sub>5</sub>BrS<sub>2</sub>O<sub>7</sub>, and has examined its potassium, barium, lead, and silver salts.

**On Trisulphoxybenzoic Acid.**—M. Kretschy.—It seemed to the author interesting to submit meta-oxybenzoic acid to the action of sulphuric acid and anhydrous phosphoric acid under increased pressure. It was found practicable to introduce the SO<sub>3</sub>H group three times into the molecule of oxy-benzoic acid. Several of the salts of the new acid are described.

**On Bixin.**—C. Etti.—The author obtains bixin as follows:—1·5 kilo. of commercial annatto freed from leaves are digested in the water bath with 2·5 kilos. alcohol at 80 per cent to which 150 grms. soda-ash must be added, the temperature being maintained at 80°. The mass takes a brown colour, and is rapidly filtered while hot; the residue pressed between heated plates and again extracted with 1·5 kilo. of alcohol at 60 p. c. The filtrates from the first and second extraction are mixed together with the addition of half their volume of water, when a part of the sodium-compound separates out on cooling, the more complete precipitation being effected on adding the needful quantity of a concentrated solution of soda. After standing for some days the precipitate, which is crystalline, is collected upon a cloth, and freed by strong pressure from the mother-liquor. It is purified by re-crystallisation, and for this purpose it is dissolved in portions, in an excess of alcohol of 60 per cent, at the temperature of 70° to 80°; quickly filtered, the filtrate again, as above described, diluted with water when cold, and mixed with solution of soda. The deposit after a few days is collected upon a cloth, pressed, stirred up to a paste with dilute alcohol, and mixed with pure and tolerably concentrated hydrochloric acid till a distinctly acid reaction is obtained. The bixin now deposited is perfectly washed with water, pressed, and finally dried at 100°. For the

preparation of the other colouring matters of annatto, the liquids filtered from the deposits of bixin-sodium are employed. They are acidulated with HCl, when a red voluminous precipitate is formed, which is washed with water, pressed, dried at 20° to 30°, ground to a fine powder, and extracted with ether till the liquid runs off only very slightly coloured. On evaporation the ether leaves a reddish black resinous mass, which has not been examined. The portion insoluble in ether is amorphous bixin. The author then gives a description in detail of crystalline and of amorphous bixin.

**The Action of Iodine upon Guanidin Carbonate and Nitroso-guanidin.**—M. v. Rechenberg.—An account of experiments undertaken with the view of producing simple substituted guanidins, after having recognised the impossibility of obtaining the free guanidin bases in sufficient quantity.

**On Atmospheric Hydrogen Peroxide** (Fourth Communication).—E. Schöne.—The author gives, as his general conclusion, the following law:—The higher above the earth's surface the condensation of atmospheric aqueous vapour takes place, the richer in hydrogen peroxide is the resulting precipitate.

**Constituents of the Mineral Water found by Boring in the Eifel, near Pelm, at the Foot of the Casselburg.**—H. Vohl.—The author infers from his analysis that the water of this spring can never serve as a substitute for the Birresborn waters.

**Mineral Constituents of the Spring at Marpingen.**—H. Vohl.—This water can have no medicinal action.

**On the Plato-iodo-nitrites.**—L. F. Nilson.—The author on a former occasion showed that the plato-nitrites of potassium and barium, on treatment with iodine and alcohol, are converted—with simultaneous formation of aldehyd and ethyl nitrite—into products which may be regarded as plato-nitrites in which two NO — O groups are replaced by a molecule of iodine. The iodised derivatives thus obtained are true intermediate links between the plato-nitrites and the iodo-platinites.

**Action of Water upon Phosphenyl-chloride and on Simple Phenylated Solid Hydric Phosphide.** C<sub>6</sub>H<sub>5</sub>P<sub>4</sub>H.—H. Götter and A. Michaelis.—Not adapted for useful abstraction.

**Oxidation of the Sulpho-xylolic Acids** (Fourth Communication).—W. Iles and I. Remsen.—The authors declare that they have been in error as regards the connection between the two xylol-sulphamides and the acid obtained,

**Constitution of the Metaxylol-sulphonic Acids.**—Oscar Jacobsen.—A lengthy paper, incapable of useful abstraction, and containing various controversial passages directed against the conclusions of MM. Iles and Remsen.

**Remarks on the Memoir "On Chlorcymol from Thymol and Substances closely connected therewith."**—Ira Remsen.—The author points out an essential error in the reasoning of the memoir quoted.

## MISCELLANEOUS.

**Congrès International d'Hygiène, Paris.**—The Council of the Sanitary Institute of Great Britain have appointed a committee, consisting of His Grace the Duke of Northumberland, President; Mr. Edwin Chadwick, C.B.; Dr. Richardson, F.R.S.; and Dr. Long Marsh, to represent the Sanitary Institute at the Congrès International d'Hygiène in Paris from the 1st to the 10th of August next. During the Congress in Paris the Société Française d'Hygiène, with which the Sanitary Institute is affiliated, will entertain at a Banquet on the 9th of August the mem-

bers of the Sanitary Institute and their other Foreign Associates. Gentlemen desirous of attending the French Congress, whether members of the Institute or not, should apply to the Registrar, at 20, Spring Gardens, S.W., who will furnish them with the necessary Bulletin d'Adhésion, as supplied by the Committee of Organisation in Paris.

## NOTES AND QUERIES.

**Analyst for Australia.**—Can anyone inform me whether there is any probability of a young analyst obtaining a situation in Australia; either with an analytical chemist or in a mineral works, also in what part?—A CONSTANT READER.

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- V. Feeling and Energy; Alternate Affections of Matter. By W. S. Duncan.

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JOSEPH HERON, Town Clerk.

Town Hall, Manchester, 31st May, 1878.

MANCHESTER CORPORATION GAS-WORKS.—AMMONIACAL LIQUOR.—The TIME for RECEIVING TENDERS has been EXTENDED from the 1st of August to the 1st of October next.—By order of the Gas Committee,

JOSEPH HERON, Town Clerk.

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 975.

CONTRIBUTIONS TO BLOWPIPE CHEMISTRY.

THIRD PAPER.—MISCELLANEOUS NOTES.

By P. CASAMAJOR.

I. *The Shortest Pocket Blowpipe.*

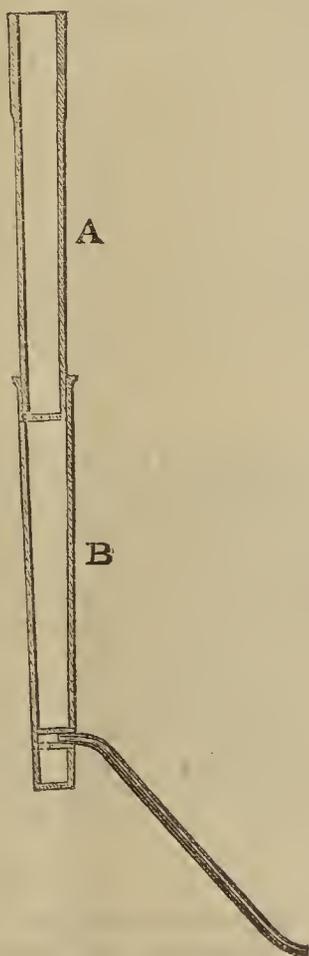
OVER two years ago I published in the CHEMICAL NEWS (vol. xxxiii., p. 50), and in the *American Chemist* (Dec., 1875), a description of a blowpipe, which, when packed for the pocket, has a length of  $4\frac{1}{2}$  inches, and, when adjusted for use, gives a length of 8 inches from the mouth-piece to the tip of the jet. This relation of  $4\frac{1}{2}$  to 8 was a trifle less than that of any pocket blowpipe that had previously been proposed.

In the above description, as published in the CHEMICAL NEWS, occurs the following:—"If the stem of the blowpipe is made in two pieces, while the jet is made with a double curve, the length, when put up for the pocket, can

FIG. 1 (full size).



FIG. 2 (scale  $\frac{1}{2}$ ).



be reduced to  $3\frac{1}{4}$  inches, which gives the still smaller ratio of  $3\frac{1}{4}$  to 8, which, I believe has never before been attained. I have one of these dimensions whose stem is formed of two conical portions with circular sections. When packed for carrying one cone fits into the other, and the curved jet fits within the inner cone."

As neither at the time of publishing the above, nor since then, have the figure or a detailed description of this blowpipe been given, I propose to give both now, as I believe that this blowpipe still enjoys the distinction of being, when packed for the pocket, the shortest ever

made. In Fig. 1 it may be seen in this condition, and in Fig. 2 it is shown as arranged for use.

In this figure we may see that the stem is formed of two conical tubes, A and B, of about the same length. The small end of A enters into the large end of B. The larger end of A is left open, while its smaller end is closed with a plate having a hole in its centre, to allow the passage of the air into B. The conical tube B is also open at its larger end, but closed by a plate at its smaller end. About half an inch from the smaller end is an opening in the tube B, made to receive a small piece of pipe, which is soldered to edges of the opening, and to a place inside of the tube B, diametrically opposite to the opening. This short piece of pipe, which serves as a socket to receive the jet, is provided with a hole, to allow the air to escape from the tube B into the jet.

A blowpipe of this kind is very easily made by taking two ordinary jeweller's blowpipes, which cost about 15 cents a-piece, and filing off the curved portion. There remain two straight conical tubes, which are placed one within the other. We may then cut from the outside tube a piece about 3 inches long, from which we make the tube A. At the smaller end is soldered a perforated plate. From the inside tube we make the pipe B, by closing its smaller end with a plate, and by putting a ring around its larger end. This ring answers the purpose of stiffening this end and keeping its shape true, and it also serves to take hold of when the tube B is to be drawn out of the tube A (see Fig. 1). The perforated plate at the smaller end of A is also designed to keep this end from deformation. It also serves as a diaphragm with a small perforation to divide A from B, which allows the stem to be divided so as to leave a lower chamber, which some think is an advantage in the case of the blowpipe of Gahn, commonly ascribed to Berzelius or Plattner.

It may be noticed in the figures that the larger end of A is made thicker than the rest of this tube. This extra thickness represents a silver tube soldered over the brass tube in the part that enters in the mouth.

The jet is made from a piece of brass tubing. Before curving it, it should be filled with rosin, to prevent it from collapsing. This jet should be made to fit very accurately in a larger piece of tubing, which is afterwards soldered in the tube B, to serve as a socket for the jet, as shown in Fig. 2. To prevent the jet from dropping out of the inner tube, this is closed with a cap, the edge of which is shown in Fig. 1.

II. *Charcoal Borers.*

In his excellent work "On the Use of the Blowpipe in Chemical Analysis and Mineralogical Determinations," Berzelius gives a charcoal borer, which is remarkable for its extreme simplicity. It consists in a conical tube of tin plate, open at both ends, these ends being sharpened with a file, so as to present two circular edges. By using either the larger or smaller end of the cone we may bore holes of two different sizes in charcoal. The diameter of the larger end is about half an inch, and that of the smaller about a quarter of an inch.

This borer is not generally known, those of Plattner being the only instruments of the kind in general use. These have the advantage of making a hole more quickly, and they never leave a core, which, in the case of the tubular borer, has to be removed afterwards with some care. Plattner's large borer gives a cavity with a rounded bottom like that of a crucible, which is often an advantage. These borers of Plattner are somewhat expensive, and also quite difficult to make, so that if a chemist was in a locality where they could not be bought he would not find it an easy matter to make them for himself.

I have been using, for several years, a form of charcoal borer which works with great rapidity and perfection, and which is of the easiest construction. The holes made by this borer are cylindrical, or slightly conical, with flat bottoms. Quite lately I have devised another form which gives cavities with curved bottoms like Plattner's large

borer, and which is also of the simplest construction, so that any one may, with little trouble, make one for himself.

The first of these forms is the conical tin tube of Berzelius, with two modifications, one of which consists in making each base of the tube not a complete circle, but

FIG. 3.



about three-quarters of a circle, as represented in Fig. 3, the object of which is to facilitate the removal of the core, as will be explained. The other is that the edges of each end are not like the edge of a knife, as in the tube of Berzelius, but like the edge of a saw.

FIG. 4.



FIG. 5.

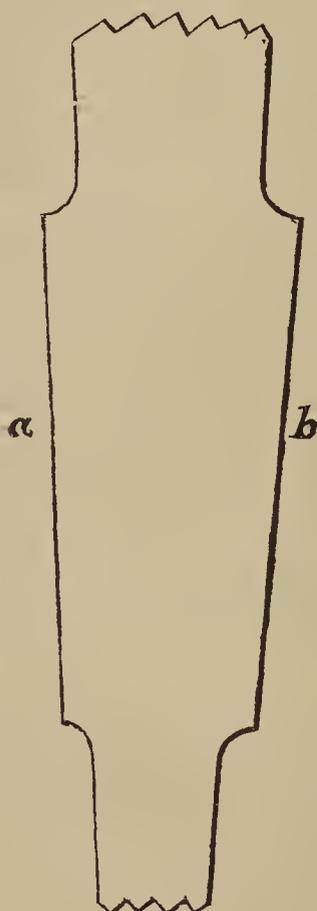


Fig. 4 represents a side view of this borer. At each end of the tin tube it may be seen that a portion, about a quarter of the metal, has been cut away. The middle portion of the tube is left entire, and the edges at this portion should be brazed or soldered together to ensure stiffness. Fig. 5 shows the shape of the sheet metal from which the borer is made. The edges *a* and *b* are to meet or overlap, and are to be brazed or soldered together.

This borer gives well-shaped holes with remarkable quickness. When the hole has been made deep enough the core is easily detached by pressing the tube against it, so that the core is pushed into the free portion of the groove, which corresponds to the part which has been removed from the conical tube.

If a borer of this kind is made with a large diameter, so as to leave a thick core which is not easily detached, a smaller hole may be bored in the core with a smaller instrument, after which the core is easily broken up and removed.

By alternately bending the teeth at the bases of the

cone outwardly and inwardly, as in the operation called *setting* for carpenter's saws, a wider groove is left around the core, which is more easily detached when the borer is of large size.

The charcoal borer which gives cavities with curved bottoms is made by cutting a plate of metal so as to give it the shape shown in Fig. 6, and bending over perpendicularly to the surface of the plate the portions at each end

FIG. 6.



FIG. 7.



which project beyond the dotted line. These projections are bent in opposite directions, as shown in Fig. 7. The dotted lines which show the outline of the borer form an ogive, which gives a good-shaped cavity. The portion beyond the dotted line which is bent perpendicularly to the face of the plate, as we have already said, should have its edges sharpened with a file, to enable the borer to work more rapidly.

By pressing this borer against a piece of charcoal, and turning it alternately to the right and to the left, a good cavity is obtained in a very short time. Borers of this kind should be made of pretty stout metal, as otherwise they become twisted by use. Tin plate known in the trade as *three cross* is sufficiently thick for the purpose.

### III. Sheet-Iron Supports.

I have been using for some time pieces of sheet-iron for supporting substances before the blowpipe flame. Sheet-iron presents several advantages for this purpose, in being very common everywhere, in costing little or nothing, and in being durable, so that the same piece may be used over and over again many times. We cannot on a plate of this kind exhibit the action of fluxes which attack iron, but we may see with distinctness the rings or deposits that are given before the blowpipe flame by antimony, zinc, bismuth, &c.

We may also obtain copper, lead, silver, tin, bismuth, &c., in the metallic state by the reducing flame, particularly in presence of carbonate of soda or cream of tartar.

To use sheet-iron as a support it must, in the first place, be rubbed with a piece of pumice or of Bath-brick

and water, until the plate looks bright. Thereby all dirt left by a previous operation and all rust are removed. Before placing anything for testing on the plate it is advisable to blow the blowpipe flame on it for a few seconds, when it becomes covered with a shining dark grey coat of magnetic oxide, on which the rings or deposits are seen with distinctness. We may, if we think preferable, cover the plate with a coat of soot, by holding it in the flame of a lamp or candle. On this coat the deposits take place equally well.

I generally use the thinnest sheet-iron obtainable, which is the kind on which are taken the photographs called *ferrotypes*. Sheets of this thickness are easily bent into any convenient shape. They may be used over and over again without any perceptible diminution of their thickness.

Iron has the advantage of being relatively a poor conductor of heat, which property enables us to hold in the hand one end of a piece of sheet-iron not more than 4 inches long, while the other end is in the blowpipe flame. If a handle is found necessary, the piece of sheet-iron may be held in a cork provided with a cut in which to insert it.

If we should want to use charcoal, I may point out that we can use a metallic plate as a charcoal holder, by making two slits crossing each other at right angles, and bending the four tongues obtained in this way, about perpendicularly to the surface of the plate. In a hole thus made in the plate it is an easy matter to hold tightly a small piece of charcoal by bending the four tongues more or less. The ring formed by the action of the flame may extend beyond the charcoal on the metal plate. This is in imitation of the plan proposed by Prof. Le Neve Foster, of using a plate of unglazed porcelain provided with a cavity for holding a piece of charcoal.

We may, instead of this, make a cavity in a piece of sheet-iron by indentation, and fill it with a paste made by mixing the substance to be tested with an excess of charcoal powder or black flux and a little water. After heating the mass, we may obtain the metallic particles by triturating in a mortar with water, and washing away the residuary carbon. If deposits are formed they will be found on the sheet-iron around the cavity.

#### IV. Alloys of Lead and Tin.

The reactions presented by alloys of lead and tin before the blowpipe flame are of such interesting nature that I need no apology for bringing them to your attention. I am not aware that the behaviour of these alloys has been specially noticed, with the exception of a brief note in an excellent paper, by Prof. Chapman, of the University of Toronto, "On some Blowpipe Reactions," in *CHEMICAL NEWS* (vol. xxxv., p. 13). In the ninth section of this paper, relating to alloys, occurs the following:—"Lead and tin unite readily, but the globule commences immediately to oxidise, throwing out excrescences of white and yellow oxide. On removal from the flame it still continues in ignition, and pushes out further excrescences. The unoxidised portion, if any, is malleable."

The reactions presented by alloys of these two metals had already attracted my attention when this note was published, as I wrote at the time to Prof. Chapman, in the course of a lively but very friendly correspondence on the occasion of his strictures on Turner's test for boracic acid.

The following experiments illustrate the points of interest in alloys of lead and tin: they were all tried with 6 decigrms. of alloy made from pure lead and pure tin:—

*Experiment 1.*—Melted together 3 decigrms. of lead and 3 decigrms. of tin. By continuing the heat before the blowpipe the alloy gives small bunches of excrescences, resembling cauliflowers. After a while the excrescences increase progressively as the blowing continues. They are at first white, afterwards yellowish. Finally, the whole mass resolves itself into cauliflowers of deep orange colour. During the formation of these excres-

cences copious white and yellow fumes are given out and deposited on the charcoal.

*Exp. 2.*—The 6 decigrms. of alloy are formed of 4 of lead and 2 of tin. In this case the reaction is violent from the very first. The bunches of cauliflower, of a deep yellow colour, are formed as soon as the metals are heated. On ceasing to blow, the reaction goes on in a lively manner. Thick fumes are given out and deposited on the charcoal.

*Exp. 3.*—The 6 decigrms. are formed by taking 4 of tin and 2 of lead. In this case the cauliflowers only begin to form in small bunches of white colour after persistent blowing. Fumes are given out slowly, and a malleable button is left.

*Exp. 4.*—Lead, 5 decigrms.; tin, 1 decigrm. After blowing a short time the deep yellow cauliflowers form, until the whole mass is oxidised. The reaction is apparently less violent than in Exp. 2.

These experiments show that when the lead is double of the tin the reaction takes place with more energy than with any other proportions. This is worthy of attention, because the atomic weight of lead (207) is nearly double of the atomic weight of tin (118). It makes it probable the deep yellow cauliflower-like excrescences are a stannate of lead. These reactions, with an alloy in which the weight of the lead is double that of the tin, also show that this alloy, when heated, absorbs oxygen with exceeding avidity, which fact may find future applications.

Although an alloy of these proportions absorbs oxygen with great avidity, Experiment 4 shows that an excess of lead does not seem to interfere in a marked degree with the reaction.

Experiments 1 and 3 were made with excess of tin, which, contrary to what takes place with lead, interferes with the formation of the excrescences.

In Experiment 3 the tin was in large excess, and the reaction was very indistinct.

A point of interest in connection with these reactions is, that although tin does not give any fumes, and that those given out by lead are very slight, alloys of these two metals give fumes which are excessively abundant, and which might mislead a person who is not on his guard to believe that zinc or antimony are present.

As both lead and tin are ordinary blowpipe reagents it may be as well to suggest that, when either of these bodies is suspected in a metallic substance to be tested, the addition of the other may furnish useful evidence. As the specific gravity of lead is 11.4 and that of tin 7.5, we may, without weighing, get approximately at the quantity of either of these metals to be added, by estimating the volume.

As an application of the foregoing I may mention that the bright foil called tin-foil—which is so extensively used in this country for wrapping around substances to be used for food—must, from its behaviour before the blowpipe, contain about twice as much lead as tin. I have not determined these proportions quantitatively.

In some works on the blowpipe it is mentioned that when a button of tin is strongly heated before the blowpipe, it continues to burn after the flame is withdrawn. I have never been able to obtain this reaction with pure tin, but it takes place readily when lead is present with the tin in sufficient quantity. The tendency to oxidation is so great in a button of alloy in which the weight of lead is double that of tin, that I do not believe that even the most expert operator would be able to keep a button of this kind from oxidation in the most perfect reduction flame that could be obtained.

#### V. Reactions for Iodides, Bromides, and Chlorides.

Several years ago Von Kobel observed that when sulphide of bismuth is heated on charcoal with iodide of potassium, a bright red coat of iodide of bismuth is obtained. From this he proposed a mixture of equal parts of sulphur and of iodide of potassium for the detection of bismuth, which he succeeded in finding in a mineral,

accompanying joseite, in which it had never been suspected. Prof. Cornwall, shortly after, proposed the same reaction for the detection of bismuth in presence of lead and antimony.

The ready formation of iodide of lead, by heating a plumbic compound with the mixture of sulphur and iodide of potassium, induced me to try the detection of iodine by heating an iodide with powdered galena. The characteristic yellow coat of plumbic iodide is deposited as soon as the flame touches the mixture. By heating chloride of sodium with galena an abundant white coat of oxychloride (?) of lead is deposited. With bromide of potassium and galena a white deposit of plumbic oxybromide (?) is obtained. When iodides, bromides, and chlorides occur together it is not possible to separate them by the use of galena, as a yellowish white coat is deposited when an iodide is mixed with either a bromide or a chloride, from which I have found it impossible to separate the yellow from the white.

If, however, instead of galena, we use a mixture of sulphur and bismuth, in connection with a mixture of an iodide with a chloride, we will obtain a yellowish coat, and beyond this red streaks. At first this result is not very promising, as the yellowish deposit resembles a mixture of iodide of lead with chloride of lead. But if we let the plate cool, and afterwards heat the yellowish deposit very slowly and carefully, the yellowish coat will separate into an outer ring of bright red iodide of bismuth, and an inner ring of oxychloride (?) of bismuth, which on cooling becomes perfectly white.

If we try the same experiment with a mixture of bromide and iodide the result is not quite so satisfactory, for although the yellowish coat—resembling that of the preceding case—becomes white on heating, the heat necessary for this causes the iodide of bismuth to be driven beyond the plate, and, although the red fumes are distinctly seen to escape, the red iodide does not remain as a witness on the plate. We may, however, by using an open tube, and by placing the mixture to be tested at one end of this tube, drive the mixed fumes of oxybromide (?) and iodide of bismuth up the tube. If afterwards we heat slowly and carefully the deposit near the end of the tube to which heat was previously applied, the white oxybromide (?) will remain, and the bright red fumes of the iodide will be driven further up the tube and deposited on its sides.

By means of a mixture of sulphur and bismuth we may, then, separate iodine from bromine and chlorine, but the separation of bromine and chlorine from one another is not possible with sulphide of bismuth.

### THIRD REPORT

#### ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.\*

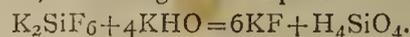
(Continued from vol. xxxvi., p. 47).

#### Estimation of Potash.

ALTHOUGH the process of determining potassium by precipitation with chloride of platinum is the method almost universally adopted by chemists of large experience in the assay of commercial potash salts, the Committee thought it desirable to investigate also the volumetric method of Stolba, which is based on the precipitation of potassium

\* Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen. Presented at the Plymouth meeting.

as silico-fluoride and the titration of the precipitate with standard alkali, according to the equation—



This process is thus described on page 176 of the seventh English edition of Fresenius's "Quantitative Analysis":—

"To the moderately concentrated solution of the potash salt in a beaker add a sufficiency of hydro-fluosilicic acid, and then an equal volume of pure strong spirit. The silico-fluoride of potassium will separate as a translucent precipitate. When it has settled, filter, wash out the beaker with a mixture of equal parts strong spirit and water, and wash the precipitate with the same mixture till the washings are no longer acid to litmus paper. Put the filter and precipitate into the beaker previously used, treat with water, add some tincture of litmus, heat to boiling, and add normal alkali solution till the fluid is just blue, and remains so after continued boiling."

With a view of preparing pure chloride of potassium for these researches, the Committee abandoned the method employed last year in favour of a simpler process suggested in a note appended to the last report:—

Commercial chlorate of potassium was re-crystallised and heated until no more oxygen was evolved, and the product was dissolved in water, filtered, a few drops of hydrochloric acid added to the clear solution, and the whole evaporated to dryness, and ignited in a muffle at a low red heat. The product was powdered and bottled. When heated on clean platinum wire in a Bunsen flame it gave no trace of yellow colour to the flame.

35 grms. of this pure salt were dissolved in 315 grms. of pure water, in order to make a solution containing exactly one-tenth of its weight of pure chloride of potassium.

In the following investigation a roughly measured quantity of this solution was run into a beaker and the exact weight taken. This method was adopted during the experiments of last year in preference to pipette measurements which were not considered satisfactory. The solution was first analysed by precipitation by nitrate of silver. The following table shows the quantities taken and the number of parts of KCl found for one hundred taken.\*

Number of Expt.	Weight of Solution.	Weight of AgCl.	KCl Found.	KCl found for 100 pts. taken.
A.	7.0805	1.3619	0.70850	100.06
B.	7.0275	1.3509	0.70278	100.00

The six following experiments were made by adhering strictly to the description of the process already quoted. A quantity of potassium chloride solution, containing about 0.7 gm. or 10 grms. of the salt, was used in each case. The standard alkali employed was very carefully prepared, and was strictly normal. It was not found practicable to wash the precipitate till the washings were no longer acid to litmus. The washing was therefore arrested when the filtrate gave no reaction with nitrate of silver:—

Expt.	Weight of Solution.	C.c. normal Alkali used.	KCl found per 100 pts. taken.
1.	7.1155	18.80 S.	98.54
2.	7.1100	18.83 P.	98.80
3.	7.0290	18.75 S.	99.90
4.	7.0190	18.75 S.	99.62
5.	7.1365	19.10 S.	99.56
6.	7.0210	18.70 P.	99.34

Although it was not to be expected that there could be any advantage in employing caustic potash in the titration instead of caustic soda, it was considered that the case was one in which it was just possible that there might be a choice, and therefore both alkalies were tried. The alkali employed in each experiment is distinguished by the letters P and S placed after the number of centimetres of normal alkali required.

\* The following are the atomic weights employed in the investigation:—K=39.137; Si=28; Ag=107.93; Cl=35.457; F=18.96.

In experiment 1 an excess of alkali was employed, and the liquid was then titrated back with sulphuric acid. It was hoped in this way to ensure the complete and speedy decomposition of the silico-fluoride, but the end of the reaction was very difficult to read, perhaps owing to the formation of silicate. It was also found to be no advantage to add the acid in sensible excess, and again titrate with alkali. In some cases decinormal alkali was employed towards the conclusion of the titration, but the end of the reaction is not sufficiently defined to make the precaution valuable. No. 2 can scarcely be considered a test experiment, for the precipitated silico-fluoride was dried on the filter, and then scraped off.

The next three experiments were made on about 1.5 grms. (twice the former quantity) of potassium chloride, the precipitated silico-fluoride being dried on the filter, scraped off, and weighed.

Expt.	Weight of Solution.	Weight of Precipitate.	KCl found per 100 pts. taken.
7.	15.0525	2.2150	99.77
8.	15.0475	2.2115	99.64
9.	15.0365	2.2070	99.52

These results do not show any great departure from the truth, especially as traces of the precipitate probably adhered to the filter, and were thus lost. The manipulation was very easy, filtration occurring rapidly, and the precipitate being easily washed, dried, and separated from the filter.

After weighing, the precipitates obtained in the last experiments were suspended in boiling water, and titrated with normal alkali, with the following results:—

Expt.	Weight of Precipitate taken.	C.c. normal Alkali used.	K <sub>2</sub> SiF <sub>6</sub> found per 100 pts. taken.
7. A.	2.2150	39.60 P.	98.40
8. A.	2.2115	39.60 S.	98.60
9. A.	2.2070	40.10 S.	99.95

In the last experiment the titration was slightly overdone. It appears, therefore, that the volumetric method gives results sensibly below the truth. Probably the error was greater in the last three experiments owing to the precipitates having been dried, and thus reacting less readily with alkali than the undried silico-fluoride. In these as in all other experiments the alkali was added very slowly towards the end of the reaction, and the liquid was well boiled after each addition.

Three more experiments by direct titration of the silico-fluoride with alkali gave the following results:—

Expt.	Weight of Sol. taken.	C.c. of normal Alkali used.	KCl found for 100 pts. taken.
10.	15.0525	40.10 P.	99.4
11.	15.0475	39.90 S.	98.9
12.	15.0365	40.10 S.	99.4

In these last experiments the large quantity of silica produced rendered the end of the reaction difficult to observe. In fact, the want of sharpness in the termination of the reaction is a serious defect of the process. A porcelain basin was found preferable to a beaker for conducting the titration.

Although in the above experiments the volume of alkali used was read to one-twentieth of a cubic centimetre, the end of the reaction could not be defined so closely, even after considerable practice. A difference of 0.1 c.c. in the volume of the standard alkali employed corresponds in the last three experiments to about 0.25 per cent of the chloride of potassium taken, and in the first six experiments to 0.5 per cent of the sample. As the quantity of potassium chloride worked on cannot be conveniently increased beyond the weights used in experiments 10, 11, and 12, it is evident that the process is not susceptible of great accuracy, even if no other disturbing influences existed.

The fact that the volumetric method gives results below the truth is probably due to the difficulty of decomposing

the last traces of silico-fluoride by alkali without introducing an excess of the latter. The trace of free alkali which suffices to change the tint of the litmus to blue seems incapable of reacting on the silico-fluoride. An attempt was made to overcome this difficulty by adding a sensible excess of alkali, boiling well, and titrating back with standard acid, but the result was not satisfactory, the end of the reaction being very obscure.

In practice it would be preferable to set the standard alkali by its action on moist silico-fluoride prepared from a known quantity of potassium chloride rather than to trust to its theoretical neutralising effect.

As the drying and weighing of the silico-fluoride requires but little more time than the titration with alkali, and gives better results, the gravimetric estimation is to be preferred. Although the process is not to be compared in accuracy to the precipitation and weighing of potassium as chloro-platinate, it might no doubt be advantageously employed in particular cases.

The next experiments were made on a mixture of 75 per cent of chloride of potassium with 25 per cent of chloride of sodium:—

Expt.	Weight of KCl Sol. taken.	NaCl taken.	C.c. normal Alkali used.	KCl found for 100 pts. taken.
13.	11.7505	0.375	42.95 S.	136.3
14.	11.7530	0.375	42.95 S.	136.3

These results show that 96.9 per cent of the total amount of alkali metal present was precipitated as silico-fluoride. In two other experiments of equal weights of potassium and sodium chlorides, 222 and 218 parts of KCl were found for 100 parts taken. The former number represents a precipitation of 96.8 per cent of the sum of the alkali metals present.

Two experiments were next made on mixtures of potassium and sodium chlorides by precipitating the solution with hydro-fluosilicic acid as before, but using a smaller proportion of spirit. One-third of the bulk of solution and wash-water consisted of rectified spirit, instead of one-half as in all previous experiments. The weights of the precipitates corresponded respectively to 169 and 188 parts of potassium chloride for 100 parts taken.

It is evident from these experiments that the process is quite worthless for the separation of potassium from sodium, and consequently that the number of cases in which it can be advantageously employed is greatly limited. Although this result was anticipated from the known properties of sodium-silico-fluoride, it was thought desirable to establish the fact by direct experiment.

Since the above experiments were completed the original paper of Stolba has been consulted. The author recommends the suspension of the precipitated silico-fluoride in a much larger quantity of water than was employed in the above experiments. This plan would cause the more perfect solution of the precipitate and probably yield somewhat higher results, but the author's experiments on pure potassium salts gave results sensibly below the truth. As the value of the process is greatly limited by its uselessness in the presence of sodium compounds, the Committee did not think it necessary to perform a fresh series of experiments with more rigid adherence to Stolba's directions.

(To be continued.)

#### Ferruginous Colouring Matter of Red Wines.—

A. Gautier.—The indigo-blue colouring matter mentioned by the author, *Comptes Rendus*, lxxxvi., p. 1507, contains more than 3.5 per cent of iron, and behaves in all its reactions as the ferrous salt of a red bibasic acid, slightly soluble in water, astringent, and very analogous to a tannin. M. Maumené, though he has not analysed this compound, seems to doubt the presence of iron in it. The cyanocyanine of Mulder is probably the impure ferrous salt of one of the red colouring matters of wine.—*Comptes Rendus*.

EDISON'S MICRO-TASIMETER.

WE are indebted to Mr. Edison for the following illustrated account of his latest invention, viz., the micro-tasimeter, or measurer of infinitesimal pressure.

The *Scientific American*, in which the account Mr. Edison sends us has already appeared, remarks that the

power of the most subtle of forces, must retire in favour of an instrument that can weigh that force.

The micro-tasimeter is the outcome of Mr. Edison's experiments with his carbon telephone. Having experimented with diaphragms of various thicknesses, he ascertained that the best results were secured by using the thicker diaphragms. At this stage he experienced a new

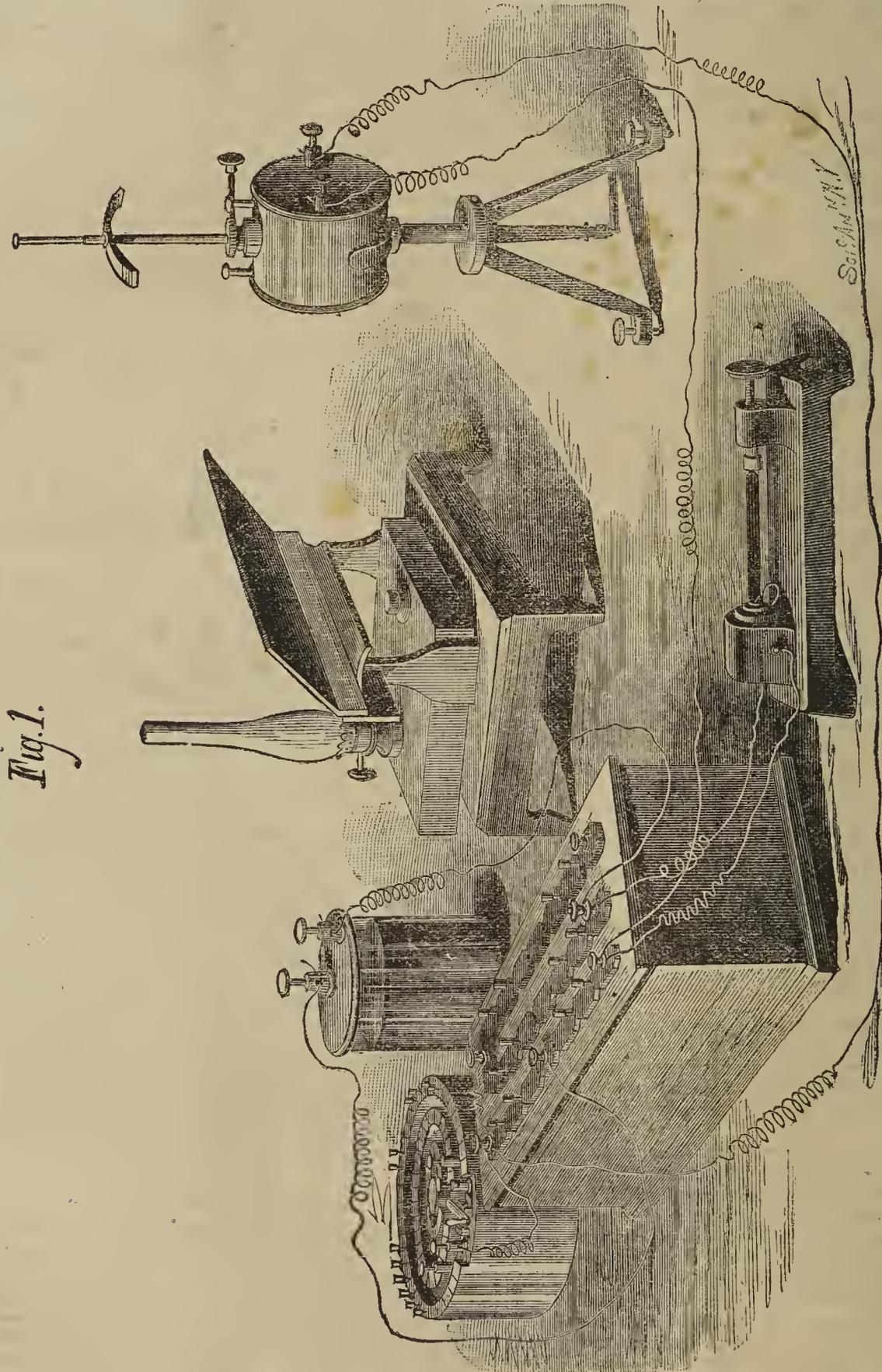


Fig. 1.

EDISON'S MICRO-TASIMETER.

thermopile, hitherto foremost among delicate indications of changes of temperature, must now be consigned to the rear ranks, and the radiometer, which exhibits the motive

difficulty. So sensitive was the carbon button to changes of condition, that the expansion of the rubber telephone handle rendered the instrument inarticulate, and finally

inoperative. Iron handles were substituted with a similar result, but with the additional feature of musical and creaky tones distinctly audible in the receiving instrument. These sounds Mr. Edison attributed to the movement of the molecules of iron among themselves during expansion. He calls them "molecular music." To avoid these disturbances in the telephone the handle was dispensed with; but it had done a great service in revealing the extreme sensitiveness of the carbon button, and this discovery opened the way for the invention of the new and wonderful instrument.

The micro-tasimeter is represented in perspective in Figs. 1 and 2, in section in Fig. 3, and the plan upon which it is arranged in the electric circuit is shown in Fig. 4.

The instrument consists essentially in a rigid iron frame for holding the carbon button, which is placed between two platinum surfaces, one of which is fixed and the other movable, and in a device for holding the object to be tested, so that the pressure resulting from the expansion of the object acts upon the carbon button.

Two stout posts, A B, project from the rigid base piece, c. A vulcanite disk, D, is secured to the post, A, by the platinum-headed screw, E, the head of which rests in the bottom of a shallow circular cavity in the centre of the disk. In this cavity, and in contact with the head of the screw, E, the carbon button, F, is placed. Upon the outer face of the button there is a disk of platinum foil, which is in electrical communication with the battery. A metallic cup, G, is placed in contact with the platinum disk to receive one end of the strip of whatever material is employed to operate the instrument.

The post B is about 4 inches from the post A, and contains a screw-acted follower, H, that carries a cup, I, between which and the cup G is placed a strip of any substance whose expansibility it is desired to exhibit. The post A is in electrical communication with a galvanometer, and the galvanometer is connected with the battery. The strip of the substance to be tested is put under a small initial pressure, which deflects the galvanometer needle a few degrees from the neutral point. When the needle comes to rest its position is noted. The slightest subsequent expansion or contraction of the strip will be indicated by the movement of the galvanometer needle. A thin strip of hard rubber, placed in the instrument, exhibits extreme sensitiveness, being expanded by heat from the hand, so as to move through several degrees the needle of a very ordinary galvanometer, which is not affected in the slightest degree by a thermopile facing and near a red-hot iron. The hand, in this experiment, is held a few inches from the rubber strip. A strip of mica is sensibly affected by the heat of the hand, and a strip of gelatin, placed in the instrument is instantly expanded by moisture from a dampened piece of paper held 2 or 3 inches away.

For these experiments the instrument is arranged as in Fig. 2, but for more delicate operations it is connected with a Thomson's reflecting galvanometer, and the current is regulated by a Wheatstone's bridge and a rheostat, so that the resistance on both sides of the galvanometer is equal, and the light-pencil from the reflector falls on 0° of the scale. This arrangement is shown in Fig. 1, and the principle is illustrated by the diagram, Fig. 4. Here the galvanometer is at g, and the instrument which is at i is adjusted, say, for example, to ten ohms resistance. At a, b, and c the resistance is the same. An increase or diminution of the pressure on the carbon button by an infinitesimal expansion or contraction of the substance under test is indicated on the scale of the galvanometer.

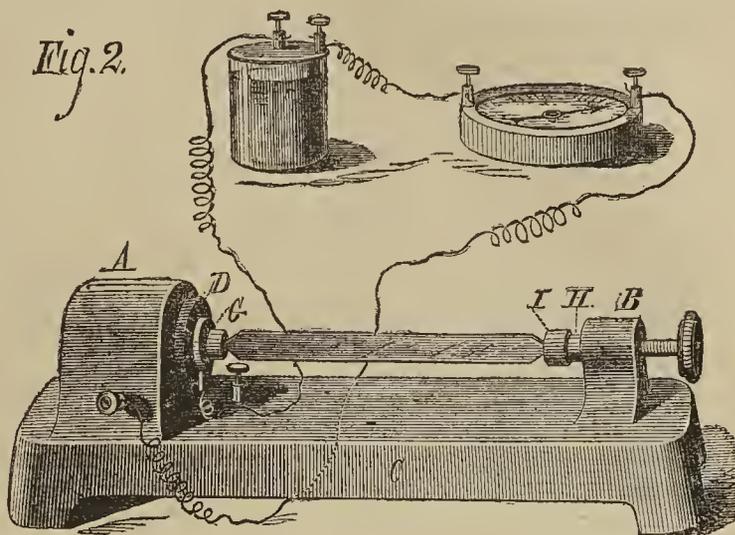
The carbon button may be compared to a valve, for, when it is compressed in the slightest degree, its electrical conductivity is increased, and when it is allowed to expand it partly loses its conducting power.

The heat from the hand, held 6 or 8 inches from a strip of vulcanite placed in the instrument—when arranged as last described—is sufficient to deflect the galvanometer-mirror so as to throw the light-beam completely off the

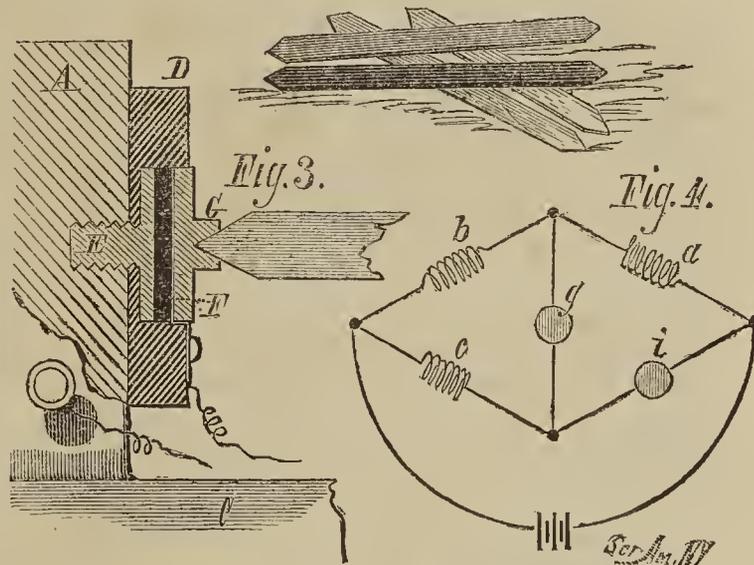
scale. A cold body placed near the vulcanite strip will carry the light-beam in the opposite direction.

Pressure that is inappreciable and undiscoverable by other means is distinctly indicated by this instrument.

Fig. 2.



Mr. Edison proposes to make application of the principle of this instrument to numberless purposes, among which are delicate thermometers, barometers, and hygrometers. He expects to indicate the heat of the stars and to weigh the light of the sun.



Speaking of this instrument, Mr. Edison says—"The heat-measurer was described and experiments shown to Professor Langley, the well known astronomer of the Alleghany Observatory, some six months ago. On his suggestion at the time, that it ought to be worked up as a very valuable boon to science, especially in the line he was investigating (that is, measuring the heat of the stellar spectra), I tried many experiments with it, and devised the form given. This apparatus was described to various members of the National Academy of Sciences, held at Washington, April 17, 18, and 19, 1878, and the Washington Star and Union newspapers published then gave a description of the instrument. Copies of these papers were at once mailed to William H. Preece, Prof. Schellen, Count du Moncel, and other physicists in Europe."

The Special Correspondent of the Daily News, at Rawlings, Wyoming, in his account of the Eclipse of the Sun on the 29th ult., says:—

"The tasimeter, the new instrument on which Professor Edison has been working unceasingly here, has proved its delicacy. During the eclipse he attached Thomson's galvanometer, the index being set to zero, when the telescope carrying the tasimeter was pointed several degrees from the sun. The point of light rapidly left the scale, when the corona was brought upon the fine slit by which

the tasimeter itself was protected. There was no chromosphere to speak of, and only one prominence, like the horn observed in 1868, but very dim."

## CORRESPONDENCE.

### DETECTION OF NITRIC ACID.

To the Editor of the Chemical News.

SIR,—I have lately ascertained that Sprengel anticipated me some time back in the application of carbolic and sulphuric acids for the detection of nitric acid, but his method of applying the reagents is different to the one I proposed. The latest edition of Fresenius contains a description of this test, and perhaps some editions not so recent as this, as I find it also in Galloway's "Manual of Qualitative Analysis," fifth edition. Both these works have only reached me lately.—I am, &c.,

DAVID LINDO.

Falmouth, Jamaica, July 8, 1878.

### THE ESTIMATION OF TANNINS.

To the Editor of the Chemical News.

SIR,—I shall be glad if you will afford me space for a brief note upon the article by Mr. H. R. Procter upon the "Estimation of Tannins," in the CHEMICAL NEWS, vol. xxxvii., p. 256. In this article Mr. Procter claims for Lowenthal the whole of the very quick and accurate method now employed to estimate the tannic only, when, as is usually the case, it co-exists with gallic acid. May I call your attention to the fact that in the CHEMICAL NEWS, vol. xxix., p. 109, appeared an article by me upon "Tea Analysis," in which I distinctly lay down the method (giving Lowenthal the credit due to him). It depends solely upon the precipitation with gelatin of the whole of the tannin in the compound under examination, and a titration with permanganate of potassa (with indigo as indicator), both before and after precipitation. For the special work I was doing it suited admirably, and performed in the cold, and with Lowenthal's additions of salt and acid in excess, is very accurate.—I am, &c.,

C. ESTCOURT.

The Analytical Sanitary Institution,  
8, St. James's Square, John Dalton Street,  
Manchester, July 30, 1878.

### WORKING UP OF NAPHTHALIN FOR USEFUL PRODUCTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxviii., p. 18), I read a letter of Mr. Watson Smith criticising my paper about naphthalin, some comments on which appear necessary to me.

Mr. Watson Smith takes exception to the form in which the discussion of naphthalin has been delivered, and seems not to agree with my having referred to the original sources and a number of patents. If Mr. W. Smith would kindly glance at the little preface of my papers on "Dyers' Chemicals" he would see that it was not my intention to deliver a complete theoretical paper, but only to give a short and intelligible *resumé* of the present state, the practical and theoretical questions, &c., of the principal tar products. The paper should be in a form in which it might have interest for non-chemists as well, and principally for these; and for this purpose I thought the quoting of "blue books" and patents desirable.

The principal point of the above-mentioned letter, however,

is Mr. W. Smith's complaint about my having taken up his field of research, "which honourably should be left to the worker." I can assure Mr. W. Smith that I fully acknowledge the existence of an "international understanding," and would be the last one to interfere with the researches on a theoretical problem of one of my colleagues. But I think, at the same time, that common sense has to be admitted as well for the forming of exceptions to the rule. It would be quite absurd to isolate questions of great importance for this industry by including them in this matter of etiquette, and to leave them entirely to the comfortable working of a single individual. Since the beginning of the manufacturing of artificial dyes, the naphthalin problem was a, or, better, the principal question being worked at by a great many chemists of this branch. What an enormous influence the solution of the naphthalin theme would have upon the whole coal-tar industry it is useless to mention. And such a burning question should be monopolised by a mere matter of etiquette? It should be left to the leisure of one man, who, by publishing results of some experiments, would keep the subject to his own use, at the same time perhaps convincing everybody by his non-results that in the ways he is following up a desirable deliverance of the question is not likely to be expected soon.

One thing, however, strikes me in Mr. Watson Smith's philippic. Since Laurent, or even Garden, in 1820, brought the first notes about the coal-tar naphthalin, that body has continually been worked at by a number of chemists. When Mr. W. Smith, "eight or nine years ago," began his researches on naphthalin he must have been aware of this subject being taken up by several of his colleagues, of whom I will only quote Messrs. Berthelot, E. Kopp, Vohl, and Ballo. It may well be asked how Mr. W. Smith, with his view of the case, could conscientiously interfere with the work of the above most eminent chemists?—I am, &c.,

J. MARZELL.

41, Woburn Place, Russell Square,  
London, W.C.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 2, July 8, 1878.

Action of Heat upon Aldol.—A. Wurtz.—The principal product is crotonic aldehyd; there is also formed a small quantity of ordinary aldehyd, and under certain circumstances a new polymer of aldehyd. The decomposition is sometimes effected at 140°, but in other cases not below 180°.

Influence of Atmospheric Electricity upon the Nutrition of Plants.—L. Grandeau.—The author, after a carefully conducted series of experiments, concludes that atmospheric electricity is a preponderating factor in the assimilative process in plants. Plants withdrawn from this influence by means of a "Faraday cage" elaborate in equal times, all other conditions being equal, from 50 to 60 per cent less of living matter than those whose growth has been effected in ordinary circumstances. Plants little raised above the soil are equally affected by atmospheric electricity. The percentage of proteic matter formed does not appear to depend on the action of atmospheric electricity, but remains proportional to the total crop. The percentage of ash is higher in plants protected from electric action, but the proportion of water is higher.

Curves of Solubility of Salicylic and Benzoic Acids.—E. Bourgoin.—The author has made a great

number of determinations of the solubility of these acids at different temperatures and expresses the result by curves.

**Diffusion of Fire-damp in Coal-mines.**—J. J. Coquil- lion.—In a former paper the author showed that fire-damp does not mix readily with air, and has a great tendency to keep in the upper parts of the galleries. He now finds that it requires three or four hours to reach the lower parts, even in small quantity, and complete diffusion requires a much longer time.

**Structure of Several Minerals.**—M. Gaudin.—The author proposes to submit to the Académie several studies which he has made on various minerals, throwing an important light upon their composition, their intimate crys- talline form, and rendering it possible to calculate—often with absolute precision—their principal angles, taking for the distance of the molecules from each other in a hori- zontal direction (lateral assemblage), or in a vertical direction (superposition), the atomic distance,  $\sqrt{2}$  atomic distance, the double or triple atomic distance—in a word, the atomic distance multiplied by a very simple number increasing with the diameter of the molecules.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*  
No. 8, 1878.

**The Atomic Weight of Glucinum.**—B. Brauner.—The specific heat of glucinum at temperatures between  $0^\circ$  and  $100^\circ = 0.4079$ . It is still, however, possible that the atomic weight of  $G = 9.2$  and that its oxide is  $GO$ . It is known that a large part of the elements with a small atomic weight, such as B, C, Mg, Al, Si, PS, at low tem- peratures, possess a smaller specific and atomic weight than should belong to them in accordance with the law of Dulong and Petit. The same is the case with the gases H, N, O, F. All these elements are distinguished by a peculiar position in the well known table of L. Meyer, which shows the dependence of atomic volume upon atomic weight (see *Die Modernen Theorien der Chemie*, 3rd edit., p. 311). A line marked in the table as "boundary of the law of Dulong and Petit" separates these elements, which at medium temperatures do not agree with this law, from the others. It is, therefore, not im- probable that, just as the elements  $B = 11$  and  $C = 12$  at low temperatures have atomic heats down to 2.5 and 1.7, or, between  $0^\circ$  to  $100^\circ$ , 3.1 and 2.5 instead of 6.5, so the contiguous element G (9.2) may have an atomic heat of merely 3.8, as would follow from the number found by MM. Nilson and Petersson. The results of the extensive investigations of M. Nilson on the platinum double salts of the rarer metals and their valence seem to testify that the atomic weight of  $G = 9.2$  rather than 13.8. It appears, further, from all experiments hitherto, that all elements, not excepting the rarer earth-metals, are capable of in- sertion in the periodic system of D. Mendelejeff and Lothar Meyer; whilst if we assume  $G = 13.8$  this system loses all significance, because their number almost coin- cides with the atomic weight of nitrogen. The author, therefore, concludes that the question of the atomic weight of glucinum can only be considered as finally decided when the vapour density of its volatile chloride has been ascertained.

**Para-chlor-benzyl-chloride and its Derivatives.**—C. Loring Jackson and A. W. Field.—Para-chlor-benzyl- chloride is no liquid, but forms white shining needles or prisms of a pleasant aromatic odour, and having a violent action upon the mucous membranes. Melting-point,  $29^\circ$ ; very volatile; sublimes at common temperatures. In- soluble in water, sparingly soluble in cold alcohol, though readily in hot; very soluble in ether, benzol, sulphide of carbon, and glacial acetic acid. If boiled with water it yields para-chlor-benzyl-alcohol and hydrochloric acid.

**The Atomic Weight of Glucinum: Reply to M. Lothar Meyer.**—L. F. Nilson and Otto Petersson.—The authors declare that it did not escape their notice that the atomic weight of the metal, 13.8, could not be con-

veniently adapted to Mendelejeff's system, but expected that this would become the subject of a scientific con- troversy. They have described the details of their ex- periments and conclusions in a paper about to appear in *Poggendorff's Annalen*. At present they merely point out some possible sources of error in the experiments of Reynolds, upon which the view opposed to their own is based.

**Frerich and Smith's Examination of the Salts of Lanthanum and Didymium.**—P. T. Cleve.—The author considers several of the statements of Frerich and Smith completely incorrect, and considers it remarkable the values found in their analyses agree exactly with numbers calculated from inaccurate formulæ.

**Difference of the Absorption Spectrum of One and the Same Substance.**—Hermann W. Vogel.—In the author's memoir (*Berichte*, vi., p. 622) he has shown by several examples that under different circumstances one and the same body may give absorption spectra of totally different characters. Further investigations on this sub- ject have shown that this peculiarity is an almost uni- versal property of all absorbent solid and liquid bodies, whether organic or inorganic; those substances which in the solid state give the same spectrum as in solution belonging to the exceptions. Hitherto the absorption spectrum of a salt or of a colouring matter has been sup- posed to signify the spectrum of its solution, assuming, often without further question, that it must be identical with that of the solid body, though examples to the con- trary were not unknown. This assumption can now be no longer maintained. For examining the spectra of solid salts and colouring matters the author employs thin strata obtained by evaporating a solution of the sub- stance upon glass plates or in watch-glasses. The results obtained could not be intelligibly described without the numerous diagrams of the original memoir.

**Sulphuretted Derivatives of Benzophenon.**—C. Engler.—The author examines the action of ammonium sulphide and potassium sulph-hydrate upon benzophenon.

**New Modes of Preparation and Certain Properties of Tetra-phenyl-ethan.**—C. Engler.—The author obtains tetra-phenyl-ethan from the pinakonoid sulphide of benzophenon from the chloride of benzophenon.

**Certain Derivatives of Acetophenon.**—C. Engler.—An examination of the sulfo-, brom-, and amido-deriva- tives of acetophenon.

**Behaviour of Quartz and of Silicic Acid in General with Microcosmic Salt.**—E. Laufer.—Quartz is pal- pably attacked by microcosmic salt at a red heat. Kaolin, if melted with the salt, yielded a bead which dissolved in water with the exception of a few traces. The deter- mination of quartz in this manner, therefore, is imprac- ticable.

**Chemical Action of Water and of Saline Solutions upon Zinc.**—A. J. C. Snyders.—Zinc decomposes saline solutions, whether dilute or concentrated, without the access of oxygen, hydrogen being liberated and zinc oxide formed. The solubility of zinc oxide in the solutions accelerates the action. The solubility of the metal varies in different salts, being greatest in those of ammonia. It seems to be determined by the formation of free alkali in as far as this, at a given temperature and con- centration can co-exist with a zinc double salt. Zinc hydroxide and carbonate are insoluble in carbonates. The solubility of zinc oxide increases with increasing concentration and rising temperature. When the saline solution is saturated with zinc oxide the decomposition proceeds, but the zinc oxide then formed remains undis- solved. On the access of oxygen free from carbonic acid the zinc oxide dissolves more rapidly, because the zinc is oxidised at the same time. The salt promotes this action, not as such, but only because it alters the surface. On the access of atmospheric carbonic acid the solvent action is somewhat delayed on account of the formation of basic

carbonate of zinc upon the metal. The decomposing and dissolving action is strongest for the chlorides and potassium sulphate, weaker for the nitrates of the alkalies and of barium and magnesium sulphate. Zinc, if air is excluded, does not act upon solutions of alkaline carbonates and sodium phosphate. If oxygen is present little zinc is dissolved by solutions of 1 per cent, the metal being protected by the coat of zinc carbonate or phosphate formed. In more dilute solutions some zinc oxide dissolves. The effect increases with the temperature, and at 0° it is very trifling. Ammoniacal solutions take up more zinc than the salts of the fixed alkalies. Hard spring waters do not act upon zinc, even when the percentage of chlorides and sulphates is considerable. Soft waters dissolve more the more the quantity of the chlorides, sulphates, and nitrates exceeds that of the carbonates and phosphates.

**Condensation Products of Tertiary Aromatic Bases.**—Otto Fischer.—A preliminary notice of the respective actions of dimethyl-anilin with oil of bitter almonds, furfural, chloral, and benzhydrol.

**Glycoside of Persian Berries, and on Rhamnodulcitol.**—C. Liebermann and O. Hörmann.—The glycosides and colouring matters of quercitron and of Persian berries are very near to each other. Identity, however, as Hlasiwetz conjectured to exist between quercitrin and xanthorhamnin and between quercetin and rhamnetin, is out of the question if both groups of compounds are directly compared. For this purpose it is sufficient to keep in view the respective solubilities. Xanthorhamnin dissolves readily in cold water, quercitrin only at a boil, and on the cooling of the solution it is at once deposited in distinct needles. Rhamnetin is scarcely soluble in water, but quercetin much more readily.

**On Phenyl-sulphocarbaminic Acid.**—B. Rathke.—Phenyl-sulphocarbamate of potassa is obtained by heating equal molecules of potassic xanthogenate and of aniline dissolved in alcohol for three or four hours with a reflux condenser. On cooling diphenyl-sulphurea separates out, whilst potassium phenyl-sulphocarbamate is deposited from the filtrate after concentration.

**On Sulphuretted Dicyan-diamin.**—B. Rathke.—This substance is decomposed by salts of silver and of other heavy metals into metallic sulphide and dicyan-diamid. At 100° conversion into guanidin sulphocyanide begins.

**Preliminary Communication.**—B. Rathke.—The author holds that he has come upon a base bearing the same relation to guanidin as does biuret to urea, and which may be named biguanid. Dicyan-diamin is intermediate between it and biuret.

**Meta-benz-bioxyanthraquinon and Anthraflavic Acid from Meta-oxy-benzoic Acid.**—E. Schunck and H. Römer.—The composition of meta-benz-bioxy-anthraquinon is expressed by the formula  $C_{14}H_8O_4$ . It melts between 291° and 293°; it congeals crystalline, and burns with a very luminous flame; it sublimes, leaving scarcely any carbonaceous matter. Iso- and anthraflavic acid do not melt at 330°. It is somewhat easily soluble in alcohol with a yellow colour, and crystallises from the solution in yellow anhydrous needles. (Iso-anthraflavic acid takes up crystalline water). Easily soluble in glacial acetic acid, in which anthraflavic acid and iso-anthraflavic acid are sparingly soluble. It is insoluble in water, but soluble in benzol, ether, and chloroform with a yellow colour. The solutions show no absorption-bands.

**On Cyan-guanidins (Second communication).**—O. Landgrebe.—An account of the action of aniline hydrochlorate upon  $\alpha$ -dicyan-triphenyl-guanidin; of that of tolydin hydrochlorate upon the same compound; of the behaviour of  $\beta$ -dicyan-triphenyl-guanidin with alkalies; and of dicyan-ditolylyl-phenyl-guanidin.

**Oxidation of Ditolylyl-parabanic Acid.**—O. Landgrebe.—The author obtains a bibasic acid by oxidising ditolylyl-parabanic acid with potassium permanganate.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*

No. 54, June, 1878.

The only paper in this issue relating to a chemical subject is derived from an English source, and has been read before the Society of Arts.

*La Correspondance Scientifique.*

July 2, 1878.

This paper appears to be chiefly devoted to physical and engineering questions. In the present issue we notice a detailed account of the controversy between Messrs. Hughes and Edison concerning the invention of the microphone.

*Reimann's Färber Zeitung,*

No. 25, 1878.

This issue is chiefly devoted to a notice of the colours and dyed and printed textile goods on view at the Paris Exhibition. Joly's process for carbonising vegetable impurities in woollen cloth is to be seen in its results, and appears not to injure the more delicate colours. The shades of Tussah silk, bleached and dyed according to Girard's process, are declared to be of finished beauty. A similar display in the English department has not the finish of the colours exhibited by the French manufacturers

No. 26, 1878.

We have here a continuation of the account of the Paris Exhibition. In the English department the colours shown by Messrs. G. Lowe; L. J. Levinstein and Sons; Brooke, Simpson, and Spiller; and Williams, Thomas, and Dower are particularly noticed. The absence of any specimens of dyed furs is remarked. The American display is pronounced to offer nothing worth notice, and the same remark is applied to Sweden and Norway. A Spanish collection of shaded woollen yarns far exceeds anything similar in the French department. Australia exhibits but little, though in fine woollen yarns it falls little short of the Berlin standard. Calico-printing in Russia has made great advances by the aid of foreign skill and protective duties.

No. 27, 1878.

The Swiss display in the Paris Exhibition is very interesting. J. R. Geigy, besides the ordinary aniline colour, exhibits diphenylamin in shining scales, methyl-blue and resorcin in crystals of the average size of soda crystals. The second side of his show-case contains ground dye-woods, extracts, and indigo substitute; the third, hæmatoxylin, eosin, cyanin, &c.; and the fourth, dyed silks. P. Monnet and Co. of La Plaine, near Geneva, excel in the blue shades of eosin (phloxin and cyanosin). They exhibit, also, aniline-scarlet, and a model of the autoclave for the production of methyl-chloride. Bind-schedler and Busch, of Bâle, exhibit the products of the alizarin manufacture, such as sublimed alizarin, anthracen and anthraquinon sublimed in splendid yellow crystals an inch in length; also eosin, methyl-eosin, and methyl-green in crystals of a coppery lustre. Freund and Merlanchon, of Bâle, exhibit phthalic acid in crystals eight inches long, resorcin in large crystals, fluorescein, eosin, both free and as a sodium salt (soluble in water), naphthylamin, Magdala red, nitronaphthalin, azo-dinaphthylamin, &c. Durand and Huguenin exhibit large crystals of phthalic acid, resorcin, and fluorescein, as also gallein and cœrulein, the recently discovered phthaleins of pyrogallallic acid. Gerber and Uhlmann exhibit large blocks of diphenylamin and the blues produced from it; also benzyl yellow, aniline grey, &c. Great praise is awarded to the Swiss silks.

No. 28, 1878.

In concluding the account of the Paris Exhibition the editor remarks that the French are fully aware of the

superiority of the Germans in dyeing, especially in woollen goods. The general character of the Exhibition is a want of novelty. The electric light is strongly recommended for use in dye works, as it permits colours to be compared as accurately as can be done by day-light.

### MISCELLANEOUS.

**Anniversaries of the Birth of Sir Humphry Davy and of Gay-Lussac.**—An American correspondent writes to remind us that the 17th of December is the hundredth anniversary of the birth of Sir Humphry Davy. Eleven days before, on the 6th, also occurs the hundredth anniversary of the birth of Gay-Lussac. The American Chemical Society propose to celebrate these two centennials in December, though in what manner has not yet been decided. One of these events being of special interest to English chemists, we venture to hope that it will not be allowed to pass by unnoticed. We shall be glad to receive any suggestions our readers may be able to send us with regard to the best form in which it could be celebrated in England.

**Another New Metal.**—According to the *Correspondance Scientifique* of July 30th, Dr. J. Lawrence Smith, Professor of Chemistry in the University of Louisville, Kentucky, has discovered a new metal belonging to the cerium group, and has named it mosandrium, after Mosander, whose researches on this class of metals are well known. The new earth mosandria, from which the metal was obtained, differs from the rest of the group of which yttria is the head by its reaction with potassic sulphate, although what this reaction is we are not informed. From cerium oxide mosandria differs by its solubility in very weak nitric acid and in alkaline solutions supersaturated with chlorine; from lanthanum by the colour of its oxide and salts, and from didymium by certain dark rays in the bright part of the spectrum. We shall refer at greater length to this discovery in our next number, giving, if possible, the physical and chemical properties of the new element.

**University of London.**—The following is a list of the candidates who have passed the recent First B.Sc. Examination:—*First Division.*—S. G. H. Barfield, private study; T. Beck, University College; J. A. B. Bennett, Downing College, Cambridge; G. J. Burns, Birkbeck Institute and private study; J. Easterbrook, M.A., University College; E. B. Stewart, B.A., private study; S. L. Hart, St. John's College, Cambridge; R. S. Heath, Trinity College, Cambridge; S. C. Hill, B.A., University College; T. Purdie, Royal School of Mines; E. H. Rennie, M.A. Syd., University College and Royal School of Mines; M. W. Richmond, University College; H. Somerville, University College and private tuition; J. H. Steel, private study; C. E. Stuart, University College and private study; F. L. Teed, University College and private study; J. C. Thresh, Owens College and private study; J. W. W. Waghorn, private study; J. R. Watson, Pannal and University Colleges; T. W. Williams, University College and Royal College of Chemistry. *Second Division.*—G. Haworth, T. Kernan, and A. F. Laloë, private study; W. Penhall, Trinity College, Cambridge; E. Radford and G. H. Whitelegge, University College. *Mathematics Only.*—J. W. Batterham, private study; A. H. N. Lewers, University College; J. D. E. Mortimer, Westminster Hospital.

### TO CORRESPONDENTS.

**F. B. Wilkinson.**—(1) The remarks on "Black-dyeing" in our issue of July 12 are taken from the *Moniteur Scientifique Quésneville*, July, 1878, p. 843. (2) The aluminate of soda test serves to detect logwood in a mixture of colouring matters, but in an adulterated extract of logwood the problem is reversed. We have to detect chestnut, &c., in logwood.

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# THE CHEMICAL NEWS.

VOL. XXXVIII. No. 976.

## THIRD REPORT

### ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.\*

(Concluded from p. 55.)

#### METHODS OF DETERMINING PHOSPHORIC ACID.

WITH respect to the general method of procedure in the assay of commercial phosphatic materials, the Committee has not thought it necessary to make any original experiments, the published and collected evidence on the subject being sufficient for the purpose.

As the result of a very careful consideration of the subject, the Committee make the following recommendations and suggestions. In most cases these are quite free from novelty; but as the evidence collected by the Committee and the results of many commercial analyses show that certain considerations and precautions are in many cases partly or wholly neglected, the Committee is of opinion that the general adoption of the following suggestions would tend greatly to diminish the number and extent of the discrepancies common in determinations of phosphoric acid.

#### *Solution of the Manure.*

The Committee is of opinion that for dissolving the soluble phosphate contained in a manufactured manure its water should invariably be employed. The water should be employed in successive small quantities, and the treatment and digestion with the solvent should not be extended over more than two or three hours. Hot water should be wholly avoided, both for the original extraction of the soluble matter and for washing the residue.

The neglect of the above precautions may cause an error in either direction. The effect of employing hot water for dissolving the soluble phosphate is shown by the fact that the cold aqueous extract of many superphosphates yields a precipitate on boiling. On the other hand, the di- and tricalcic phosphates undergo change on boiling with water, with partial solution in some cases.

For the solution of the portion of the manure insoluble in water, or for the determination of the total phosphoric acid, hydrochloric acid is the most suitable. In manures containing iron the addition of a few drops of nitric acid is desirable to ensure the complete peroxidation of any ferrous compound which may be present.

In manures containing silica the evaporation of the acid solution to dryness should never be omitted. The neglect of the precaution causes the precipitation of the silica at a subsequent stage, and is liable to cause a serious error. Another advantage of the evaporation to dryness is the partial elimination of any fluorine which may be present.

In cases in which much organic matter is present, iron and aluminium cannot be precipitated satisfactorily. In such cases the original sample or the residue insoluble in water should be ignited with an alkaline oxidising mixture before treating it with acid.

\* Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen. Presented at the Plymouth meeting.

Fresenius, Neubauer, and Luck\* have recommended the employment of dilute sulphuric acid for the extraction of the total phosphoric acid from a manure. The advantage claimed for this modification is that the iron and aluminium remain chiefly undissolved. As, however, a small and not very constant amount of iron undergoes solution, the advantage of this method is considerably diminished.

#### *Separation of the Iron and Aluminium.*

In all cases in which more than traces of iron or aluminium are present, the Committee is strongly of opinion that they should be separated. In the first place, several of the most satisfactory methods of determining phosphoric acid are vitiated by the presence of these metals; and, secondly, the manurial value of the sample is affected by their presence. It is therefore doubly important that they should not be ignored.

The removal of the aluminium and iron from the solution is readily effected by neutralising any excess of acid with ammonia and adding ammonium acetate, when iron and aluminium are thrown down as phosphates, which may be filtered off and weighed. The operation should be conducted in a cold or but slightly warm solution. If the liquid be heated a calcium phosphate is thrown down.

#### *The Oxalic Acid Method.*

In employing this method it is very desirable to previously separate iron and aluminium acetate. Besides the advantages already mentioned, this precaution renders it unnecessary to add an organic acid before precipitating the phosphate with magnesia. The use of an organic acid prevents the complete separation of the lime, oxalate of calcium being soluble in citrate of ammonium, and tends to falsify the subsequent precipitation with "magnesia mixture."

The presence of ammonium acetate facilitates rather than prevents the precipitation of the calcium as oxalate. On rendering the filtrate from the oxalate of calcium precipitate alkaline with ammonia, a small additional precipitation of oxalate of calcium may occur. If the solution of the manure has been made with acid, and subsequent evaporation of the acid liquid to dryness has been neglected, the precipitate here formed may contain silica or fluoride of calcium. If the separation of the iron and aluminium has been omitted, citric acid must be added before making the solution alkaline with ammonia. Of course, if a precipitate is formed at this stage, from whatever cause, it must be separated before adding "magnesia mixture."

#### *Direct Citric Acid Method.*

In this method the iron, aluminium, and calcium are all retained in solution by means of citrate of ammonium, and no attempt is made to separate the calcium as oxalate, but the phosphate is at once precipitated from the ammoniacal solution by magnesia mixture. Although in the hands of several chemists of high repute this convenient method gives very good results, the sources of error are too numerous to be wholly disregarded. Titration of the precipitate with uranium appears preferable to direct weighing.

#### *Precipitation with "Magnesia Mixture."*

Repeated experiments having shown that the employment of sulphate of magnesium for the precipitation of ammonio-magnesium phosphate is attended with considerable tendency to error, the Committee is of opinion that it should be definitely abandoned in favour of the chloride.

The volume of "magnesia mixture" employed for the precipitation should only be in moderate excess of the amount necessary to completely precipitate the phosphate present.

The use of a large excess of the precipitant causes a more rapid separation of the double phosphate, but is attended

with such a serious tendency to error that any advantage gained is more than counterbalanced. The precipitation should be conducted in the cold. The proportion of free ammonia in the liquid should be large.

If the above precautions are duly observed, and silica, fluorine, iron, and aluminium be previously removed, it will rarely be necessary to purify the precipitate by solution in acid and re-precipitation with ammonia. In re-precipitating, some "magnesia mixture" should be added, as its presence tends to reduce the solubility of the precipitate in the ammoniacal liquid.

In igniting the precipitate, the heat should be very gentle at first, and afterwards be raised as high as possible. If citric acid has been employed the ignited precipitate is often discoloured. This may be remedied by cautious treatment in the crucible with strong nitric acid, followed by re-ignition.

If the precipitate of ammonio-magnesium phosphate be titrated by standard solution of uranium instead of being weighed many of the above precautions are rendered superfluous.

#### Estimation by Uranium.

The removal of iron and aluminium by addition of an alkaline acetate in the cold, with determination of the phosphoric acid in the filtrate by means of a standard solution of uranium, is a method which, in the opinion of the Committee, deserves extended employment. The use of an acetate in a slightly acid solution brings the liquid into just the condition required for the use of the uranium process. The proportions of acetic acid and alkaline acetate employed and the volume of the solution should be approximately constant. The uranium nitrate should be standardised with an acetic acid solution of pure precipitated ammonio-magnesium phosphate or tricalcic phosphate, instead of with phosphate of sodium.

The titration should be *converse*, the solution of the phosphate being added to that of the uranium. The latter should be mixed with a constant proportion of acetic acid, and heated on a bath of boiling water. The indicator should be powdered potassium ferrocyanide on a white porcelain slab. Owing to the reversal of the usual process, the brown colour of the ferrocyanide of uranium becomes gradually fainter till the end of the titration.

#### Molybdic Acid Method.

Sonnenschein's process of precipitation with molybdic acid, with subsequent treatment with magnesia mixture and weighing as magnesium pyrophosphate, is probably the most uniformly accurate of all known processes for determining phosphoric acid. It appears always to be employed when great accuracy is desired, and some chemists use it habitually. In some respects, however, the process is not well fitted for general use, for the following reasons:—

A very large excess of molybdic acid, above that which is actually precipitated as "phospho-molybdate of ammonium," is required for the complete separation of the phosphoric acid of the solution. The reagent is somewhat expensive, and there is no simple process of recovering the molybdenum from the filtrate.

The yellow precipitate contains less than 4 per cent of anhydrous phosphoric acid, and thus becomes very bulky and unmanageable when the quantity of phosphoric acid present exceeds 0.1 or 0.2 of a gramme. This fact leads to the employment of very small quantities of the material, and, as the yellow precipitate has to be subsequently re-dissolved and precipitated with magnesia mixture in the ordinary way, the error liable to occur from the use of an usually small weight of the sample detracts greatly from the value of the method.

The above considerations, together with the loss of time and expense incident to the use of the process, prevent the Committee from recommending it for general adoption, though they are of opinion that in many instances

it may be used with great advantage, and that in some cases it is simply invaluable.

Pisani has described a method of determining molybdic acid by reducing its acid solution with zinc, and titrating the brown liquid with standard permanganate.

J. Macagno has proposed to apply this process to the determination of phosphoric acid by first precipitating the latter with "molybdate solution," and then titrating the molybdic acid in the precipitate in the above manner.

The Committee has instituted some experiments on this process, but the results were very unsatisfactory.

#### Reduced Phosphates.

It is well known that the soluble phosphate of some superphosphates has a tendency to pass back into the insoluble condition. It is plausibly argued that the finely-divided insoluble phosphate thus produced is equal in manurial value to the soluble phosphate originating it, and therefore that in judging of the value of the manure the insoluble "reduced" phosphate should be stated separately, and regarded as of equal manurial value to the actual soluble phosphate.

The methods which have been employed for the determination of "reduced" phosphate are based on the ready solubility of such precipitated phosphate in certain liquids or on its easy decomposition by certain alkaline salts. For its solution citrate of ammonium has been employed, and for its decomposition with formation of a soluble phosphate oxalate of ammonium\* or bicarbonate of sodium† is used.

A series of very suggestive experiments on Chesshire's bicarbonate of sodium and Sibson's oxalate of ammonium methods have been communicated to the Committee by Mr. M. J. Lansdell, and as they appear to show conclusively the valueless character of either of the above processes for determining "reduced" phosphates, the results are given in full. The samples were all passed through the same sieve, and the proportions employed were those recommended by the authors:—

	Sample contained (equal to $\text{Ca}_3\text{P}_2\text{O}_8$ ). Per cent.	Dissolved (equal to $\text{Ca}_3\text{P}_2\text{O}_8$ ). By Sibson's method. By Chesshire's method.	
		Per cent.	Per cent.
Cambridge coprolite	56.07	8.32	2.23
Bone-ash .. .. .	76.87	10.58	3.07
Navassa phosphate..	65.62	7.48	5.73
German phosphate..	60.74	8.04	2.09
Redonda phosphate (dried) .. .. .	87.42	19.72	56.97
Redonda phosphate (lump) .. .. .	86.58	19.10	64.65

By employing a solution of bicarbonate of twice the above strength, the Redonda phosphate gave equal to 84.3 of  $\text{Ca}_3\text{P}_2\text{O}_8$  in solution.

Using a smaller quantity of the sample in the oxalate method, 47.76 per cent passed into solution.

It appears, therefore, that reduced phosphates are indicated by each process even in natural phosphatic materials which have never been treated with acid, and hence the methods of determination are useless.‡

The same objections apply to the citrate of ammonium method, especially with respect to the phosphate of aluminium, known as "Redonda phosphate." It follows, therefore, that the latter comparatively cheap material would (if introduced into a superphosphate) be mistaken for and quoted as "reduced phosphate."

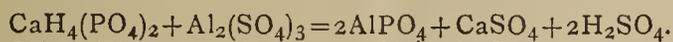
From the above considerations it appears that any known method of determining the reduced phosphates is purely arbitrary.

\* CHEMICAL NEWS, September 1869, p. 123.

† *Ibid.*, September 3, 1862, p. 111: Church's "Laboratory Guide," 3rd edition, p. 146.

‡ Mr. John Hughes has made experiments leading to a similar conclusion. CHEMICAL NEWS, xix., 229, and xx., 111.

It is now generally admitted that the cause of the "going back" to the condition of insoluble phosphate is the presence of iron or aluminium in the manure, and many chemists are of opinion that the "reduced" phosphates actually consist of the phosphates of iron and aluminium, produced by some such reaction as the following:—



At any rate, it is a fact that only manures containing iron and aluminium have a tendency to form reduced phosphates, so that the manufacturer has the remedy in his own hands—to avoid using mineral phosphate containing iron or aluminium.

In the analysis of mineral phosphates the proportion of oxide of iron and alumina is usually stated, but these constituents rarely appear in the analyses of "superphosphates" made therefrom.

It is generally held that the phosphates of iron and aluminium have a very limited manurial value, and this fact is a strong argument against the reduced phosphates being calculated into and credited as phosphate of calcium. The value of a manure so largely depends on the proportion of oxide and alumina present that the Committee is very strongly of opinion that the united percentage of these two bases in a manufactured manure (superphosphate) should always be stated. By doing so, the manufacturer or purchaser would be enabled to judge of the probability of a newly-made manure "going back" on keeping, and he would be in a better position to form an opinion of the true value of the sample. At the same time, the estimation of the "reduced" phosphates would often be rendered superfluous.

The actual mode of occurrence of some of the constituents of manures is very uncertain, and although interesting in a strictly scientific sense, is of very limited practical importance.

#### STATEMENT OF THE RESULTS OF ANALYSES OF COMMERCIAL PHOSPHATES.

With respect to the mode of statement of the results of analyses of manufactured phosphates the Committee holds the following opinions.

When found in quantities greater than traces, the proportions of oxide of iron and alumina in the sample should always be stated, and also their equivalents of the corresponding phosphates ( $\text{FePO}_4$  and  $\text{AlPO}_4$ ) and the equivalent of the latter in tricalcic phosphate. Hence that item of the analysis would appear somewhat as follows:—

Oxide of iron and alumina .. .. .	Per cent. A.
(Equal to phosphates of iron and aluminium .. .. .)	B p.c.)
(Equal to neutral phosphate of calcium .. .. .)	C p.c.)

If it be preferred for any reason to state the iron and aluminium as phosphates instead of oxides, the following form would be suitable:—

Phosphates of iron and aluminium ..	Per cent. B.
(Equal to neutral phosphate of calcium .. .. .)	C p.c.)
(Containing anhydrous phosphoric acid .. .. .)	D p.c.)

The object of stating the equivalents in phosphate of calcium and phosphoric acid is to give the manufacturer or purchaser an estimate of the tendency of the sample to "go back," owing to the formation of reduced phosphates.

The Committee is of opinion that the soluble phosphate in a manure prepared with acid is best stated as acid calcium phosphate, though in some cases it may be questioned whether it wholly exists in that form. The term "biphosphate" should as far as possible be abandoned, but as this cannot be done suddenly, it is recommended that the equivalent of  $\text{CaH}_4(\text{PO}_4)_2$  in  $\text{CaP}_2\text{O}_6$  should also be given. It is likewise desirable to state the equivalent

amount of bone phosphate [ $\text{Ca}_3(\text{PO}_4)_2$ ] from which the soluble phosphate has been derived. Hence the statement of the soluble phosphate will be somewhat as follows:—

Soluble acid phosphate of calcium ..	Per cent. E.
(Equal to so-called "biphosphate" of lime .. .. .)	F p.c.)
(Equal to neutral phosphate of calcium (bone phosphate) made soluble .. .. .)	G p.c.)
(Containing anhydrous phosphoric acid .. .. .)	H p.c.)

The statement of the insoluble phosphate presents no difficulty.

The Committee is not prepared to make any recommendation respecting the statement of the calcium sulphate, but is of opinion that whether the anhydrous or hydrated substance is entered as existent in the sample, the equivalent of the other should also be added in parenthesis.

#### MENDING PLATINUM CRUCIBLES, &c.

By THOMAS GARSIDE, F.C.S.

SOME months ago I had a platinum dish, which had a small hole on the side near the bottom, and the dish was consequently useless for most purposes. I was about to consign it to the old platinum, when it struck me that this metal being "weldable," I might manage to repair it. Having already a mould for this dish, made of plaster-of-Paris, and not of wood, this served admirably as an anvil. I then cut a piece of moderately thin platinum foil, about 3 m.m. diameter, and rubbed this and the part of the dish where the hole was with sea-sand until perfectly bright and clean. Having fixed the dish and its mould in an upright position, I laid the platinum foil over the hole, and directed the flame from a table blowpipe upon the spot. A pair of scissors served as a hammer, and by gently tapping with these, the two pieces of platinum united perfectly, and made so neat a joint that one would scarcely observe it unless one's attention was called to it. I have used the dish for all kinds of purposes since, but the union is as good as ever. In the above operation the plaster-of-Paris mould, although very dry, was split and cracked by the heat in all directions, nevertheless it had sufficient cohesion to last until the operation was concluded. I find that platinum wires are very easily joined in this way.

10, Cross-street, Southport.

#### MORPHIA REACTIONS.

By DAVID LINDO.

DURING the analysis of a complex mixture it was noticed that the aqueous solution exhibited an intense green colour. This solution was found to contain ammonia and copper salts with organic matter, which proved to be morphia. I have not seen this colour-reaction mentioned before, and as it might sometimes prove useful as a confirmatory test for morphia, I have endeavoured to ascertain the conditions most favourable to its development. These appear to be as follows:—

Dissolve 1 part crystallised sulphate of copper in 10 parts of water; add solution of ammonia cautiously and with active stirring until the precipitate is just dissolved.

To ascertain if this solution is fit for the intended purpose, dissolve 2 grains muriate morphia in 1 ounce of distilled water: place some of this in a test-tube, add a few drops of the test-fluid, and shake the vessel slightly. If a precipitate or permanent turbidity is observed, the test-fluid requires a little more ammonia, which should be added in small quantity at a time, and the mixture well

shaken after each addition, as a notable excess prevents the test from acting. Adding ammonia to the morphia mixture that is being tested to rectify deficiency in the test-fluid will not be found to answer.

When a few drops of a properly-prepared test-fluid are added to a neutral solution of morphia salt of the above strength, and the tube is slightly shaken, no cloudiness will be observed, but the fluid assumes a magnificent emerald-green colour either immediately or after a short time. Weaker solutions may require to be gently heated, but the mixture must not be boiled or the reaction is destroyed, suboxide of copper being precipitated.

Of a stronger solution of morphia salt one drop is sufficient to give a good reaction on a white porcelain surface. The test-fluid should be applied on a slender glass rod, and stirred in as soon as it is taken from the bottle.

If the copper solution has not been added in sufficient quantity the colour obtained will be yellowish green. Large excess of the reagent destroys the reaction, and so does the addition of a few drops of liquor ammonia.

Phenol is the only other colourless organic compound I have met with as yet which affords a similar colour-reaction with the test, but further experience on this point is desirable.

Falmouth, Jamaica, June 25, 1878.

### ON THE ORIGIN OF ELEMENTARY SUBSTANCES, AND ON SOME NEW RELATIONS OF THE ATOMIC WEIGHTS.\*

By HENRY WILDE.

THE hypothesis that the solar system, as at present constituted, was formed by the successive condensations of a gaseous substance rotating under the influence of a central force, has so much evidence in its favour, that it may be affirmed to equal the best of that obtained from the geological record of the changes which, in past times, have taken place on the surface of the terrestrial globe. That this gaseous or primordial substance consisted of a chaotic mixture of the 65 elements known to chemists is a notion too absurd to be entertained by any one possessing the faculty of philosophic thinking, as the regular gradation of properties observable in certain groups of elements clearly shows that elementary species are not eternal, but have a history which it is the proper object of physical science to unfold.

One of the principal facts which to my mind establishes the nebular theory of the formation of planetary systems on a firm basis, is Bode's empirical law of the distances of the members of the solar system from each other, and from the central body, as in this law is comprehended the idea of nebular condensation in definite proportions. Now, if elementary species were created from a homogeneous substance, possessing a capacity for change in definite proportions, it is probable that the greater number of elements would be formed during, or after, the transition of the nebular matter from the annular to the spheroidal form. Moreover, as great cosmic transitions are not made *per saltum*, it might be expected that some modification of the law of nebular condensation into planetary systems, as exhibited in Bode's law, would be found on the further condensation of the primitive matter into elementary species.

The relations such as I have indicated exist between the nebular and elementary condensations, represented by the planetary distances on the one hand, with the atomic weights of well-defined groups of elementary substances on the other, will be evident on comparing the numbers in the following tables:—

	I.
0.0.4=	4 Mercury.
1×3+4=	7 Venus.
2×3+4=	10 Earth.
4×3+4=	16 Mars.
8×3+4=	28 Ceres, Pallas, &c.
16×3+4=	52 Jupiter.
32×3+4=	100 Saturn.
64×3+4=	196 Uranus.

In the above table the numbers expressing the relative distances of the planetary bodies from the sun, and from each other, are obtained by multiplying successively the difference (3) between the distance of the first and second members of the system, by a geometric series, and adding to the products the constant distance (4) of the first member from the sun. Now, if the atomic weight of the second member of the alkaline and silver group of metals (Na=23) be multiplied successively by an arithmetical series, then will the products, minus the atomic weight of the first member (Li=7), be the atomic weight of all the elements belonging to that group.

	II.
0.0.7=	Li= 7
1×23.0=	Na= 23
2×23-7=	Ka= 39
3×23-7=	Cu= 62
4×23-7=	Rb= 85
5×23-7=	Ag=108
6×23-7=	Cs=131
7×23-7=	—=154
8×23-7=	—=177
9×23-7=	Hg=200

Again, by multiplying in like manner the atomic weight of the second member of the alkaline earth and cadmium groups of metals, the products, minus the atomic weight of the first member (Gl=8), are the atomic weights of all the elements of this group.

	III.
0.0.8=	Gl= 8
1×24.0=	Mg= 24
2×24-8=	Ca= 40
3×24-8=	Zn= 64
4×24-8=	Sr= 88
5×24-8=	Cd=112
6×24-8=	Ba=136
7×24-8=	—=160
8×24-8=	—=184
9×24-8=	Pb=208

The further relations observable between interplanetary voids and atomic condensations of the natural groups of elements in tables II. and III. are as follows:—

1. The regular geometric series of the planetary distances commences at the second member of the system, and the regular arithmetical series of atomic weights commences at the second and corresponding member of each group.

2. As the atomic weight of the second element in each group is half the sum of the atomic weights of the first and third elements, so is the distance of the second member of the solar system an arithmetical mean, or half the sum of the distances of the first and third members.

3. The atomic weight of the fourth member in each group of elements is equal to the sum of the atomic weights of the second and the third; and the distance of the fourth member of the solar system is also equal, within a unit, to the sum of the distances of the second and third members.

4. As the smallest planetary distance is a constant function of the distances of the outer planetary bodies, so is the smallest atomic weight in each group a similar function of all the higher members of the series to which it belongs. It will also be observed that the plus and

\* A Paper read before the Manchester Literary and Philosophical Society, April 30, 1878.

minus signs of these constants are correlated respectively with the interplanetary spaces and the elementary condensations.

5. Each of the atomic weights, after the third in the groups, is an arithmetical mean of any pair of atomic weights at the same distance above and below it; and the distance of each member of the solar system (minus the constant 4) is a mean proportional of the distances of any two members, externally and internally to it, from the central body.

6. The geometric ratio of the planetary distances from each other terminates at the two members nearest the central body, and approaches to an arithmetical one; and a similar departure is also noticeable from the regular arithmetical series of the atomic weights of the first two members of the groups, which renders the third less than an arithmetical mean of the atomic weights of the second and fourth members.

While most of the atomic weights in tables II. and III., excluding fractions, agree with those generally received by chemists, the remainder, except Cæsium = 133, do not vary more than a unit from the classical numbers. When it is considered that some of these numbers have been obtained by doubling the fractions of the old atomic weights, and that slight differences in the determinations may arise from the latent affinity which some elements have for minute quantities of another, the numbers in the tables are remarkably near to those determined by experiment—more so, in fact, than is Bode's law to the actual distances of the planets from the sun.

It will be observed that there are gaps to be occupied by two elements in the first group, with atomic weights 154 and 177, and by their homologues of position in the second group, with atomic weights 160 and 184, which remain to be discovered.

The numerical relations subsisting among the atomic weights in tables II. and III., and their resemblance to the homologous series in organic chemistry, afford further evidence in support of the theory that elementary species are formed by the successive condensations of a primordial substance of small specific gravity and low atomic weight. The physical and chemical properties of hydrogen, especially its low atomicity and its exact multiple relations with many elementary substances, long since suggested to Prout that this element might be the ponderable base of all the others.\* Prout's hypothesis has not, however, made much progress, as chemical knowledge was not sufficiently advanced in his time to enable the intermediate steps to be perceived by which elements of high atomicity could be built up from hydrogen; and, besides this, the hypothesis afforded no explanation of the widely diverging properties of elements having nearly the same atomic weights. If, however, it be assumed that a particle of hydrogen combines successively with one, two, three, or more of its own particles, to form the molecules  $H_2$ ,  $H_3$ ,  $H_4$ ,  $H_5$ ,  $H_6$ ,  $H_7$ , and that each of these molecules forms the type of a group of elements under it, the intermediate steps between the low atomic weight of hydrogen and the high atomic weights of other elements are perceived, and the different properties of elements of approximately equal atomic weights admit of a rational explanation.

Although it is herein assumed that hydrogen is the ponderable base of all elementary species, it is probable that this element itself, as further maintained by Prout, may have been evolved from an ethereal substance of much greater tenuity.† Further knowledge of the outer regions of the solar atmosphere, and of the zodiacal light, may possibly indicate the steps by which hydrogen was formed.

I would also observe that the term "molecule" is here used only in the sense of a larger or denser particle of matter, and does not imply the idea of a composite

aggregation of the separate particles, each preserving its distinctive character after the molecule is formed, any more than rain drops preserve their distinctive character after falling into the ocean. It appears to me much more in accordance with the truth of nature to suppose that the smallest conceivable particle of a chemical substance or compound has the same physical properties absolutely as the mass. If it be objected that such a union of particles would have relations of infinity, as is therefore inconceivable, it may be answered that the central particles of a rotating body have mathematical and physical relations of a similar kind, and as the instrument of thought is incapable of forming a distinct conception of the magnitude of the infinitesimals involved in a centre of rotation, still less is it capable of comprehending the mode of union of the unknowable essences on which the physical qualities of chemical substances, after combination, depend. Philosophical chemists, I apprehend, will hereafter be able to refer the origin of the theory of the composite structure of matter, after chemical union, to the influence of ideas derived principally from the mechanical mixtures employed in pharmacy and in the culinary art.

In the present hypothesis it is assumed that a mass of hydrogen, of a curvilinear form, acquired a motion of rotation about a central point, which caused it to take a spiral or convoluted form. As each successive spiral or convolution was formed the particles of hydrogen combined with themselves as far as the septenary combination to constitute the type of each group of elements—the number of types or groups being equal to the number of convolutions of the rotating gas. According to this view, the elementary groups may be represented as forms of  $H_n$ ,  $H_{2n}$ ,  $H_{3n}$ ,  $H_{4n}$ ,  $H_{5n}$ ,  $H_{6n}$ ,  $H_{7n}$ ; the internal convolutions forming the highest type  $H_{7n}$ , and the outer convolution the type  $H_n$ . That on a further condensation of the elementary matter, a transition from the spiral to the annular form occurred, during, or after which, the group or species under each type was generated in concentric zones, and in the order of their atomic weights, until the highest member of each species was formed. That as the elementary vapours began to condense or assume the liquid form their regular stratification would be disturbed by eruptions of the imprisoned vapours from the interior of the rotating mass. This disturbance would be further augmented by the subsequent combination of the negative with the positive elements, and also by the variable solubility of their newly formed compounds; so that the evidence of such stratification of the elementary vapours as I have indicated, must necessarily be more fragmentary than that of the geological record. The constant association in nature, however, of several elements belonging to the same group, a remarkable example of which is the presence of lithium, potassium, rubidium, and cæsium in a single mineral, *lepidolite*, appears to confirm this view of the primitive arrangement of elementary vapours.

In the table at end are arranged all the known elements in natural groups, wherein gaps appear as in tables II. and III., which indicate the existence of missing elements. The atomic weights of other elements which have not been sufficiently investigated are also determined.

If the theory which I have enunciated of the evolution of elementary substances from hydrogen in definite proportions be correct, the numbers representing the atomic weights also represent the number of particles of hydrogen from which the elements were formed. Where these numbers do not coincide exactly, as in the case of  $Cu=62$ , and its homologue of position,  $Zn=64$ , which are each a unit less than the classical numbers, it is not to be supposed that these discrepancies are due to errors of experiment, but to some unknown cause which prevents their true atomicity from being ascertained.

Although the ideas of chemists on the classification and quantivalence of elements have greatly changed

\* *Annals of Philosophy*, vol. vi., 330, 1815; vol. vii., 113, 1816.  
† "Prout's Chemistry and Meteorology," 8th Bridgewater Treatise, p. 130.

during recent years, there is no question that the alkaline metals, lithium, sodium, potassium, rubidium, and cesium, belong to the group which I have classified under  $Hn$ . Chemists are also agreed that silver, notwithstanding the great divergence of some of its characteristics from those of the alkaline metals, also belongs to the same group. Now some of the physical and chemical properties of copper and mercury are more nearly allied to those of silver than to metals of other groups, and recent investigations have shown that silver may, like copper, be regarded as bivalent, since many of its compounds can be represented by formulæ exactly analogous to those of cuprous compounds with which they are isomorphous.\* The position of Hg, Ag, and Cu, as alternate members of the series  $Hn$ , indicate their relationship with sodium, and are thereby brought into still closer connection with Li, K, Rb, and Cs. That a relationship exists between sodium and silver, by the isomorphism of their anhydrous sulphates and in other ways, has already been pointed out by Odling. The greater specific gravity of sodium, while possessing a lower atomic weight than potassium, its passivity in the liquid state to the action of chlorine,† and its inferior volatility and oxidability to K, confirm the relationship of Na to the heavy metals of the series.

From what cause elements possessing physical properties so widely different should be associated alternately in regular order in the same series can only, in the present state of knowledge, be a subject of speculation; but, if the views which I have enunciated on the formation of the types  $Hn$ — $H7n$  be correct, it may be conceived that after the transition of the cosmical vapours from the spiral to the annular form, the gaseous material of each pair of members might rotate in concentric zones, separate from each other by an interval of space. It may be further conceived that the rotating zones of elementary matter were of sufficient thickness to cause a difference of density between their upper and lower regions. That the zones were in a highly electrical condition, and that their mutual influence on each other, through the annular space between them, would induce opposite electrical conditions in their external and internal regions; all the inner and denser regions of the zones being in a negative, and the outer or rarer regions in a positive electrical condition. Each zone would then be in a condition to form an electro-positive and an electro-negative element, which, on a subsequent condensation, would separate and form two zones of elements having dissimilar properties alternating with the other members of the same series.

Just as silver and sodium are the connecting links between Hg and Cu, and the alkaline metals Li, K, Rb, and Cs, so do cadmium and magnesium connect lead and zinc with the alkaline earth metals glucinum, calcium, strontium, and barium, which I have classified as forms of  $H2n$ . The classification of glucinum, with the alkaline earth metals has only recently been made, but chemists are not yet agreed upon the atomic weight of this element, as it has been fixed at  $G1=7$  (Awdejew) and  $G1=9.4$  (Reynolds). It may, however be suspected from the anomalously high specific gravity assigned to glucinum (2.10) as compared with that of magnesium (sp. gr. 1.74), and with their homologues of position, Li (sp. gr. 0.59) and Na (sp. gr. 0.97), that this element has not been isolated in a state of purity.‡ By assigning to glucinum the atomic weight  $G1=8$ , it enters as a multiple into all the members of the series  $H2n$ , and may be regarded as the product of the first, second, or third powers of  $H2$ .

While the property of quantivalence would appear to be correlated with the number of hydrogen particles in

the typical molecules from which the elements were evolved, and is a valuable aid in the classification of elementary species, this property in the present state of knowledge is not in many cases sufficient, of itself, to indicate the group to which an element belongs. This will be seen from the recognised bivalency of copper and mercury, and by the doubtful quantivalence of silver, and by analogy of sodium, all of which belong to the series  $Hn$ . That tetratomic lead = 208, is a member of the group  $H2n$ , is shown by the isomorphism of its oxide, carbonate, and sulphate, with the oxides, carbonates, and sulphates of barium, strontium, and calcium, besides which there is no other place vacant in the system of elements where one with the atomic weight and physical properties of lead would fit.

Were it not for the analogous physical properties, and the numerical relations subsisting among the elements grouped as forms of  $H3n$ , their classification from the property of quantivalence alone would have hardly been possible. There can, however, be little doubt that aluminium, yttrium, erbium, and thorium are rightly classified together, and that indium and thallium are true analogues of each other. As considerable interest attaches to this group at the present time, on account of the recent additions which have been made to it by the aid of spectral analysis, I here show the atomicities of its members in a separate table, calculated on the same principles as those in tables II. and III.

## IV.

0.0	.12=C	= 12
1 × 27.	0=Al	= 27
2 × 27	-12=—	= 42
3 × 27	-12=—	= 69
4 × 27	-12=—	= 96
5 × 27	-12=Yt	= 123
6 × 27	-12=In	= 150
7 × 27	-12=E	= 177
8 × 27	-12=Tl	= 204
9 × 27	-12=Th	= 231

It will be observed that there are three elements missing in this group, the atomic weights of which can be predicted in like manner with those of the missing elements in the preceding groups. The table also affords the means of correcting and determining the atomicities of the series which, from their rarity, have not been sufficiently investigated. It will be further observed that, besides the similar numerical relations of the members of this group with those shown in tables II. and III., the atomic weights are all multiples of 3, and are classified accordingly as forms of  $H3n$ .

The spectral reactions of this series of elements are remarkable from the oxides of carbon and erbium giving a spectrum of lines at low temperatures, and by the simplicity of the spectral lines of indium and thallium in the more refrangible parts of the spectrum. The atomic weights of C, Al, Tl, and Th are identical with those generally received, and afford presumptive evidence that the atomic weights of the intermediate members are equally correct. It will, however, be observed that the atomic weights of yttrium and indium are double the accepted numbers ( $Y=61.7$ ,  $In=75.6$ ); but in regard to the latter element it has not yet been definitely agreed which multiple of 37.6, the original determination, shall be the classical one, as the atomicity has been fixed by different chemists at 75.6, 113, and 150, the number assigned to it in the table. The relations which the double atomic weights of In and Yt have to each other, and with their homologues of position, Cs, Ba, Ag, and Cd, in tables II. and III., render it highly probable that the atomic weights of Y and In in the table are correct. For similar reasons it is probable that the atomic weight of erbium will be found to be 177. It is only very recently that any investigations of the atomic weight of this rare element have been made, from the difficulty

\* "Quantivalence of Silver,—Wislicenus, "Watts, Dic. Chem.," 2nd Suppl., 1088.

† "Watts, Dic. Chem.," Suppl., 1030.

‡ Since this paper was written, M.M. Nilson and Petterson have communicated to the French Academy the results of their researches on the physical properties of glucinum, and have found for the metal a density equal to 1.64, which, although still too high, the theoretical density being about 1.3, is less than that of magnesium, and, consequently, stands in the same order of density as lithium and sodium.—*Comptes Rendus*, April 1st, 1877, p. 825.

attending its isolation from yttrium, with which it is found associated in nature. According to some chemists, the atomic weight of erbium is 112.6, which, in relation to 177, is nearly in the ratio of 5 to 8. The more recent researches of M. Cleve on the quantivalence of this element have, however, raised its atomic weight to 170.55\* which, considering the wide difference between it and the previous determination, is a near approximation to the number in the table. The researches of the same chemist have also raised the atomic weight of yttrium from 61.7, the accepted determination, to 89.5, or three-fourths the calculated value. Now the history of chemical science abundantly shows that it is only after long and repeated investigation that the highest quantivalence of an element can be ascertained, and the result of M. Cleve's researches is a further confirmation of the correctness of the atomic weights of yttrium and erbium given in the table.

By comparing the electro-positive members of the series  $H_n$  with those of  $H_{2n}$ , it will be seen that a complete parallelism exists between them; the light alkaline, and alkaline earth metals alternating with the heavy members in homologous positions in both series. Odling has already indicated that this is the natural order of the dissimilar members of the zinc-calcic group of elements,† and similar alternations in other natural groups have been recognized in the arrangement of elements proposed by Mr. Newlands‡ and Mendeleeff.||

Just as  $Cu=62$ ,  $Ag=108$ , and  $x=154$ , alternate with  $Rb=85$ ,  $Cs=131$ , and  $x=177$ , in the series  $H_n$ ; and  $Zn=64$ ,  $Cd=112$ , and  $x=160$ , alternate with  $Sr=88$ ,  $Ba=136$ , and  $x=184$ ; so in the series  $H_{3n}$ , do  $x=69$ ,  $Yt=123$ , and  $Eb=177$ , alternate with  $x=96$ ,  $In=150$ , and  $Tl=204$ . Again, just as  $K$ ,  $Rb$ ,  $Cs$ , and  $x=154$ , are analogues of each other in the series  $H_n$ , so are  $x=42$ ,  $x=96$ ,  $In$ , and  $Tl$ , analogues of each other in the series  $H_{3n}$ , and are in homologous positions with the alkaline and alkaline earth metals in the series  $H_n$  and  $H_{2n}$ . The specific gravities of analogous members of these two series, except glucinum, which is anomalous, increase in the order of their atomic weight, and so far as the specific gravities of the members of the series  $H_{3n}$  have been ascertained, they follow the same order. Now M. Lecoq de Boisbaudran has shown that the new metal which he has discovered, and named gallium,§ is, from its spectral reactions and other properties, the analogue of indium and thallium. The position of the new metal in the series  $H_{3n}$  should therefore be either  $- =42$ , homologous with  $Ca$ , and  $K$ , or  $- =96$ , homologous with  $Sr$  and  $Rb$ . In comparing the alkaline metals of the series  $H_n$ , the specific gravity of sodium (0.97), as will be seen, is greater than that of potassium (0.86), although  $Na$  has a less atomic weight; and the same inversion of specific gravities in relation to atomic weights is observable in their homologues of position  $Mg$  (sp. gr. 1.74), and  $Ca$  (sp. gr. 1.58), in the series  $H_{2n}$ . It may therefore be assumed that the missing member  $x=42$ ,  $H_{3n}$ , would have a less specific gravity than  $Al$  (sp. gr. 2.56); probably 2.5. Now, the specific gravity of gallium, as determined by M. Lecoq de Boisbaudran, is 5.9,¶ and its analogues indium and thallium have specific gravities of 7.42, and 11.9 respectively, consequently  $x=42$  is not gallium. If gallium were  $x=69$  it would be the analogue of  $Y$ ,  $E$ , and  $Th$ , and homologous in position with  $Zn$  and  $Cu$ , whereas it has been shown to be the analogue of  $In$  and  $Tl$  and homologous in position with  $Sr$  and  $Rb$ . There is then no other place for a metal having the physical properties of gallium but the one assigned to it in the series  $H_{3n}$ , with the atomic weight=96, and forming a triad with

indium and thallium. If, however, the experimental determination of the atomicity of gallium pass through the same stages as the atomicities of indium, yttrium, and other members of the series, its atomic weight will be represented by the sub-multiple and proportional numbers 48 and 72.\*

(To be continued).

## NOTICES OF BOOKS.

*Second Annual Report of the Inspector and Assayer of Liquors to the Commonwealth of Massachusetts.*  
Boston: A. J. Wright.

It appears that of the samples of liquors submitted to chemical examination about 33 per cent were either of very inferior quality and were more or less adulterated. The tabulated analytical report gives in connection with every sample the name of the vendor. A very large majority of the liquors examined were ardent spirits, very few samples of wines or malt-liquors having been taken. The adulterants discovered are neither novel nor interesting, consisting as a rule of water, with sugar, colouring-matters, and in one case methylic alcohol. The nine samples of beer and ale analysed were found free from cocculus indicus, strychnia, and picric acid, or "any other bitter except that of hops and malt." One sample of native American wine, "California claret," has been examined: it contains 9.2 per cent of alcohol and the solid residue, 11.4 per cent, consists merely of vegetable acids and astringents naturally derived from the grape. No magenta or other artificial colouring matter was present.

*Guide to the Literature of the Dairy and of Cattle-keeping in General.* ("Führer durch die Literatur über Milchwirtschaft und Molkereiwesen, Butter und Kaesefabrikation sowie Rindviehzucht überhaupt.") Leipzig: H. Voigt.

AN alphabetical catalogue of works on the above subjects.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 3, July 15, 1878.

Remarks Concerning the Influence of Atmospheric Electricity of Low Tension upon Vegetation.—M. Berthelot.—Referring to M. Grandeau's paper "On the Influence of Atmospheric Electricity upon the Nutrition of Plants" (*Comptes Rendus*, lxxxvii., No. 2), the author recalls the analogy of the result with his own experiments on the formation of nitrogenous matters under the influence of atmospheric electricity. Hitherto in agricultural chemistry there has been understood under the name of atmospheric electricity merely the formation of nitric and nitrous acids and their ammoniacal salts, produced by the passage of lightning, without having any idea of the direct reactions which may come into play between

\* *Bull. Société Chimique de Paris*, tome xxi., 344, 1874.

† "Watts, Dic. Chem.," 1865, vol. iii., 963—Classification of Metals.

‡ *CHEM. NEWS*, vol. xii., 83; vol. xiii., 113.

§ Die periodische Gesetzmässigkeit der chemischen Elemente—*Ann. Chem. Pharm.*, Suppl. Band, viii., 133—229, 1872; *Phil. Mag.*, 5th S., vol. i., 543.

¶ *Comptes Rendus*, tome lxxxi., 403, 1000, 1865

¶ *Phil. Mag.* 5th S. vol. ii., 398.

\* From a calcination of the gallo-ammoniacal alum, M. Lecoq de Boisbaudran has recently found for gallium the equivalent 70.03, and from a calcination of the nitrate, 69.6—(*Comptes Rendus*, April 15, 1878.) The researches of M. Berthelot on the specific heat of gallium indicate, however, a higher equivalent for the metal than 70.03, as the atomic heat calculated from this determination (5.52 solid) is lower than that of any other metal except silicium.—*Ibid.*, April 15th 1878.

plants and the atmosphere. Yet these latter seem to me the more important, the smallness of the effects being compensated by their duration and by the extent of the surfaces influenced.

**Electro-metallurgy of Cobalt.**—A. Gaiffe.—The author has been struck with the beauty of cobalt galvanically deposited as well as by its hardness. It is not oxidised like iron, and much less care is required to keep its surface in good condition. Its beautiful white colour will make it suitable for the decoration of other metals. The bath used was a neutral solution of the double sulphate of ammonia and cobalt, which does not require nearly so much care as the nickel baths. The anode may be a sheet of platinum, or better a plate of cobalt, either cast or forged. To obtain a white and adhesive deposit the current ought to be regulated at the outset, at 6 units of electro-motor force of the standard of the British Association, and be brought to 3 units only when the entire surface of the article to be coated has become white.

**Reform of Certain Analytical Processes Employed in the Laboratories of Agricultural Stations and of Observatories of Chemical Meteorology. Volumetric Determination of the Sulphates in Waters.**—

A. Houzeau.—The process brought forward is simple and sufficiently precise. Qualities obtained by introducing into the volumetric method three new features:—(1.) The use of the "drop-counter" in place of the graduated burette. (2.) The evaluation of time in the accomplishment of the chemical reaction. (3.) The substitution of an empirical equivalent for the theoretic equivalent in the relation between the precipitant and the substance precipitated. One centilitre of water is poured into a test-tube 120 m.m. in length and 18 m.m. in diameter, and a drop of acetic acid is added. There are poured then by means of a "drop-counter" with a greased orifice (25 drops to 1 c.c.) 2, 4, 6, 8, or 10 drops of a standard solution of chloride of barium, containing per litre 30.5 grms. BaCl<sub>2</sub>·HO. After waiting 3 minutes, if a turbidity has been formed, the liquid is poured upon a single or double paper filter, previously moistened and drained, and of a capacity of about 12 c.c. The filtrate, which ought to be perfectly bright if the paper is of good quality, is received in a test-tube similar to the foregoing. One drop or more of the barytic solution is then poured in, and after the lapse of three minutes if a turbidity appears the liquid is thrown upon the same unwashed filter. The addition of the reagent is thus continued, and the filtration until the last drops of barium chloride no longer causes any cloudiness in the liquid in the space of three minutes. The advantage of the drop-counter is that it enables two or three determinations to be made simultaneously upon different samples of water with a single instrument. Two determinations of sulphate may thus be made in less than half an hour.

**Specific Gravities of Solutions of Pure Sugar.**—M. Barbet.—A table showing the theoretic and experimental weight per litre, with the increase of weight for every percentage of sugar from 1 to 90.

*Bulletin de la Societe Chimique de Paris,*  
No. 12, June 20, 1878.

**Synthesis of Cyan-acetyl-ureas and of Murexoin.** E. Mulder.—The author obtains cyan-acetyl-urea on treating the chloride of cyan-acetyl with urea. It represents a derivative in which three atoms of carbon are successively united with a residue of urea, as is the case with barbituric acid. Cyan-acetyl-dimethyl-urea is produced by the action of the chloride of cyan-acetyl upon dimethyl-urea. If treated with a small quantity of nitric acid of sp. gr. 1.2 this urea gives rise to the formation of a compound of a fine purple-red colour, which is murexoin.

**Russian Chemical Society.** Session April 6/18, 1878.—M. Setschinoff announces, in order to take date, that

in studying the action of carbonic acid upon albumen he finds that upon heating ordinary white of egg in a vacuum at 30° to 35° it gradually assumes a gelatinous texture, and is transformed into very hard fibrous flocks, having a great resemblance to the flocks of blood fibrin.

M. Beilstein, on his own behalf and on that of M. Kourbatoff, mentions that on causing ammonium sulphide to act upon symmetric dichloro-nitrobenzin, dichloro-anilin and dichloro-azoxybenzin are obtained.

M. Beilstein also described the result of the researches of M. Eremine on the preparation of ozone. The latter finds that an aqueous solution of oxalic acid absorbs a considerable quantity of ozone. This solution appears to be more stable in the light than in darkness. For coating the corks and joints needful in the preparation of ozone the author recommends the following mixtures:—For the corks a mixture of paraffin, wax, and rosin, and for the joints or lutes a mixture of glycerin and gelatin.

E. Wagner gave an account of M. Eltekoff's researches on the action of water and oxide of lead on the combinations of hydrocarbides of the series C<sub>n</sub>H<sub>2n</sub> with the halogens.

E. Wagner also described the investigations of M. Muller upon the nitrophthalic acids. The author gave a detailed description of the preparation, properties, and separation of the two nitrophthalic acids formed by the action of nitric upon phthalic acid. The new nitrophthalic acid, which the author names isonitrophthalic acid, melts at 160°, whilst the melting-point of the other is 204° to 206°.

M. Mendeleef on behalf of E. Schœne described the action of hydrogen peroxide upon the oxy compounds of thallium. Whether in solution or in the gaseous state it converts thallous oxide into a brown oxide insoluble in water. The brown colouration of ozonoscopic paper impregnated with thallium cannot, therefore, serve as proof of the presence of ozone in the atmosphere in which the author has previously demonstrated the presence of hydric peroxide.

M. Wreden announces that he has converted ordinary camphor into a liquid isomer by the action of dilute hydrochloric acid at 190°. The new compound boils at 187° to 193°. Its sp. gr. = 0.913, and it does not crystallise at a temperature of -17°.

M. Rudneff made a preliminary communication on the trimethyl-carbinamin obtained by M. Boutlerow as a secondary product of the preparation of trimethyl-acetic acid.

M. Kaschirsky communicated the results of his researches on the action of zinc-methyl upon the bromo-anhydrides of the saturated mono-bromated fatty acids of the series *a*.

M. Menchoutkine announces that the researches on the etherification of the primary and secondary alcohols which he had previously communicated to the Society contains errors which will necessitate further experiments. It is to be remarked that at present the limit of the ethylacetic system, according to these new researches, coincides with that given by M. Berthelot.

**Determination of Manganese in Irons, Cast-irons, and Steels; in Spiegel, Ferromanganese, and Ores.**

—M. Deshays.—When to a nitric or nitrosulphuric solution of manganese there is added a certain quantity of plumbic dioxide there is immediately produced a violet-red colouration, varying in intensity and in tone according to the quantity of manganese contained in the acid liquor. In all cases the colouration is so much the stronger as the quantity of manganese is more considerable, but it is still perceptible, even in case of extremely minute quantities. The tone varies according as the liquid contains nitric acid alone or a mixture of nitric and sulphuric, according to the degree of oxidation of the manganese, and also according to its origin. Thus, when employing the plumbic acid reaction for the qualitative detection of manganese in cast-irons and ores, we may have tones varying from the red of an onion skin to a

deep violet. To obtain comparable tints it is essentially necessary to operate under the same conditions, and to measure exactly the quantities of acid and of peroxide employed. In spite of these precautions, in the case of ores, the tone of the colouration seems to vary with the state of oxidation of the manganese. This reaction has been applied by M. Leclerc for the determination of manganese in soils and ashes, and subsequently M. Boussingault has used it for irons and steels. These two *savants* employed a standard solution of mercurous nitrate, which, if poured into the violet liquor containing the manganese, reduces the permanganic acid and decolourises the liquor. Up to 0.300 per cent of manganese the quantity of the reducing liquid employed to produce this decolouration appears proportional to the percentage of manganese; above this it is no longer proportional. The author has sought to utilise this method, but unsuccessfully, the majority of the steels now manufactured by the Bessemer and Martin processes containing more than 0.500 per cent of manganese. On the other hand, in case of cast-irons and ores, he has merely obtained irregular and conflicting results. On substituting for the mercurous nitrate a solution of arsenious acid analogous to that employed in chlorimetry the results appeared better, and the author has thought the method applicable for determining tolerably high proportions of manganese. As the hydrochloric solution of arsenious acid is difficult to prepare and often forms a deposit in the bottles he has finally adopted the arsenite of soda.

**Fermentation of Beer.**—P. Muller.—An account of the vegetable growths which modify alcoholic fermentation.

*Chemiker Zeitung.*  
No. 27.

In this issue is an interesting account of the manufacture of a fine quality of lamp-black,—so-called diamond black—by the combustion of the natural gas issuing from two wells at Gambier, in Ohio. The yearly production is about 16 tons, and the quality is excellent.

The "Germanic Museum" at Nürnberg has been recently enriched with a number of mathematical and physical instruments and apparatus.

Amber is found in Roumania. It differs in colour from that obtained on the coasts of the Baltic, being occasionally rose, red, brown, blue, green, and black. Specimens are occasionally found containing veins and spots resembling silver and gold in colour. In chemical composition and probable origin the Roumanian amber does not differ from the Prussian.

A rich deposit of coal has been discovered at Chala Alta, near Olazco, in Peru. The quantity is calculated as sufficient for the entire wants of South America for a long time.

**Tartar in Wines.**—Dr. M. Büchner.—The author finds that, on submitting wine to a low temperature, almost half the tartar present is deposited, and is not redissolved on a subsequent rise of temperature. A low percentage of tartar is no proof that water has been added. The percentage of tartar bears no direct proportion to the percentage of ash.—(*Dingler's Polytech. Journal.*)

Metallic tungsten, chemically pure, is now manufactured in Hanover at a very low price.

No. 28.

**Chemical Industry at the Paris Exhibition.**—Dr. C. Deite.—The author here treats of petroleum, mineral wax, or ceresin, bees'-wax, and turpentine. He considers that the Russian mineral oil from the wells of the Caucasus will never be able to compete with the American, both on account of the difficulty of transport and of the inferior quality. The Gallician petroleum may, in course of time, prove a formidable rival to the American.

Ceresin is prepared from ozokerit, and is chiefly manufactured in Austria. The total yield of ozokerit in Galicia, in 1875, amounted to 20 million kilos. Italy takes the first rank in the utilisation of bees'-wax, the yearly production of the kingdom being estimated at from 6 to 7 million kilos. The wax bleached in Venice is considered the best, and its excellence is ascribed to the fact of its immunity from the dust of the main land.

**The Condition of the Public Laboratories of France.**—An important and interesting paper. The author maintains that, as far as the applications of chemistry to the arts and manufactures are concerned, France can only claim the third rank.

**Tropæolin as an Alkalimetric Indicator.**—The reaction is said to be far from sufficiently distinct for use in volumetric analysis.

No. 29.

This issue contains an account of the oil and fat manufacture as represented at the Paris Exhibition.

**Process for the Detection of Alcohol in Ethereal Oils.**—A Drechsler.—The author uses a solution of 1 part potassium bichromate in 10 parts of nitric acid of spec. grav. 1.30. This new reagent shows the presence even of the smallest traces of alcohol in ethereal oils, as on its addition there is evolved, along with the specific odour of the oil, the well-known pungent smell of nitrite of ethyl-oxide, whilst, at the same time, a very characteristic change of colour occurs, which is very different, according to the quality of the different ethereal oils, and is best observed by using for the experiment small porcelain capsules shaped like a watch-glass. Five to six drops of the oil in question are poured into a capsule, 2 or 3 drops of the reagent are added, and the whole is let stand. In certain oils a remarkably beautiful play of colour appears in the mixture.

**Lustre and Colour of Potassium.**—Dr. Erckmann.—As a lecture experiment, the author introduces a piece of potassium, of the size of a pea, into a small test-tube, heats to fusion, turns the glass round and round till the metal congeals, and then seals up the tube. The greater part of the potassium is deposited on the sides of the tube as a specular metallic coating, resembling silver, and can be exhibited during lectures, &c. The other alkaline metals may be similarly treated.

It is reported from Munich that a case of arsenical poisoning has occurred in a man who has been suffering from a disease of the eyes, and who has for a long time worn a green silk screen over his face.

*Biedermann's Central-blatt,*  
Heft 2.

**Water-Examination and Water-Pollution.**—Dr. H. Vohl, Dr. F. Fischer, and J. P. Dahlem.—Dr. Vohl has examined the waters of the Rhine, between Cologne and Mühlheim, with particular reference to the putrid matters introduced by cesspools, privies, domestic and industrial residues. As the material for his investigations, he selected the incrustations and residual waters from the boilers of steam-boats, which ply upon certain parts of the river only, choosing those only where no compositions are used to prevent deposits. In the incrustations, the presence of arsenic was distinctly recognised, derived doubtless from the waste waters of dye and colour-works. The tests applied for other poisonous metallic oxides, such as copper, lead, and zinc, gave negative results. A not inconsiderable amount of phosphoric acid owes its presence, according to Dr. Vohl, to the influx of excrementitious liquids. The existence of fatty acids in the concretions proves the contamination of the water with soap-lyes. In the concentrated residual waters were found considerable quantities of chlorine and nitrites, a proof that the river receives large quantities of animal refuse. The presence of sulphuretted hydrogen indicates,

with great probability, the presence of sulphites and hyposulphites, whose origin is still dubious. Dahlem rejects all the methods hitherto in use for testing the purity of drinking water, such as Fleck's silver-solution, permanganate, microscopic examination, &c., and declares that all depends here on the reply to the chemico-biological question:—"Is the organic matter present in water of such a kind that it can serve as nutriment for the low organisms belonging to the family of moulds?" As these organisms have the property of flourishing better upon congealed albuminoids than upon such as are still in solution, and can do this upon materials coated or saturated with such compounds, the author selected for his experiments in this direction the production of films by means of a solution of tannin at 5 per cent. Of this, he pours 5 c.c. into 100 c.c. of the water under examination, and finds that in all waters where a turbidity rose, whether sooner or later, mould appeared, forming a thick crust, whilst in the opposite case, under perfectly similar circumstances—a temperature of 12° to 15° (C. or R.?)—no mould appeared even on standing for weeks.

**Studies on Soil.**—Eugen Risler.—An examination of the soils of the Canton Valais, of the "mollasse" occupying the territory between the Alps and the Jura, and of the glacier diluvium of the cantons Valais and Geneva.

**The Activity of the Earth-worm in the Fertility of the Soil.**—V. Hensen.—The author maintains that soils considered barren are made fit for vegetation by the two-fold activity of the worms, which open passages for the roots and line these passages with humus. In sandy soils the burrows of the earth-worm extend almost vertically to a depth of 3, 4, or even 6 feet, and are sometimes carried horizontally at the bottom. These passages are coated inwardly with the black excrements of the worm. Old worm burrows are occupied by the roots of the plants growing on the surface, which send out capillary rootlets to the walls of the burrow. The question whether all the roots of plants found growing in the subsoil have originally penetrated down worm-burrows cannot be decided with certainty. A microscopic examination of the masses deposited by earth-worms shows that they resemble the well-rotted leaf-mould used by gardeners in potting plants; most of the vegetable cells are destroyed through single cells, and fragments of

tissues remain, mixed with many sand-granules. The statement that the earth-worm gnaws the roots of plants is, according to the author, totally unsupported by facts. The intestines of the worm never contain parts of recent plants.

**On High Percentages of Nitrogen in Peaty Soils, and in Humiferous Marls, and on the Signification of Certain Humates Concerning the Absorption of Ammonia.**—Prof. H. Ritthausen.—The author has repeatedly found in peat, peat soils, and humiferous marls, quantities of nitrogen higher than occur in ordinary soils. In consequence of similar observations, peat has been recommended as a manure. In a sample of peat dried at 100°, the author found 3.22 per cent of nitrogen. It appears that humus and similar bodies retain ammonia energetically, forming sparingly soluble nitrogenous bodies, which partly consist of ammonia-humates of lime and magnesia.

**Researches on Seeds from High Latitudes.**—Prof. A. Petermann.—The author concludes that the seeds of Timothy grass, clover, pine and fir, gathered in Sweden, between latitudes 55°20' and 60°40', are distinguished from those grown in more southern lands by their higher germinating power, which is shown not merely by the large number of fruitful seeds, but also by the energy of the process of germination; by their cleanness, and by their great average absolute weight. These results are in accordance with the principle of natural selection.

**Influence of Gypsum in Water used for Brewing.**—L. Geisler, C. Frank, and O. Schottler.—The yield of extract from the malt is considerably diminished by the presence of gypsum in the water, though amount of proteinoids in the wort is not affected. The proportion of phosphoric acid in the wort is reduced by nearly half, and the ash undergoes no increase proportionate to the quantity of gypsum.

## Heft 3.

**Presence of Hydrogen Peroxide in the Atmosphere.**—Sergius Kern.—The author found Houzeau's view—that the amount of hydric peroxide in the air is influenced by the locality—confirmed in so far that he could detect a difference between the respective proportions present in the rain of St. Petersburg and of Moscow.

## COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JULY, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Ni- trates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Sulphuric hydride.	Hardness on Clark's Scale.	
		Saline.	Organic.								Before Boiling.	After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
<i>Thames Water Companies.</i>												
Grand Junction .. ..	Slightly turbid	0.001	0.010	0.125	0.068	19.20	5.970	0.648	0.94	1.130	13.7	3.00
West Middlesex .. ..	Slightly turbid	0.001	0.010	0.090	0.067	18.50	5.580	0.612	1.01	1.200	14.3	3.60
Southwark and Vauxhall	Clear	0.001	0.011	0.090	0.067	17.60	5.420	0.648	1.01	1.230	13.7	3.00
Chelsea .. .. .	Clear	0.001	0.009	0.075	0.057	18.30	5.120	0.684	0.94	1.370	13.2	3.30
Lambeth .. .. .	Clear	0.001	0.009	0.105	0.068	18.70	5.750	0.720	1.01	1.470	13.2	3.30
<i>Other Companies.</i>												
Kent .. .. .	Clear	0.000	0.002	0.390	0.010	29.80	8.340	0.684	1.72	3.730	20.6	6.50
New River .. .. .	Clear	0.000	0.008	0.135	0.046	18.30	5.580	0.648	0.94	0.930	13.2	3.30
East London .. .. .	Clear	0.000	0.008	0.090	0.046	19.90	6.200	0.828	1.16	1.400	13.7	3.00

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B

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BRITISH ASSOCIATION  
FOR THE  
ADVANCEMENT OF SCIENCE.

DUBLIN MEETING, AUGUST 14, 1878.

## INAUGURAL ADDRESS OF THE PRESIDENT,

WILLIAM SPOTTISWOODE, M.A., D.C.L., LL.D.,  
F.R.S., F.R.A.S., F.R.G.S.

ON looking back at the long array of distinguished men who both in this and in the sister countries have filled the chair of the British Association; on considering also the increased pains which have been bestowed upon, and the increased importance attaching to, the Presidential Address; it may well happen when, as on this occasion, your choice has fallen upon one outside the sphere of professional Science, that your nominee should feel unusual diffidence in accepting the post. Two considerations have, however, in my own case outweighed all reasons for hesitation: First, the uniform kindness which I received at the hands of the Association throughout the eight years during which I had the honour of holding another office; and, secondly, the conviction that the same goodwill which was accorded to your Treasurer would be extended to your President.

These considerations have led me to arrange my observations under two heads, viz., I propose first to offer some remarks upon the purposes and prospects of the Association with which, through your suffrages, I have been so long and so agreeably connected; and, secondly, to indulge in a few reflections, not indeed upon the details or technical progress, but upon the external aspects and tendencies of the Science which on this occasion I have the honour to represent. The former of these subjects is perhaps trite; but as an old man is allowed to become garrulous on his own hobby, so an old officer may be pardoned for lingering about a favourite theme. And, although the latter may appear somewhat unpromising, I have decided to make it one of the topics of my discourse, from the consideration that the holder of this office will generally do better by giving utterance to what has already become part of his own thought, than by gathering matter outside of its habitual range for the special occasion. For, as it seems to me, the interest (if any) of an address consists, not so much in the multitude of things therein brought forward, as in the individuality of the mode in which they are treated.

The British Association has already entered its fifth decade. It has held its meetings, this the 48th, in twenty-eight different towns. In six cities of note, viz., York, Bristol, Newcastle-on-Tyne, Plymouth, Manchester, and Belfast, its curve of progress may be said to have a node, or point through which it has twice passed; in the five Universities of Oxford, Cambridge, Dublin, Edinburgh, and Glasgow, and in the two great commercial centres, Liverpool and Birmingham, it may similarly be said to have a triple point, or one through which it has three times passed. Of our forty-six Presidents more than half (twenty-six, in fact) have passed away; while the remainder hold important posts in Science, and in the Public Service, or in other avocations not less honourable in themselves, nor less useful to the commonwealth. And whether it be due to the salubrity of the climate or

to the calm and dispassionate spirit in which Science is pursued by its votaries here, I do not pretend to say; but it is a fact that the earliest of our ex-Presidents still living, himself one of the original members of the Association, is a native of and resident in this country.

At both of our former meetings held in Dublin, in 1835 and 1857 respectively, while greatly indebted to the liberal hospitality of the citizens at large, we were, as we now are, under special obligations to the authorities of Trinity College for placing at our disposal buildings, not only unusually spacious and convenient in themselves, but full of reminiscences calculated to awake the scientific sympathies of all who may be gathered in them. At both of those former Dublin meetings the venerable name of Lloyd figured at our head; and if long-established custom had not seemed to preclude it, I could on many accounts have wished that we had met for a third time under the same name. And although other distinguished men, such as Dr. Robinson, Professors Stokes, Tyndall, and Andrews, are similarly disqualified by having already passed the Presidential chair, while others again, such as Sir W. R. Hamilton, Dr. M'Cullagh, and Professor Jukes, are permanently lost to our ranks, still we should not have had far to seek, had we looked for a President in this fertile island itself. But as everyone connected with the place of meeting partakes of the character of host towards ourselves as guests, it has been thought by our oldest and most experienced members that we should better respond to an invitation by bringing with us a President to speak as our representative than by seeking one on the spot; and we may always hope on subsequent occasions that some of our present hosts may respond to a similar call.

But leaving our past history, which will form a theme more appropriate to our jubilee meeting in 1881, at the ancient city of York, I will ask your attention to a few particulars of our actual operations.

Time was when the Royal Societies of London and Edinburgh and the Royal Irish Academy were the only representative bodies of British Science and the only receptacles of memoirs relating thereto. But latterly the division of labour, so general in industrial life, has operated in giving rise to special Societies, such as the Astronomical, the Linnæan, the Chemical, the Geological, the Geographical, the Statistical, the Mathematical, the Physical, and many others. To both the earlier or more general, and the later or more special societies alike, the British Association shows resemblance and affinity. We are general in our comprehensiveness; we are special in our sectional arrangement; and in this respect we offer not only a counterpart, but to some extent a counterpoise, to the general tendency to subdivision in Science. Further, still, while maintaining in their integrity all the elements of a strictly scientific body, we also include, in our character of a microcosm, and under our more social aspect, a certain freedom of treatment, and interaction of our various branches, which is scarcely possible among separate and independent societies.

The general business of our meetings consists, first, in receiving and discussing communications upon scientific subjects at the various sections into which our body is divided, with discussions thereon; secondly, in distributing, under the advice of our Committee of Recommendations, the funds arising from the subscriptions of members and associates; and, thirdly, in electing a Council upon whom devolves the conduct of our affairs until the next meeting.

The communications to the sections are of two kinds, viz., papers from individuals, and reports from Committees.

As to the subject-matter of the papers, nothing which falls within the range of Natural Knowledge, as partitioned among our sections, can be considered foreign to the purposes of the Association; and even many applications of Science, when viewed in reference to their scientific basis, may properly find a place in our proceedings.

So numerous, however, are the topics herein comprised, so easy the transition beyond these limits, that it has been thought necessary to confine ourselves strictly within this range, lest the introduction of other matters, however interesting to individual members, should lead to the sacrifice of more important subjects. As to the form of the communications, while it is quite true that every scientific conclusion should be based upon substantial evidence, every theory complete before being submitted for final adoption, it is not the less desirable that even tentative conclusions and hypothetical principles when supported by sufficient *prima facie* evidence, and enunciated in such a manner as to be clearly apprehended, should find room for discussion at our sectional meetings. Considering, however, our limitations of time, and the varied nature of our audience, it would seem not inappropriate to suspend, mentally if not materially, over the doors of our section rooms, the Frenchman's dictum, that no scientific theory "can be considered complete until it is so clear that it can be explained to the first man you meet in the street."

Among the communications to the Sections, undoubtedly the most important, as a rule, are the Reports; that is to say, documents issuing from specially appointed committees, some of which have been recipients of the grants mentioned above. These Reports are in the main of two kinds. First, accounts of observations carried on for a series of years, and intended as records of information on the special subjects; such, for instance, have been those made by the Kew Committee, by the committees on Luminous Meteors, on British Rainfall, on the Speed of Steamships, on Underground Temperature, on the Exploration of certain Geological Caverns, &c. These investigations, frequently originating in the energy and special qualifications of an individual, but conducted under the control of a Committee, have in many cases been continued from year to year, until either the object has been fully attained, or the matter has passed into the hands of other bodies, which have thus been led to recognise an inquiry into these subjects as part and parcel of their appropriate functions. The second class is one which is perhaps even more peculiar to the Association; viz., the Reports on the progress and present state of some main topics of Science. Among these may be instanced the early Reports on Astronomy, on Optics, on the Progress of Analysis; and later, those on Electrical Resistance, and on Tides; that of Professor G. G. Stokes on Double Refraction; that of Professor H. J. Smith, on the Theory of Numbers; that of Mr. Russell, on Hyper-elliptic Transcendents, and others. On this head Professor Carey Foster, in his address to the Mathematical and Physical Section at our meeting last year, made some excellent recommendations, to which, however, I need not at present more particularly refer, as the result of them will be duly laid before the section in the form of the report from a Committee to whom they were referred. It will be sufficient here to add that the wide extension of the Sciences in almost every branch, and the consequent specialisation of the studies of each individual, have rendered the need for such reports more than ever pressing; and if the course of true Science should still run smooth it is probable that the need will increase rather than diminish.

If time and space had permitted, I should have further particularised the Committees, occasionally appointed, on subjects connected with education. But I must leave this theme for some future President, and content myself with pointing out that the British Association alone among scientific societies concerns itself directly with these questions, and is open to appeals for counsel and support from the great teaching body of the country.

One of the principal methods by which this Association materially promotes the advancement of Science, and consequently one of its most important functions, consists in grants of money from its own income in aid of special scientific researches. The total amount so laid out during

the forty-seven years of our existence has been no less than £44,000; and the average during the last ten years has been £1450 per annum. These sums have not only been in the main wisely voted and usefully expended; but they have been themselves productive of much additional voluntary expenditure of both time and money on the part of those to whom the grants have been entrusted. The results have come back to the Association in the form of papers and reports, many of which have been printed in our volumes. By this appropriation of a large portion of its funds, the Association has to some extent anticipated, nay, even it may have partly inspired the ideas, now so much discussed, of the Endowment of Research. And whether the aspirations of those who advocate such endowment be ever fully realised or not, there can, I think, be no doubt whatever that the Association in the matter of these grants has afforded a most powerful stimulus to original research and discovery.

Regarded from another point of view these grants, together with others to be hereafter mentioned, present a strong similarity to that useful institution, the Professoriate Extraordinary of Germany, to which there are no foundations exactly corresponding in this country. For, beside their more direct educational purpose, these Professorships are intended, like our own grants, to afford to special individuals an opportunity of following out the special work for which they have previously proved themselves competent. And in this respect the British Association may be regarded as supplying, to the extent of its means, an elasticity which is wanting in our own Universities.

Besides the funds which through your support are at the disposal of the British Association, there are, as is well known to many here present, other funds of more or less similar character, at the disposal or subject to the recommendations of the Royal Society. There is the Donation Fund, the property of the Society; the Government Grant of £1000 per annum, administered by the Society; and the Government Fund of £4000 per annum (an experiment for five years) to be distributed by the Science and Art Department, both for research itself and for the support of those engaged thereon, according to the recommendations of a Committee consisting mainly of Fellows of the Royal Society. To these might be added other funds in the hands of different Scientific Societies.

But although it must be admitted that the purposes of these various funds are not to be distinguished by any very simple line of demarcation, and that they may therefore occasionally appear to overlap one another, it may still, I think, be fairly maintained that this fact does not furnish any sufficient reason against their co-existence. There are many topics of research too minute in their range, too tentative in their present condition, to come fairly within the scope of the funds administered by the Royal Society. There are others, ample enough in their extent, and long enough in their necessary duration, to claim for their support a national grant, but which need to be actually set on foot or tried before they can fairly expect the recognition either of the public or of the Government. To these categories others might be added, but the above-mentioned instances will perhaps suffice to show that even if larger and more permanent funds were devoted to the promotion of research than is the case at present, there would still be a field of activity open to the British Association as well as to other scientific bodies which may have funds at their disposal.

On the general question it is not difficult to offer strong arguments in favour of permanent national Scientific Institutions; nor is it difficult to picture to the mind an ideal future when Science and Art shall walk hand in hand together, led by a willing minister into the green pastures of the Endowment of Research.\* But while

\* It is worth while to compare the following passage from Plato's "Republic," Book vii. (Jowett's translation):  
"After plane geometry, we took solids in revolution instead of

allowing this to be no impossible a future, we must still admit that there are other and less promising possibilities, which under existing circumstances cannot be altogether left out of our calculations. I am therefore on the whole inclined to think that, while not losing sight of larger schemes, the wisest policy, for the present at all events, and pending the experiment of the Government Fund, will be to confine our efforts to a careful selection of definite persons to carry out definite pieces of work; leaving to them the honour (or the onus if they so think it) of justifying from time to time a continuation of the confidence which the Government or other supporting body may have once placed in them.

Passing from the proceedings to other features and functions of our body, it should be remembered that the continued existence of the Association must depend largely upon the support which it receives from its members and associates. Stinted in the funds so arising, its scientific effectiveness would be materially impaired; and deprived of them, its existence would be precarious. The amount at our disposal in each year will naturally vary with the population, with the accessibility, and with other circumstances of the place of meeting; there will be financially, as well as scientifically, good years and bad years. But we have in our invested capital a sum sufficient to tide over all probable fluctuations, and even to carry us efficiently through several years of financial famine, if ever such should occur. This seems to me sufficient; and we have therefore, I think, no need to increase our reserve, beyond perhaps the moderate addition which a prudent treasurer will always try to secure against expenditure which often increases and rarely diminishes.

But however important this material support may be to our existence and well being, it is by no means all that is required. There is another factor which enters into the product, namely, the personal scientific support of our best men. It is, I think, not too much to say, that without their presence our meetings would fail in their chief and most important element, and had best be discontinued altogether. We make, it must be admitted, a demand of sensible magnitude in calling upon men who have been actively engaged during a great portion of the year, at a season when they may fairly look for relaxation, to attend a busy meeting, and to contribute to its proceedings; but unless a fair quota at least of our veterans, and a good muster of our younger men, put in their appearance, our gatherings will be to little purpose. There was a period within my own recollection when it was uncertain whether the then younger members of our scientific growth would cast in their lot with us or not, and when the fate of the Association depended very much upon their decision. They decided in our favour; they have since become Presidents, Lecturers, and other functionaries of our body; with what result it is for you to judge.

Of the advantages which may possibly accrue to the locality in which our meetings are held, it is not for us to speak; but it is always a ground for sincere satisfaction to learn that our presence has been of any use in stimulating an interest, or in promoting local efforts, in the direction of Science.

taking solids in themselves; whereas after the second dimension the third, which is concerned with cubes and dimensions of depth, ought to have been followed.

"It is true, Socrates; but these subjects seem to be as yet hardly explored.

"Why, yes, I said, and for two reasons; in the first place, no government patronises them, which leads to a want of energy in the study of them, and they are difficult; in the second place, students cannot learn them unless they have a teacher. But then a teacher is hardy to be found, and even if one could be found, as matters now stand, the students of these subjects, who are very conceited, would not mind him; that, however, would be otherwise if the whole state patronised and honoured them, then they would listen, and there would be continuous and earnest search, and discoveries would be made; since, even now, disregarded as they are by the world, and maimed of their fair proportions, and although none of their votaries can tell the use of them, still these studies force their way by their natural charm, and very likely they may emerge into light."

The functions of the British Association do not, however, terminate with the meeting itself. Beside the special committees already mentioned, there remains a very important body, elected by the General Committee, viz., the Council, which assembles at the office in London from time to time as occasion requires. To this body belongs the duty of proposing a President, of preparing for the approval of the General Committee the list of Vice-Presidents and sectional officers, the selection of evening lecturers, and other arrangements for the coming meeting.

At the present time another class of questions occupies a good deal of the attention of the Council. In the first generation of the Association, and during the period of unwritten, but not yet traditional, law, questions relating to our own organisation or procedure either "settled themselves," or were wisely left to the discretionary powers of those who had taken part in our proceedings during the early years of our existence. These and other kindred subjects now require more careful formularisation and more deliberate sanction. And it is on the shoulders of the Council that the weight of these matters in general falls. These facts deserve especial mention on the present occasion, because one part of our business at the close of this meeting will be to bid farewell officially to one who has served us as Assistant Secretary so long and so assiduously that he has latterly become our main repertory of information, and our mentor upon questions of precedent and procedure. The post hitherto held by Mr. Griffith (for it is to him that I allude) will doubtless be well filled by the able and energetic member who has been nominated in his place; but I doubt not that even he will be glad for some time to come to draw largely upon the knowledge and experience of his predecessor.

But, beside matters of internal arrangement and organisation, the duties of the Council compromise a variety of scientific subjects referred to them by the General Committee, at the instance of the Committee of Recommendations, for deliberation and occasionally for action. With the increasing activity of our body in general, and more particularly with that of our various officers, these duties have of late years become more varied and onerous than formerly; nor is it to be wished that they should diminish in either variety or extent.

Once more, questions beyond our own constitution, and even beyond the scope of our own immediate action, such as education, legislation affecting either the promotion or the applications of science to industrial and social life, which have suggested themselves at our meetings, and received the preliminary sanction of our Committee of Recommendations, are frequently referred to our Council. These, and others which it is unnecessary to particularise, whether discussed in full Council or in committees specially appointed by that body, render the duties of our councillors as onerous as they are important.

While the Government has at all times, but in a more marked manner of late years, recognised the Royal Society of London, with representatives from the sister societies of Dublin and of Edinburgh, as the body to which it should look for counsel and advice upon scientific questions, it has still never shown itself indisposed to receive and entertain any well-considered recommendation from the British Association. Two special causes have in all probability contributed largely to this result. First, the variety of elements comprised by the Association, on account of which its recommendations imply a more general concurrence of scientific opinion than those of any other scientific body. Secondly, the peculiar fact, that our period of maximum activity coincides with that of minimum activity of other scientific bodies, is often of the highest importance. At the very time when the other bodies are least able, we are most able, to give deliberate consideration, and formal sanction, to recommendations whether in the form of applications to Government or otherwise which may arise. In many of these, time is an element so essential,

that it is not too much to say, that without the intervention of the British Association many opportunities for the advancement of Science, especially at the seasons in question, might have been lost. The Government has moreover formally recognised our scientific existence by appointing our President for the time being a member of the Government Fund Committee; and the public has added its testimony to our importance and utility by imposing upon our President and officers a variety of duties, among which are conspicuous those which arise out of its very liberal exercise of civic and other hospitality.

Of the nature and functions of the Presidential address this is perhaps neither the time nor the place to speak; but if I might for a moment forget the purpose for which we are now assembled, I would take the opportunity of reminding those who have not attended many of our former meetings that our annual volumes contain a long series of addresses on the progress of Science, from a number of our most eminent men, to which there is perhaps no parallel elsewhere. These addresses are perhaps as remarkable for their variety in mode of treatment as for the value of their subject-matter. Some of our Presidents, and especially those who officiated in the earlier days of our existence, have passed in review the various branches of Science, and have noted the progress made in each during the current year. But, as the various Sciences have demanded more and more special treatment on the part of those who seriously pursue them, so have the cases of individuals who can of their own knowledge give anything approaching to a general review become more and more rare. To this may be added the fact that although no year is so barren as to fail in affording sufficient crop for a strictly scientific budget, or for a detailed report of progress in research, yet one year is more fertile than another in growths of sufficient prominence to arrest the attention of the general public, and to supply topics suitable for the address. On these accounts apparently such a Presidential survey has ceased to be annual, and has dropped into an intermittence of longer period. Some Presidents have made a scientific principle, such as the Time-element in natural phenomena, or Continuity, or Natural Selection, the theme of their discourse, and have gathered illustrations from various branches of knowledge. Others again, taking their own special subject as a fundamental note, and thence modulating into other kindred keys, have borne testimony to the fact that no subject is so special as to be devoid of bearing or of influence on many others. Some have described the successive stages of even a single but important investigation; and while tracing the growth of that particular item, and of the ideas involved in it, have incidentally shown to the outer world what manner of business a serious investigation is. But there is happily no pattern or precedent which the President is bound to follow; both in range of subject-matter and in mode of treatment each case has exercised his undoubted right of taking an independent line. And it can hardly be doubted that a judicious exercise of this freedom has contributed more than anything else to sustain the interest of a series of annual discourses extending now over nearly half a century.

The nature of the subjects which may fairly come within the scope of such a discourse has of late been much discussed; and the question is one upon which everyone of course is entitled to form his own judgment; but lest there should be any misapprehension as to how far it concerns us in our corporate capacity, it will be well to remind my hearers that as, on the one hand, there is no discussion on the Presidential address, and the members as a body express no formal opinion upon it, so, on the other, the Association cannot fairly be considered as in any way committed to its tenor or conclusions. Whether this immunity from comment and reply be really on the whole so advantageous to the President as might be supposed need not here be discussed; but suffice it to say, that the case of an audience assembled to listen without

discussion finds a parallel elsewhere, and in the parallel case it is not generally considered that the result is altogether either advantageous to the speaker or conducive to excellence in the discourse.

But, apart from this, the question of a limitation of range in the subject-matter for the Presidential address is not quite so simple as may at first sight appear. It must, in fact, be borne in mind that, while on the one hand knowledge is distinct from opinion, from feeling, and from all other modes of subjective impression, still the limits of knowledge are at all times expanding, and the boundaries of the known and the unknown are never rigid or permanently fixed. That which in time past or present has belonged to one category may in time future belong to the other. Our ignorance consists partly in ignorance of actual facts, and partly also in ignorance of the possible range of ascertainable fact. If we could lay down beforehand precise limits of possible knowledge, the problem of Physical Science would be already half solved. But the question to which the scientific explorer has often to address himself is not merely whether he is able to solve this or that problem, but whether he can so far unravel the tangled threads of the matter with which he has to deal as to weave them into a definite problem at all. He is not like a candidate at an examination with a precise set of questions placed before him; he must first himself act the part of the examiner and select questions from the repertory of nature, and upon them found others, which in some sense are capable of definite solution. If his eye seem dim, he must look steadfastly, and with hope into the misty vision, until the very clouds wreath themselves into definite forms. If his ear seem dull, he must listen patiently and with sympathetic trust to the intricate whisperings of nature,—the goddess, as she has been called, of a hundred voices—until here and there he can pick out a few simple notes to which his own powers can resound. If, then, at a moment when he finds himself placed on a pinnacle from which he is called upon to take a perspective survey of the range of science, and to tell us what he can see from his vantage ground; if, at such a moment, after straining his gaze to the very verge of the horizon, and after describing the most distant of well-defined objects, he should give utterance also to some of the subjective impressions which he is conscious of receiving from regions beyond; if he should depict possibilities which seem opening to his view; if he should explain why he thinks this a mere blind alley and that an open path; then the fault and the loss would be alike ours if we refused to listen calmly, and temperately to form our own judgment on what we hear; then assuredly it is we who would be committing the error of confounding matters of fact and matters of opinion if we failed to discriminate between the various elements contained in such a discourse, and assumed that they had all been put on the same footing.

But to whatever decision we may each come on these controverted points, one thing appears clear from a retrospect of past experience, viz., that first or last, either at the outset in his choice of subject or in the conclusions ultimately drawn therefrom, the President, according to his own account at least, finds himself on every occasion in a position of "exceptional or more than usual difficulty." And your present representative, like his predecessors, feels himself this moment in a similar predicament. The reason which he now offers is that the branch of science which he represents is one whose lines of advance, viewed from a mathematician's own point of view, offer so few points of contact with the ordinary experiences of life or modes of thought, that any account of its actual progress which he might have attempted must have failed in the first requisite of an address, namely, that of being intelligible.

Now if this esoteric view had been the only aspect of the subject which he could present to his hearers, he might well have given up the attempt in despair. But although in its technical character Mathematical Science

suffers the inconveniences, while it enjoys the dignity, of its Olympian position, still in a less formal garb, or in disguise, if you are pleased so to call it, it is found present at many an unexpected turn; and although some of us may never have learnt its special language, not a few have, all through our scientific life, and even in almost every accurate utterance, like Molière's well-known character, been talking mathematics without knowing it. It is, moreover, a fact not to be overlooked that the appearance of isolation, so conspicuous in mathematics, appertains in a greater or less degree to all other sciences, and perhaps also to all pursuits in life. In its highest flight each soars to a distance from its fellows. Each is pursued alone for its own sake, and without reference to its connection with, or its application to, any other subject. The pioneer and the advanced guard are of necessity separated from the main body, and in this respect mathematics does not materially differ from its neighbours. And, therefore, as the solitariness of mathematics has been a frequent theme of discourse, it may be not altogether unprofitable to dwell for a short time upon the other side of the question, and to inquire whether there be not points of contact in method or in subject-matter between mathematics and the outer world which have been frequently overlooked; whether its lines do not in some cases run parallel to those of other occupations and purposes of life; and lastly, whether we may not hope for some change in the attitude too often assumed towards it by the representatives of other branches of knowledge and of mental activity.

In his Preface to the "Principia" Newton gives expression to some general ideas which may well serve as the key-note for all future utterances on the relation of mathematics to natural, including also therein what are commonly called artificial, phenomena.

"The ancients divided mechanics into two parts, rational and practical; and since artizans often work inaccurately, it came to pass that mechanics and geometry were distinguished in this way, that everything accurate was referred to geometry, and everything inaccurate to mechanics. But the inaccuracies appertain to the artizan and not to the art, and geometry itself has its foundation in mechanical practice, and is in fact nothing else than that part of universal mechanics which accurately lays down and demonstrates the art of measuring."\* He next explains that rational mechanics is the science of motion resulting from forces, and adds, "The whole difficulty of philosophy seems to me to lie in investigating the forces of nature from the phenomena of motion, and in demonstrating that from these forces other phenomena will ensue." Then, after stating the problems of which he has treated in the work itself, he says, "I would that all other natural phenomena might similarly be deduced from mechanical principles. For many things move me to suspect that everything depends upon certain forces in virtue of which the particles of bodies, though forces not yet understood, are either impelled together so as to cohere in regular figures, or are repelled and recede from one another."

Newton's views, then, are clear. He regards mathematics not as a method independent of, though applicable to, various subjects, but as itself the higher side or aspect of the subjects themselves; and it would be little more than a translation of his notions into other language, little more than a paraphrase of his own words, if we were to describe the mathematical as one aspect of the material world itself, apart from which all other aspects are but incomplete sketches, and, however accurate after their own kind, are still liable to the imperfections of the inaccurate artificer. Mr. Burrowes, in his Preface to the first volume of the *Transactions of the Royal Irish Academy*, has carried out the same argument, approaching it from the other side. "No one science," he says, "is so

little connected with the rest as not to afford many principles whose use may extend considerably beyond the science to which they primarily belong, and no proposition is so purely theoretical as to be incapable of being applied to practical purposes. There is no apparent connexion between duration and the cycloidal arch, the properties of which have furnished us with the best method of measuring time; and he who has made himself master of the nature and affections of the logarithmic curve has advanced considerably towards ascertaining the proportionable density of the air at various distances from the earth. The researches of the mathematician are the only sure ground on which we can reason from experiments; and how far experimental science may assist commercial interests is evinced by the success of manufactures in countries where the hand of the artificer has taken its direction from the philosopher. Every manufacture is in reality but a chemical process, and the machinery requisite for carrying it on but the right application of certain propositions in rational mechanics." So far your Academician. Every subject, therefore, whether in its usual acceptation, scientific, or otherwise, may have a mathematical aspect; as soon, in fact, as it becomes a matter of strict measurement, or of numerical statement, so soon does it enter upon a mathematical phase. This phase may, or it may not, be a prelude to another in which the laws of the subject are expressed in algebraical formulæ or represented by geometrical figures. But the real gist of the business does not always lie in the mode of expression, and the fascination of the formulæ or other mathematical paraphernalia may after all be little more than that of a theatrical transformation scene. The process of reducing to formulæ is really one of abstraction, the results of which are not always wholly on the side of gain; in fact, through the process itself the subject may lose in one respect even more than it gains in another. But long before such abstraction is completely attained, and even in cases where it is never attained at all, a subject may to all intents and purposes become mathematical. It is not so much elaborate calculations or abstruse processes which characterise this phase as the principles of precision, of exactness, and of proportion. But these are principles with which no true knowledge can entirely dispense. If it be the general scientific spirit which at the outset moves upon the face of the waters, and out of the unknown depth brings forth light and living forms, it is no less the mathematical spirit which breathes the breath of life into what would otherwise have ever remained mere dry bones of fact, which re-unites the scattered limbs and re-creates from them a new and organic whole.

And as a matter of fact, in the words used by Professor Jellett at our meeting at Belfast, viz., "Not only are we applying our methods to many sciences already recognised as belonging to the legitimate province of mathematics, but we are learning to apply the same instrument to sciences hitherto wholly or partially independent of its authority. Physical Science is learning more and more every day to see in the phenomena of Nature modifications of that one phenomenon (namely, Motion) which is peculiarly under the power of mathematics." Echoes are these, far off and faint perhaps, but still true echoes, in answer to Newton's wish that all these phenomena may some day "be deduced from mechanical principles."

If, turning from this aspect of the subject, it were my purpose to enumerate how the same tendency has evinced itself in the Arts, unconsciously it may be to the artists themselves, I might call as witnesses each one in turn with full reliance on the testimony which they would bear. And, having more special reference to mathematics, I might confidently point to the accuracy of measurement, to the truth of curve, which according to modern investigation is the key to the perfection of classic art. I might triumphantly cite not only the architects of all ages, whose art so manifestly rests upon mathematical principles; but I might cite also the literary as well as the artistic remains of the great artists of Cinquecento;

\* Compare with this the latter part of Plato's "Philebus," on knowledge and the handicraft arts; also Prof. Jowett's "Introduction" thereto.

both painters and sculptors, in evidence of the geometry and the mechanics which, having been laid at the foundation, appear to have found their way upwards through the superstructure of their works.\* And in a less ambitious sphere, but nearer to ourselves in both time and place, I might point with satisfaction to the great school of English constructors of the 18th century in the domestic arts, and remind you that not only the engineer and the architect, but even the cabinet-makers, devoted half the space of their books to perspective and to the principles whereby solid figures may be delineated on paper, or what is now termed descriptive geometry.†

Nor perhaps would the sciences which concern themselves with reasoning and speech, nor the kindred art of Music, nor even Literature itself, if thoroughly probed, offer fewer points of dependence upon the science of which I am speaking. What, in fact, is Logic but that part of universal reasoning; Grammar, but that part of universal speech; Harmony and Counterpoint, but that part of universal music, "which accurately lays down," and demonstrates (so far as demonstration is possible) precise methods appertaining to each of these Arts? And I might even appeal to the common consent which speaks of the mathematical as the pattern form of reasoning and model of a precise style.

Taking, then, precision and exactness as the characteristics which distinguish the mathematical phase of a subject, we are naturally led to expect that the approach to such a phase will be indicated by increasing application of the principle of measurement, and by the importance which is attached to numerical results. And this very necessary condition for progress may, I think, be fairly described as one of the main features of scientific advance in the present day.

If it were my purpose, by descending into the arena of special sciences, to show how the most various investigations alike tend to issue in measurement, and to that extent to assume a mathematical phase, I should be embarrassed by the abundance of instances which might be adduced. I will therefore confine myself to a passing notice of a very few, selecting those which exemplify not only the general tendency, but also the special character of the measurements now particularly required, viz., that of minuteness, and the indirect method by which alone we can at present hope to approach them. An object having a diameter of an 80,000th of an inch is perhaps the smallest of which the microscope could give any well-defined representation; and it is improbable that one of 120,000th of an inch could be singly discerned with the highest powers at our command.‡ But the solar beams and the electric light reveal to us the presence of bodies far smaller than these. And, in the absence of any means of observing them singly, Prof. Tyndall has suggested a scale of these minute objects in terms of the lengths of luminiferous waves. To this he was led, not by any attempt at individual measurement, but by taking account of them in the aggregate, and observing the tints which they scatter laterally when clustered in the form of actinic clouds.¶ The small bodies with which experimental Science has recently come into contact are not confined to gaseous molecules, but comprise also complete organisms; and the same philosopher has made a profound study of the momentous influence exerted by these minute organisms in the economy of life.§ And if, in view of their specific effects, whether deleterious or other, on human life, any qualitative classification or quantitative estimate be ever possible, it seems that it must be effected by some such method as that indicated above.

Again, to enumerate a few more instances of the mea-

surement of minute quantities, there are the average distances of molecules from one another in various gases and at various pressures; the length of their free path, or range open for their motion without coming into collision; there are movements causing the pressures and differences of pressure under which Mr. Crookes's radiometers execute their wonderful revolutions.\* There are the excursions of the air while transmitting notes of high pitch, which through the researches of Lord Rayleigh appear to be of a diminutiveness altogether unexpected.† There are the molecular actions brought into play in the remarkable experiments by Dr. Kerr,‡ who has succeeded, where even Faraday failed, in effecting a visible rotation of the plane of polarisation of light in its passage through electrified dielectrics, and on its reflexion at the surface of a magnet. To take one more instance, which must be present to the minds of us all, there are the infinitesimal ripples of the vibrating plate in Mr. Graham Bell's most marvellous invention. Of the nodes and ventral segments in the plate of the telephone which actually converts sound into electricity and electricity into sound, we can at present form no conception. All that can now be said is that the most perfect specimens of Chladni's sand figures on a vibrating plate, or of Kundt's lycopodium heaps in a musical tube,|| or even Mr. Sedley Taylor's more delicate vortices in the films of the Phoneidoscope,§ are rough and sketchy compared with these. For notwithstanding the fact that in the movements of the Telephone-plate we have actually in our hand the solution of that Old World problem, the construction of a speaking machine, yet the characters in which that solution is expressed are too small for our powers of decipherment. In movements such as these we seem to lose sight of the distinction, or perhaps we have unconsciously passed the boundary between massive and molecular motion.¶

Through the Phonograph\*\* we have not only a transformation, but a permanent and tangible record of the mechanism of speech. But the differences upon which articulation (apart from loudness, pitch, and quality) depends, appear from the experiments of Fleeming Jenkin and of others to be of microscopic size.†† The Microphone affords another instance of the unexpected value of minute variations—in this case of electric currents; and it is remarkable that the gist of the instrument seems to lie in obtaining and perfecting that which electricians have hitherto most scrupulously avoided, viz., loose contact.

Once more, Mr. De la Rue has brought forward as one of the results derived from his stupendous battery of 10,000 cells, strong evidence for supposing that a voltaic discharge, even when apparently continuous, may still be an intermittent phenomenon; but all that is known of the period of such intermittence is, that it must recur at exceedingly short intervals. And in connexion with this subject it may be added that, whatever be the ultimate explanation of the strange stratification which the voltaic discharge undergoes in rarefied gases, it is clear that the alternate disposition of light and darkness must be dependent on some periodic distribution in space or sequence in time which can at present be dealt with only in a very general way. In the exhausted column we have a vehicle for electricity not constant like an ordinary conductor, but itself modified by the passage of the discharge, and perhaps subject to laws differing materially from those which it obeys at atmospheric pressure. It may also be that some of the features accompanying stratification form a

\* "On Attraction and Repulsion resulting from Radiation," *Phil. Trans.*, 1874, p. 501; 1875, p. 519; 1876, p. 325.

† *Philosophical Magazine*, April, 1878.

‡ *Phil. Mag.*, 1875, vol. ii., pp. 337, 446; 1877, vol. i., p. 321; 1878, vol. i., p. 161.

|| *Poggendorff's Annalen*, tom. xxxv., p. 337.

§ *Proceedings of Royal Society*, 1878.

¶ The Papers on the Telephone are too numerous to specify.

\*\* See various Papers in *Nature*, and elsewhere, during the last twelve months.

†† *Phil. Trans.*, vol. clxix., pp. 55 and 155, and other Papers catalogued in the "Appendix to Part II. of the Memoir."

\* See "Trattato della Pittura, by Leonardo da Vinci; also the 'Memoir on the MSS. of L. d. V.'" by Venturi, 1797.

† "The Gentleman and Cabinet Maker's Director," by Thomas Chippendale; London, 1754. "The Cabinet Maker and Upholsterer's Drawing Book," by Thomas Sheraton; London, 1793.

‡ See Sorby's "Address to the Microscopical Society," 1876.

|| *Phil. Trans. of the Royal Society*, 1870, p. 333; and 1876, p. 27.

§ *Phil. Trans.*, 1877, p. 149.

magnified image of phenomena belonging to disruptive discharges in general, and that consequently, so far from expecting among the known facts of the latter any clue to an explanation of the former, we must hope ultimately to find in the former an elucidation of what is at present obscure in the latter. A prudent philosopher usually avoids hazarding any forecast of the practical application of a purely scientific research. But it would seem that the configuration of these striæ might some day prove a very delicate means of estimating low pressures, and perhaps also for effecting some electrical measurements.

Now, it is a curious fact that almost the only small quantities of which we have as yet any actual measurements are the wave-lengths of light, and that all others, excepting so far as they can be deduced from these, await future determination. In the meantime, when unable to approach these small quantities individually, the method to which we are obliged to have recourse is, as indicated above, that of averages, whereby, disregarding the circumstances of each particular case, we calculate the average size, the average velocity, the average direction, &c., of a large number of instances.\* But although this method is based upon experience, and leads to results which may be accepted as substantially true; although it may be applicable to any finite interval of time, or over any finite area of space (that is, for all practical purposes of life), there is no evidence to show that it is so when the dimensions of interval or of area are indefinitely diminished. The truth is that the simplicity of Nature which we at present grasp is really the result of infinite complexity, and that below the uniformity there underlies a diversity whose depths we have not yet probed, and whose secret places are still beyond our reach.

The present is not an occasion for multiplying illustrations, but I can hardly omit a passing allusion to one all-important instance of the application of the statistical method. Without its aid social life, or the History of Life and Death, could not be conceived at all, or only in the most superficial manner. Without it we could never attain to any clear ideas of the condition of the Poor, we could never hope for any solid amelioration of their condition or prospects. Without its aid sanitary measures, and even medicine, would be powerless. Without it the politician and the philanthropist would alike be wandering over a trackless desert.

It is, however, not so much from the side of Science at large as from that of Mathematics itself that I desire to speak. I wish from the latter point of view to indicate connexions between Mathematics and other subjects, to prove that hers is not after all such a far-off region, nor so undecipherable an alphabet, and to show that even at unlikely spots we may trace under-currents of thought which, having issued from a common source, fertilise alike the mathematical and the non-mathematical world.

Having this in view I propose to make the subject of special remark some processes peculiar to modern Mathematics; and, partly with the object of incidentally removing some current misapprehensions, I have selected for examination three methods in respect of which mathematicians are often thought to have exceeded all reasonable limits of speculation, and to have adopted for unknown purposes an unknown tongue. And it will be my endeavour to show not only that in these very cases our science has not outstepped its own legitimate range, but that even art and literature have unconsciously employed methods similar in principle. The three methods in question are, first, that of Imaginary Quantities; secondly, that of Manifold Space; and thirdly, that of Geometry not according to Euclid.

First it is objected that, abandoning the more cautious methods of ancient mathematicians, we have admitted into our formulæ quantities which by our own showing, and even in our own nomenclature, are imaginary or impossible; nay, more, that out of them we have formed a variety of new algebras to which there is no counterpart

whatever in reality; but from which we claim to arrive at possible and certain results.

On this head it is in Dublin, if anywhere, that I may be permitted to speak. For to the fertile imagination of the late Astronomer Royal for Ireland we are indebted for that marvellous Calculus of Quaternions which is only now beginning to be fully understood, and which has not yet received all the applications of which it is doubtless capable. And even although this calculus be not co-extensive with another which almost simultaneously germinated on the Continent,\* nor with ideas more recently developed in America, yet it must always hold its position as an original discovery,† and as a representative of one of the two great groups of generalised algebras (viz., those the squares of whose units are respectively negative unity and zero), the common origin of which must still be marked on our intellectual map as an unknown region. Well do I recollect how in its early days we used to handle the method as a magician's page might try to wield his master's wand, trembling as it were between hope and fear, and hardly knowing whether to trust our own results until they had been submitted to the present and ever-ready counsel of Sir W. R. Hamilton himself.

To fix our ideas, consider the measurement of a line, or the reckoning of time, or the performance of any mathematical operation. A line may be measured in one direction or in the opposite; time may be reckoned forward or backward: an operation may be performed or be reversed, it may be done or may be undone; and if having once reversed any of these processes we reverse it a second time, we shall find that we have come back to the original direction of measurement or of reckoning, or to the original kind of operation.

Suppose, however, that at some stage of a calculation our formulæ indicate an alteration in the mode of measurement such that, if the alteration be repeated, a condition of things not the same as, but the reverse of, the original will be produced. Or suppose that, at a certain stage, our transformations indicate that time is to be reckoned in some manner different from future or past, but still in a way having definite algebraical connexion with time which is gone and time which is to come. It is clear that in actual experience there is no process to which such measurements correspond.‡ Time has no meaning except as future or past; and the present is but the meeting point of the two. Or, once more, suppose that we are gravely told that all circles pass through the same two imaginary points at an infinite distance, and that every line drawn through one of these points is perpendicular to itself. On hearing the statement we shall probably whisper, with a smile or a sigh, that we hope it is not true; but that in any case it is a long way off, and perhaps, after all, it does not very much signify. If, however, as mathematicians we are not satisfied to dismiss the question on these terms, we ourselves must admit that we have here reached a definite point of issue. Our science must either give a rational account of the dilemma or yield the position as no longer tenable.

Special modes of explaining this anomalous state of things have occurred to mathematicians. But, omitting details as unsuited to the present occasion, it will, I think,

\* Grunert's "Archiv," vol. vi., p. 337; also separate work, Berlin, 1862.

† "Linear Associative Algebra," by Benjamin Peirce; Washington City, 1870.

‡ Sir W. Thomson, *Cambridge Mathematical Journal*, vol. iii., p. 174. Jevons's "Principles of Science," vol. ii., p. 438. But an explanation of the difficulty seems to me to be found in the fact that the problem, as stated, is one of the conduction of heat, and that the "impossibility" which attaches itself to the expression for the "time" merely means that previous to a certain epoch the conditions which gave rise to the phenomena were not those of conduction, but those of some other action of heat. If, therefore, we desire to comprise the phenomena of the earlier as well as of the later period in one problem, we must find some more general statement, viz., that of physical conditions which at the critical epoch will issue in a case of conduction. I think that Prof. Clifford has somewhere given a similar explanation.

\* See Maxwell "On Heat," chap. xxii.

be sufficient to point out in general terms that a solution of the difficulty is to be found in the fact that the formulæ which give rise to these results are more comprehensive than the signification assigned to them; and when we pass out of the condition of things first contemplated, they cannot (as it is obvious they ought not) give us any results intelligible on that basis. But it does not therefore by any means follow that upon a more enlarged basis the formulæ are incapable of interpretation; on the contrary, the difficulty at which we have arrived indicates that there must be some more comprehensive statement of the problem which will include cases impossible in the more limited, but possible in the wider, view of the subject.

A very simple instance will illustrate the matter. If from a point outside a circle we draw a straight line to touch the curve, the distance between the starting-point and the point of contact has certain geometrical properties. If the starting-point be shifted nearer and nearer to the circle the distance in question becomes shorter, and ultimately vanishes. But as soon as the point passes to the interior of the circle the notion of a tangent and distance to the point of contact cease to have any meaning; and the same anomalous condition of things prevails as long as the point remains in the interior. But if the point be shifted still further, until it emerges on the other side, the tangent and its properties resume their reality, and are as intelligible as before. Now the process whereby we have passed from the possible to the impossible, and again re-passed to the possible (namely, the shifting of the starting-point) is a perfectly continuous one, while the conditions of the problem as stated above have abruptly changed. If, however, we replace the idea of a line touching by that of a line cutting the circle, and the distance of the point of contact by the distances at which the line is intercepted by the curve, it will easily be seen that the latter includes the former as a limiting case, when the cutting line is turned about the starting-point until it coincides with the tangent itself. And further, that the two intercepts have a perfectly distinct and intelligible meaning whether the point be outside or inside the area. The only difference is that in the first case the intercepts are measured in the same direction; in the latter in opposite directions.

The foregoing instance has shown one purpose which these imaginaries may serve, viz., as marks indicating a limit to a particular condition of things, to the application of a particular law, or pointing out a stage where a more comprehensive law is required. To attain to such a law we must, as in the instance of the circle and tangent, reconsider our statement of the problem; we must go back to the principle from which we set out, and ascertain whether it may not be modified or enlarged. And even if in any particular investigation, wherein imaginaries have occurred, the most comprehensive statement of the problem of which we are at present capable fails to give an actual representation of these quantities; if they must for the present be relegated to the category of imaginaries; it still does not follow that we may not at some future time find a law which will endow them with reality, nor that in the meantime we need hesitate to employ them, in accordance with the great principle of continuity, for bringing out correct results.

If, moreover, both in Geometry and in Algebra we occasionally make use of points or of quantities, which from our present outlook have no real existence, which can neither be delineated in space of which we have experience nor measured by scale as we count measurement; if these imaginaries, as they are termed, are called up by legitimate processes of our science; if they serve the purpose not merely of suggesting ideas, but of actually conducting us to practical conclusions; if all this be true in abstract science, I may perhaps be allowed to point out, in illustration of my argument, that in Art unreal forms are frequently used for suggesting ideas, for conveying a meaning for which no others seem to be suitable or adequate. Are not forms unknown to Biology, situations in-

compatible with gravitation, positions which challenge not merely the stability but even the possibility of equilibrium,—are not these the very means to which the artist often has recourse in order to convey his meaning and to fulfil his mission? Who that has ever revelled in the ornamentation of the Renaissance, in the extraordinary transitions from the animal to the vegetable, from faunical to floral forms, and from these again to almost purely geometric curves, who has not felt that these imaginaries have a claim to recognition very similar to that of their congeners in mathematics? How is it that the grotesque paintings of the Middle Ages, the fantastic sculpture of remote nations, and even the rude art of the pre-historic past, still impress us, and have an interest over and above their antiquarian value; unless it be that they are symbols which, although hard of interpretation when taken alone, are yet capable from a more comprehensive point of view of leading us mentally to something beyond themselves, and to truths which, although reached through them, have a reality scarcely to be attributed to their outward forms?

Again, if we turn from Art to Letters, truth to nature and to fact is undoubtedly a characteristic of sterling literature; and yet in the delineation of outward nature itself, still more in that of feelings and affections, of the secret parts of character and motives of conduct, it frequently happens that the writer is driven to imagery, to an analogy, or even to a paradox, in order to give utterance to that of which there is no direct counterpart in recognised speech. And yet which of us cannot find a meaning for these literary figures, an inward response to imaginative poetry, to social fiction, or even to those tales of giant and fairyland written, it is supposed, only for the nursery or schoolroom? But in order thus to reanimate these things with a meaning beyond that of the mere words, have we not to reconsider our first position, to enlarge the ideas with which we started; have we not to cast about for some thing which is common to the idea conveyed and to the subject actually described, and to seek for the sympathetic spring which underlies both; have we not, like the mathematician, to go back as it were to some first principles, or, as it is pleasanter to describe it, to become again as a little child?

Passing to the second of the three methods, viz., that of Manifold Space, it may first be remarked that our whole experience of space is in three dimensions, viz., of that which has length, breadth, and thickness; and for certain purposes we restrict our ideas to two dimensions as in plane geometry, or to one dimension as in the division of a straight line, we do this only by consciously and of deliberate purpose setting aside, but not annihilating, the remaining one or two dimensions. Negation, as Hegel has justly remarked, implies that which is negative, or, as he expresses it, affirms the opposite. It is by abstraction from previous experience, by a limitation of its results, and not by any independent process, that we arrive at the idea of space whose dimensions are less than three.

It is doubtless on this account that problems in plane geometry which, although capable of solution on their own account, become much more intelligible, more easy of extension, if viewed in connection with solid space, and as special cases of corresponding problems in solid geometry. So eminently is this the case, that the very language of the more general method often leads us almost intuitively to conclusions which, from the more restricted point of view, require long and laborious proof. Such a change in the base of operations has, in fact, been successfully made in geometry of two dimensions, and although we have not the same experimental data for the further steps, yet neither the modes of reasoning, nor the validity of its conclusions, are in any way affected by applying an analogous mental process to geometry of three dimensions; and by regarding figures in space of three dimensions as sections of figures in space of four, in the same way that figures in plano are sometimes considered as sections of figures in solid space. The addition of a fourth dimension to space not only extends the actual

properties of geometrical figures, but it also adds new properties which are often useful for the purposes of transformation or of proof. Thus it has recently been shown that in four dimensions a closed material shell could be turned inside out by simple flexure, without either stretching or tearing;\* and that in such a space it is impossible to tie a knot.†

Again, the solution of problems in geometry is often effected by means of algebra; and as three measurements, or co-ordinates as they are called, determine the position of a point in space, so do three letters or measureable quantities serve for the same purpose in the language of algebra. Now, many algebraical problems involving three unknown or variable quantities admit of being generalised so as to give problems involving many such quantities. And as, on the one hand, to every algebraical problem involving unknown quantities or variables by ones, or by twos, or by threes, there corresponds a problem in geometry of one or of two or of three dimensions; so on the other, it may be said that to every algebraical problem involving many variables there corresponds a problem in geometry of many dimensions.

There is, however, another aspect under which even ordinary space presents to us a four-fold, or indeed a manifold, character. In modern Physics, space is regarded, not as a vacuum in which bodies are placed and forces have play, but rather as a plenum with which matter is co-extensive. And from a physical point of view the properties of space are the properties of matter, or of the medium which fills it. Similarly, from a mathematical point of view, space may be regarded as a *locus in quo*, as a plenum, filled with those elements of geometrical magnitude which we take as fundamental. These elements need not always be the same. For different purposes different elements may be chosen; and upon the degree of complexity of the subject of our choice will depend the internal structure or mani-foldness of space.

Thus, beginning with the simplest case, a point may have any singly infinite multitude of positions in a line, which gives a one-fold system of points in a line. The line may revolve in a plane about any one of its points, giving a two-fold system of points in a plane; and the plane may revolve about any one of the lines, giving a three-fold system of points in space.

Suppose, however, that we take a straight line as our element, and conceive space as filled with such lines. This will be the case if we take two planes, *e.g.*, two parallel planes, and join every point in one with every point in the other. Now the points in a plane form a two-fold system, and it therefore follows that the system of lines is four-fold; in other words, space regarded as a plenum of lines is four-fold. The same result follows from the consideration that the lines in a plane, and the planes through a point, are each two-fold.

Again, if we take a sphere as our element we can through any point as a centre draw a singly infinite number of spheres, but the number of such centres is triply infinite; hence space as a plenum of spheres is four-fold. And, generally, space as a plenum of surfaces has a manifoldness equal to the number of constants required to determine the surface. Although it would be beyond our present purpose to attempt to pursue the subject further, it should not pass unnoticed that the identity in the four-fold character of space, as derived on the one hand from a system of straight lines, and on the other from a system of spheres, is intimately connected with the principles established by Sophus Lie in his researches on the correlation of these figures.

If we take a circle as our element we can around any point in a plane as a centre draw a singly infinite system of circles; but the number of such centres in a plane is doubly infinite; hence the circles in a plane form a three-

fold system, and as the planes in space form a three-fold system, it follows that space as a plenum of circles is six-fold.

Again, if we take a circle as our element, we may regard it as a section either of a sphere or of a right cone (given except in position) by a plane perpendicular to the axis. In the former case the position of the centre is four-fold; the directions of the plane, like that of a pencil of lines perpendicular thereto, two-fold; and the radius of the sphere one-fold; six-fold in all. In the latter case, the position of the vertex is three-fold; the direction of the axis two-fold; and the distance of the plane of section one-fold: six-fold in all, as before. Hence space as a plenum of circles is six-fold.

Similarly, if we take a conic as our element, we may regard it as a section of a right cone (given except in position) by a plane. If the nature of the conic be defined, the plane of section will be inclined at a fixed angle to the axis; otherwise it will be free to take any inclination whatever. This being so, the position of the vertex will be three-fold; the direction of the axis two-fold; the distance of the plane of section from the vertex one-fold; and the direction of that plane one-fold if the conic be defined, two-fold if it be not defined. Hence, space as a plenum of definite conics will be seven-fold, as a plenum of conics in general eight-fold. And so on for curves of higher degrees.

This is in fact the whole story and mystery of manifold space. It is not seriously regarded as a reality in the same sense as ordinary space; it is a mode of representation, or a method which, having served its purpose, vanishes from the scene. Like a rainbow, if we try to grasp it, it eludes our very touch; but, like a rainbow, it arises out of real conditions of known and tangible quantities, and if rightly apprehended it is a true and valuable expression of natural laws, and serves a definite purpose in the science of which it forms part.

Again, if we seek a counterpart of this in common life, I might remind you that perspective in drawing is itself a method not altogether dissimilar to that of which I have been speaking; and that the third dimension of space, as represented in a picture, has its origin in the painter's mind, and is due to his skill, but has no real existence upon the canvass which is the groundwork of his art. Or again, turning to literature, when in legendary tales, or in works of fiction, things past and future are pictured as present, has not the poetic fancy correlated time with the three dimensions of space, and brought all alike to a common focus? Or, once more, when space already filled with material substances is mentally peopled with immaterial beings, may not the imagination be regarded as having added a new element to the capacity of space, a fourth dimension of which there is no evidence in experimental fact?

The third method proposed for special remark is that which has been termed Non-Euclidean Geometry; and the train of reasoning which has led to it may be described in general terms as follows:—Some of the properties of space, which on account of their simplicity, theoretical as well as practical, have, in constructing the ordinary system of geometry, been considered as fundamental, are now seen to be particular cases of more general properties. Thus a plane surface and a straight line may be regarded as special instances of surfaces and lines whose curvature is everywhere uniform or constant. And it is perhaps not difficult to see that, when the special notions of flatness and straightness are abandoned, many properties of geometrical figures which we are in the habit of regarding as fundamental will undergo profound modification. Thus a plane may be considered as a special case of the sphere, *viz.*, the limit to which a sphere approaches when its radius is increased without limit. But even this consideration trenches upon an elementary proposition relating to one of the simplest of geometrical figures. In plane triangles the interior angles are together equal to two right angles; but in triangles traced on the surface of a sphere this pro-

\* S. Newcomb, "On Certain Transformations of Surfaces," *American Journal of Mathematics*, vol. i., p. 1.

† Tait "On Knots," *Transactions of the Royal Society of Edinburgh*, vol. xxviii., p. 145; Klein, *Mathematische Annalen*, ix., p. 478.

position does not hold good. To this other instances might be added.

Further, these modifications may affect not only our ideas of particular geometrical figures, but the very axioms of the science itself. Thus, the idea, which in fact lies at the foundation of Euclid's method, viz., that a geometrical figure may be moved in space without change of size or alteration of form, entirely falls away, or becomes only approximate in a space wherein dimension and form are dependent upon position. For instance, if we consider merely the case of figures traced on a flattened globe like the earth's surface, or upon an eggshell, such figures cannot be made to slide upon the surface without change of form, as is the case with figures traced upon a plane or even upon a sphere. But, further still, these generalisations are not restricted to the case of figures traced upon a surface: they may also apply to solid figures in a space whose very configuration varies from point to point. We may, for instance, imagine a space in which our rule or scale of measurement varies as it extends, or as it moves about, in one direction or another; a space, in fact, whose geometric density is not uniformly distributed. Thus we might picture to ourselves such a space as a field having a more or less complicated distribution of temperature, and our scale as a rod instantaneously susceptible of expansion or contraction under the influence of heat: or we might suppose space to be even crystalline in its geometric formation, and our scale and measuring instruments to accept the structure of the locality in which they are applied. These ideas are doubtless difficult of apprehension, at all events at the outset; but Helmholtz has pointed out a very familiar phenomenon which may be regarded as a diagram of such a kind of space. The picture formed by reflexion from a plane mirror may be taken as a correct representation of ordinary space, in which, subject to the usual laws of perspective, every object appears in the same form and of the same dimensions whatever be its position. In like manner, the picture formed by reflexion from a curved mirror may be regarded as the representation of a space wherein dimension and form are dependent upon position. Thus in an ordinary convex mirror objects appear smaller as they recede laterally from the centre of the picture; straight lines become curved; objects infinitely distant in front of the mirror appear at a distance only equal to the focal length behind. And by suitable modifications in the curvature of the mirror, representations could similarly be obtained of space of various configurations.

The diversity in kind of these spaces is of course infinite; they vary with the mode in which we generalise our conceptions of ordinary space; but upon each as a basis it is possible to construct a consistent system of geometry, whose laws, as a matter of strict reasoning, have a validity and truth not inferior to those with which we are habitually familiar. Such systems having been actually constructed, the question has not unnaturally been asked whether there is anything in nature or in the outer world to which they correspond; whether, admitting that for our limited experience ordinary geometry amply suffices, we may understand that for powers more extensive in range or more minute in definition some more general scheme would be requisite? Thus, for example, although the one may serve for the solar system, is it legitimate to suppose that it may fail to apply at distances reaching to the fixed stars or to regions beyond? Or, again, if our vision could discern the minute configuration of portions of space, which to our ordinary powers appear infinitesimally small, should we expect to find that all our usual Geometry is but a special case, sufficient indeed for daily use, but after all only a rough approximation to a truer although perhaps more complicated scheme? Traces of these questions are in fact to be found in the writings of some of our greatest and most original mathematicians. Gauss, Riemann, and Helmholtz have thrown out suggestions radiating as it were in these various directions from a common centre; while Cayley, Sylvester, and Clifford in this

country, Klein in Germany, Lobatcheffsky in Russia, Bolyai in Hungary, and Beltrami in Italy, with many others, have reflected kindred ideas with all the modifications due to the chromatic dispersion of their individual minds. But to the main question the answer must be in the negative. And, to use the words of Newton, since "Geometry has its foundation in mechanical practice," the same must be the answer until our experience is different from what it now is. And yet, all this notwithstanding, generalised conceptions of space are not without their practical utility. The principle of representing space of one kind by that of another, and figures belonging to one by their analogues in the other, is not only recognised as legitimate in pure mathematics, but has long found its application in cartography. In maps or charts, geographical positions, the contour of coasts, and other features, belonging in reality to the earth's surface, are represented on the flat; and to each mode of representation, or projection as it is called, there corresponds a special correlation between the spheroid and the plane. To this might perhaps be added the method of descriptive geometry, and all similar processes in use by engineers, both military and civil.

It has often been asked whether modern research in the field of Pure Mathematics has not so completely outstripped its physical applications as to be practically useless; whether the analyst and the geometer might not now, and for a long time to come, fairly say, "hic artem remumque repono," and turn his attention to Mechanics and to Physics. That the Pure has outstripped the Applied is largely true; but that the former is on that account useless is far from true. Its utility often crops up at unexpected points; witness the aids to classification of physical quantities, furnished by the ideas (of Scalar and Vector) involved in the Calculus of Quaternions; or the advantages which have accrued to Physical Astronomy from Lagrange's Equations, and from Hamilton's Principle of Varying Action; on the value of Complex Quantities, and the properties of general Integrals, and of general theorems on integration for the Theories of Electricity and Magnetism. The utility of such researches can in no case be discounted, or even imagined beforehand. Who, for instance, would have supposed that the Calculus of Forms or the Theory of Substitutions would have thrown much light upon ordinary equations; or that Abelian Functions and Hyperelliptic Transcendents would have told us anything about the properties of curves; or that the Calculus of Operations would have helped us in any way towards the figure of the Earth? But upon such technical points I must not now dwell. If, however, as I hope, it has been sufficiently shown that any of these more extended ideas enable us to combine together, and to deal with as one, properties and processes which from the ordinary point of view present marked distinctions, then they will have justified their own existence; and in using them we shall not have been walking in a vain shadow, nor disquieting our brains in vain.

These extensions of mathematical ideas would, however, be overwhelming if they were not compensated by some simplifications in the processes actually employed. Of these aids to calculation I will mention only two, viz., symmetry of form and mechanical appliances; or, say, Mathematics as a Fine Art, and Mathematics as a Handicraft. And first, as to symmetry of form. There are many passages of algebra in which long processes of calculation at the outset seem unavoidable. Results are often obtained in the first instance through a tangled maze of formulæ, where at best we can just make sure of our process step by step, without any general survey of the path which we have traversed, and still less of that which we have to pursue. But almost within our own generation a new method has been devised to clear this entanglement. More correctly speaking, the method is not new, for it is inherent in the processes of algebra itself, and instances of it, unnoticed perhaps or disregarded, are to be found cropping up throughout nearly all mathematical treatises.

By Lagrange, and to some extent also by Gauss, among the older writers, the method of which I am speaking was recognised as a principle; but beside these perhaps no others can be named until a period within our own recollection. The method consists in symmetry of expression. In algebraical formulæ combinations of the quantities entering therein occur and recur; and by a suitable choice of these quantities the various combinations may be rendered symmetrical, and reduced to a few well known types. This having been done, and one such combination having been calculated, the remainder, together with many of their results, can often be written down at once, without further calculations, by simple permutations of the letters. Symmetrical expressions, moreover, save as much time and trouble in reading as in writing. Instead of wading laboriously through a series of expressions which, although successively dependent, bear no outward resemblance to one another, we may read off symmetrical formulæ, of almost any length, at a glance. A page of such formulæ becomes a picture: known forms are seen in definite groupings; their relative positions, or perspective as it may be called, their very light and shadow, convey their meaning almost as much through the artistic faculty as through any conscious ratiocinative process. Few principles have been more suggestive of extended ideas or of new views and relations than that of which I am now speaking. In order to pass from questions concerning plane figures to those which appertain to space, from conditions having few degrees of freedom to others which have many—in a word, from more restricted to less restricted problems—we have in many cases merely to add lines and columns to our array of letters or symbols already formed, and then read off pictorially the extended theorems.

Next as to mechanical appliances. Mr. Babbage, when speaking of the difficulty of ensuring accuracy in the long numerical calculations of theoretical astronomy, remarked, that the science which in itself is the most accurate and certain of all had, through these difficulties, become inaccurate and uncertain in some of its results. And it was doubtless some such consideration as this, coupled with his dislike of employing skilled labour where unskilled would suffice, which led him to the invention of his calculating machines. The idea of substituting mechanical for intellectual power has not lain dormant; for beside the arithmetical machines whose name is legion (from Napier's Bones, Earl Stanhope's calculator, to Schultz and Thomas's machines now in actual use) an invention has lately been designed for even a more difficult task. Prof. James Thomson has in fact recently constructed a machine which, by means of the mere friction of a disk, a cylinder, and a ball, is capable of effecting a variety of the complicated calculations which occur in the highest application of mathematics to physical problems.\* By its aid it seems that an unskilled labourer may, in a given time, perform the work of ten skilled arithmeticians. The machine is applicable alike to the calculation of tidal, of magnetic, of meteorological, and perhaps also of all other periodic phenomena. It will solve differential equations of the second and perhaps of even higher orders. And through the same invention the problem of finding the free motions of any number of mutually attracting particles, unrestricted by any of the approximate suppositions required in the treatment of the Lunar and Planetary Theories, is reduced to the simple process of turning a handle.

When Faraday had completed the experimental part of a physical problem, and desired that it should thenceforward be treated mathematically, he used irreverently to say, "Hand it over to the calculators." But truth is ever stranger than fiction; and if he had lived until our day, he might with perfect propriety have said, "Hand it over to the machine."

Had time permitted, the foregoing topics would have led me to point out that the mathematician, although

concerned only with abstractions, uses many of the same methods of research as are employed in other sciences, and in the arts, such as observation, experiment, induction, imagination. But this is the less necessary because the subject has been already handled very ably, although with greater brevity than might have been wished, by Professor Sylvester in his address to Section A. at our meeting at Exeter.

In an exhaustive treatment of my subject there would still remain a question which in one sense lies at the bottom of all others, and which through almost all time has had an attraction for reflective minds, viz., What was the origin of mathematical ideas? Are they to be regarded as independent of, or dependent upon, experience? The question has been answered sometimes in one way and sometimes in another. But the absence of any satisfactory conclusion may after all be understood as implying that no answer is possible in the sense in which the question is put; or rather that there is no question at all in the matter, except as to the history of actual facts. And, even if we distinguish, as we certainly should, between the origin of ideas in the individual and their origin in a nation or mankind, we should still come to the same conclusion. If we take the case of the individual, all we can do is to give an account of our own experience; how we played with marbles and apples; how we learnt the multiplication table, fractions, and proportion; how we were afterwards amused to find that common things conformed to the rules of number; and later still, how we came to see that the same laws applied to music and to mechanism, to astronomy, to chemistry, and to many other subjects. And then, on trying to analyse our own mental processes, we find that mathematical ideas have been imbibed in precisely the same way as all other ideas, viz., by learning, by experience, and by reflexion. The apparent difference in the mode of first apprehending them and in their ultimate cogency arises from the difference of the ideas themselves, from the preponderance of quantitative over qualitative considerations in mathematics, from the notions of absolute equality and identity which they imply.

If we turn to the other question, How did the world at large acquire and improve its idea of number and of figures? How can we span the interval between the savage who counted only by the help of outward objects, to whom 15 was "half the hands and both the feet," and Newton or Laplace? The answer is the history of mathematics and its successive developments, arithmetic, geometry, algebra, &c. The first and greatest step in all this was the transition from number in the concrete to number in the abstract. This was the beginning not only of mathematics but of all abstract thought. The reason and mode of it was the same as in the individual. There was the same general influx of evidence, the same unsought-for experimental proof, the same recognition of general laws running through all manner of purposes and relations of life. No wonder then if, under such circumstances, mathematics, like some other subjects and perhaps with better excuse, came after a time to be clothed with mysticism; nor that, even in modern times, they should have been placed upon an *à priori* basis, as in the philosophy of Kant. Number was so soon found to be a principle common to many branches of knowledge that it was readily assumed to be the key to all. It gave distinctness of expression, if not clearness of thought, to ideas which were floating in the untutored mind, and even suggested to it new conceptions. In "the one," "the all," "the many in one," (terms of purely arithmetic origin,) it gave the earliest utterance to men's first crude notions about God and the world. In "the equal," "the solid," "the straight," and "the crooked," which still survive as figures of speech among ourselves, it supplied a vocabulary for the moral notions of mankind, and quickened them by giving them the power of expression. In this lies the great and enduring interest in the fragments which remain to us of the Pythagorean philosophy.

\* *Proceedings of the Royal Society*, Feb. 3, 1876, and May 9, 1878.

The consecutive processes of Mathematics led to the consecutive processes of Logic; but it was not until long after mankind had attained to abstract ideas that they attained to any clear notion of their connection with one another. In process of time the leading ideas of Mathematics became the leading ideas of Logic. The "one" and the "many" passed into the "whole" and its "parts;" and thence into the "universal" and the "particular." The fallacies of Logic, such as the well-known puzzle of Achilles and the tortoise, partake of the nature of both sciences. And perhaps the conception of the infinite and the infinitesimal, as well as of negation, may have been in early times transferred from Logic to Mathematics. But the connection of our ideas of number is probably anterior to the connection of any of our other ideas. And as a matter of fact, geometry and arithmetic had already made considerable progress when Aristotle invented the syllogism.

General ideas there were, beside those of mathematics—true flashes of genius which saw that there must be general laws to which the universe conforms, but which saw them only by occasional glimpses, and through the distortion of imperfect knowledge; and although the only records of them now remaining are the inadequate representations of later writers, yet we must still remember that to the existence of such ideas is due not only the conception, but even the possibility of Physical Science. But these general ideas were too wide in their grasp, and in early days at least were connected to their subjects of application by links too shadowy, to be thoroughly apprehended by most minds; and so it came to pass that one form of such an idea was taken as its only form, one application of it as the idea itself; and philosophy, unable to maintain itself at the level of ideas, fell back upon the abstractions of sense, and, by preference, upon those which were most ready to hand, namely, those of mathematics. Plato's ideas relapsed into a doctrine of numbers; mathematics into mysticism, into neo-Platonism, and the like. And so, through many long ages, through good report and evil report, mathematics have always held an unsought-for sway. It has happened to this science as to many other subjects, that its warmest adherents have not always been its best friends. Mathematics have often been brought into matters where their presence has been of doubtful utility. If they have given precision to literary style, that precision has sometimes been carried to excess, as in Spinoza and perhaps Descartes; if they have tended to clearness of expression in philosophy, that very clearness has sometimes given an appearance of finality not always true; if they have contributed to definition in theology, that definiteness has often been fictitious, and has been attained at the cost of spiritual meaning. And, coming to recent times, although we may admire the ingenuity displayed in the logical machines\* of Earl Stanhope and of Stanley Jevons, in the "Formal Logic" of De Morgan, and in the "Calculus" of Boole;† although as mathematicians we may feel satisfaction that these feats (the possibility of which was clear *à priori*) have been actually accomplished; yet we must bear in mind that their application is really confined to cases where the subject matter is perfectly uniform in character, and that beyond this range they are liable to encumber rather than to assist thought.

\* For example, in Herbart's "Psychologie."

† A specimen will be found in the "Moralia" of Gregory the Great, Lib. I., c. xiv., of which I quote only the arithmetical part:

"Quid in septenario numero, nisi summa perfectionis accipitur? Ut enim humanæ rationis causas de septenario numero taceamus, quæ afferunt, quod idcirco perfectus sit, quia exprimo pari constat, et primo, impari; ex primo, qui dividi potest, et primo, qui dividi non potest; certissimè scimus, quod septenarium numerum Scriptura Sacra pro perfectione ponere consuevit. . . . A septenario quippe numero in duodenarium surgitur. Nam septenarius suis in se partibus multiplicatus, ad duodenarium tenditur. Sive enim quatuor per tria, sive per quatuor tria ducantur, septem in duodecim vertuntur. . . . Jam superius dictum est quod in quinquagenario numero, qui septem hebdomadibus ac monade additâ impletur, requies designatur; denario autem numero summa perfectionis exprimetur."

Not unconnected with this intimate association of ideas and their expression is the fact that, whichever may have been cause, whichever effect, or whether both may not in turn have acted as cause and effect, the culminating age of classic art was contemporaneous with the first great development of mathematical science. In an earlier part of this discourse I have alluded to the importance of mathematical precision recognised in the technique of art during the Cinquecento; and I have now time only to add that on looking still further back‡ it would seem that sculpture and painting, architecture and music, nay even poetry itself, received a new, if not their first true, impulse at the period when geometric form appeared fresh chiselled by the hand of the mathematician, and when the first ideas of harmony and proportion rang joyously together in the morning tide of art.

Whether the views on which I have here insisted be in any way novel, or whether they be merely such as from habit or from inclination are usually kept out of sight, matters little. But whichever be the case, they may still furnish a solvent of that rigid aversion which both Literature and Art are too often inclined to maintain towards Science of all kinds. It is a very old story that, to know one another better, to dwell upon similarities rather than upon diversities, are the first stages towards a better understanding between two parties; but in few cases has it a truer application than in that here discussed. To recognise the common growth of scientific and other instincts until the time of harvest is not only conducive to a rich crop, but it is also a matter of prudence, lest in trying to root up weeds from among the wheat, we should at the same time root up that which is as valuable as wheat. When Pascal's father had shut the door of his son's study to mathematics, and closeted him with Latin and Greek, he found on his return that the walls were teeming with formulæ and figures, the more congenial product of the boy's mind. Fortunately for the boy, and fortunately also for Science, the mathematics were not torn up, but were suffered to grow together with other subjects. And all said and done, the lad was not the worse scholar or man of letters in the end. But, truth to tell, considering the severance which still subsists in education and during our early years between Literature and Science, we can hardly wonder if when thrown together in the afterwork of life they should meet as strangers; or if the severe garb, the curious implements, and the strange wares of the latter should seem little attractive when contrasted with the light companionship of the former. The day is yet young, and in the early dawn many things look weird and fantastic which in fuller light prove to be familiar and useful. The out-comings of Science, which at one time have been deemed to be but stumbling-blocks scattered in the way, may ultimately prove stepping stones which have been carefully laid to form a pathway over difficult places for the children of "sweetness and of light."

The instances on which we have dwelt are only a few out of many in which Mathematics may be found ruling and governing a variety of subjects. It is as the supreme result of all experience, the framework in which all the varied manifestations of Nature have been set, that our science has laid claim to be the arbiter of all knowledge. She does not indeed contribute elements of fact, which must be sought elsewhere; but she sifts and regulates

‡ Approximate dates B.C. of—

Sculptors, Painters, and Poets.	Mathematicians.
Stesichorus, 600.	Thales, 600.
Pindar, 522-442.	Pythagoras, 550.
Æschylus, 500-450.	Anaxagoras, 500-450.
Sophocles, 495-400.	Hippocrates, 460.
Euripides, 480-400.	
Phidias, 488-432.	
Praxiteles, 450-400.	Theætetus, 440.
Zeuxis, 400.	Archytas, 400.
Apelles, 350.	
Scopas, 350.	Euclid, 323-284.

them: she proclaims the laws to which they must conform if those elements are to issue in precise results. From the data of a problem she can infallibly extract all possible consequences, whether they be those first sought or others not anticipated; but she can introduce nothing which was not latent in the original statement. Mathematics cannot tell us whether there be or be not limits to time or space; but to her they are both of indefinite extent, and this in a sense which neither affirms nor denies that they are either infinite or finite. Mathematics cannot tell us whether matter be continuous or discrete in its structure; but to her it is indifferent whether it be one or the other, and her conclusions are independent of either particular hypothesis. Mathematics can tell us nothing of the origin of matter; of its creation or its annihilation she deals only with it in a state of existence; but within that state its modes of existence may vary from our most elementary conception to our most complex experience. Mathematics can tell us nothing beyond the problems which she specifically undertakes; she will carry them to their limit, but there she stops, and upon the great region beyond she is imperturbably silent.

Conterminous with space and coeval with time is the kingdom of Mathematics; within this range her dominion is supreme; otherwise than according to her order nothing can exist; in contradiction to her laws nothing takes place. On her mysterious scroll is to be found written for those who can read it that which has been, that which is, and that which is to come. Everything material which is the subject of knowledge has number, order, or position; and these are her first outlines for a sketch of the universe. If our more feeble hands cannot follow out the details, still her part has been drawn with an unerring pen, and her work cannot be gainsayed. So wide is the range of mathematical science, so indefinitely may it extend beyond our actual powers of manipulation, that at some moments we are inclined to fall down with even more than reverence before her majestic presence. But so strictly limited are her promises and powers, about so much that we might wish to know does she offer no information whatever, that at other moments we are fain to call her results but a vain thing, and to reject them as a stone when we had asked for bread. If one aspect of the subject encourages our hopes, so does the other tend to chasten our desires; and he is perhaps the wisest, and in the long run the happiest among his fellows, who has learnt not only this science, but also the larger lesson which it indirectly teaches, namely, to temper our aspirations to that which is possible, to moderate our desires to that which is attainable, to restrict our hopes to that of which accomplishment, if not immediately practicable, is at least distinctly within the range of conception. That which is at present beyond our ken may, at some period and in some manner as yet unknown to us, fall within our grasp; but our science teaches us, while ever yearning with Goethe for "Light, more light," to concentrate our attention upon that of which our powers are capable, and contentedly to leave for future experience the solution of problems to which we can at present say neither yea nor nay.

It is within the region thus indicated that knowledge in the true sense of the word is to be sought. Other modes of influence there are in society and in individual life, other forms of energy beside that of intellect. There is the potential energy of sympathy, the actual energy of work; there are the vicissitudes of life, the diversity of circumstance, health, and disease, and all the perplexing issues, whether for good or for evil, of impulse and of passion. But although the book of life cannot at present be read by the light of Science alone, nor the wayfarers be satisfied with the few loaves of knowledge now in our hands, yet it would be difficult to overstate the almost miraculous increase which may be produced by a liberal distribution of what we already have, and by a restriction of our cravings within the limits of possibility.

In proportion as method is better than impulse, deli-

berate purpose than erratic action, the clear glow of sunshine than irregular reflexion, and definite utterances than an uncertain sound; in proportion as knowledge is better than surmise, proof than opinion; in that proportion will the mathematician value a discrimination between the certain and the uncertain, and a just estimate of the issues which depend upon one motive power or the other. While on the one hand he accords to his neighbours full liberty to regard the unknown in whatever way they are led by the noblest powers that they possess, so on the other he claims an equal right to draw a clear line of demarcation between that which is a matter of knowledge and that which is at all events something else, and to treat the one category as fairly claiming our assent, the other as open to further evidence. And yet, when he sees around him those whose aspirations are so fair, whose impulses are so strong, whose receptive faculties so sensitive, as to give objective reality to what is often but a reflex from themselves, or a projected image of their own experience, he will be willing to admit that there are influences which he cannot as yet either fathom or measure, but whose operation he must recognise among the facts of our existence.

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## ADDRESS TO THE CHEMICAL SECTION

BY

Professor MAXWELL SIMPSON, M.D., F.R.S.,  
President of the Section.

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My position here is a highly honourable, but by no means a comfortable one. Naturally, you expect to hear from me something new about the Science which occupies the attention of this Section, and I have the miserable feeling that I must disappoint you. How can I possibly find a fact in Chemistry with which you are not already acquainted? If, in order to cater for you, I go to France, Germany, Russia, or America, I find the abstractors of the Chemical Society have been there before me, and have swept everything of value into their *Journal*. Chemists are now kept perfectly acquainted with the progress of Science in every part of the world, and therefore the *raison d'être* of this Address, so far as announcing the discoveries of the year is concerned, has passed away. I therefore propose, instead of giving you a concentrated essence of the last twelve numbers of the *Journal of the Chemical Society*, to bring before you the claims of this Science to a place in general education, and the claims of original research to a place in the curriculum for higher degrees in our Universities.

I have been devoted to Chemistry all my life. It has been my business and my pleasure. The longer I live the more deeply am I impressed with the advantages to be derived from its study, and I am anxious that these advantages should be shared by the rising generation.

Whether we take into account the value of the knowledge acquired, the discipline of the intellectual faculties in acquiring that knowledge, or the effect on the character, surely we have a right to give the study of this Science a prominent place in our Schools and colleges. It would be difficult to over-estimate the value and extent of the knowledge we derive from Chemistry. Without it we can know nothing about the air we breathe, the water we drink, or the food we eat; we cannot understand the processes of combustion, respiration, fermentation, or putrefaction, or the endless chemical changes which are continually in operation around us, and which affect our lives for good or for evil. In a word, the whole of the phenomena of Nature must for ever remain to us, more or less, an inscrutable mystery.

Again, is it not desirable that we should have some acquaintance with the Chemical Arts, from which we derive so many of our comforts and luxuries? Should we not know something of the arts of photography, dyeing, me-

tallurgy—something of the manufacture of glass and china, and of the thousand beautiful things that are constantly in our hands? Not only is the knowledge we obtain from Chemistry very considerable in itself, but it furnishes us with a key which enables us to unlock vast stores of knowledge contained in several other sciences—these are, Physics, Geology, Mineralogy, Physiology, and I may now add, Astronomy. Physics and Chemistry are so intimately connected that it is difficult to say where the one begins and the other ends. The help that Chemistry gives to Physics is shown by the number of chemists who have distinguished themselves as physicists. I may mention a few belonging to our own time—Andrews, Bunsen, Faraday, Frankland, Graham, Guthrie, and Regnault.

With regard to mental discipline, the mind of the student is exercised in both the inductive and deductive methods of reasoning. His original faculties are stimulated by the consciousness that he can in many cases readily test the worth of his ideas by experiment. With inexpensive apparatus and a good balance, the intelligent student can make out for himself some of the laws and many of the facts of the Science, and it may be, also, add to them. He glides insensibly from the known to the unknown. Indeed, his spirit of inquiry demands, in most cases, to be curbed rather than spurred. Some students are constantly finding out new methods of analysis or discovering the precious metals in impossible places.

The readiness with which we can cross over into the *terra incognita* of Chemistry, and make little explorations there, constitutes in my opinion the great charm of this science, and, to a great extent, its value as an educational agent. What I wish to insist upon is, that the student of Chemistry can reach the field of original work sooner than the student of most other sciences. Once he commences original research, the development of his intellectual faculties rapidly progresses. His imagination is daily exercised in propounding new theories, and devising experiments in order to ascertain their truth or falsehood. And what more valuable intellectual training can there be than the habit of subjecting our ideas to the test of inexorable experiment? In the world outside Chemistry we are, alas! too ready to take things for granted. The chemist's motto is *prove all things*. The ancients adopted a different method: they assumed certain principles and reasoned from them. They therefore did little in science.

Chemistry promotes in a remarkable manner accuracy, thoroughness, and circumspection. An organic analysis requires six weighings: if any one of these is inaccurate, the results are worthless. A qualitative test carelessly applied may cause us, in a research, to waste months in the pursuit of a phantom or Will-o'-the-Wisp which can have no corporeal existence. If we have to employ absolute alcohol in our experiments, we must not be satisfied with going through the ceremony of making it absolute, but we must assure ourselves that it *is* absolute. Unless we are sure of every step in our research, our results become doubtful, and therefore of no value.

On the circumspection, also, of the original worker large demands are made. The avenues by which error may creep in and vitiate his results are very numerous. These he must foresee, and endeavour to close up. Laboratory work teaches us to use our senses aright, sharpens our powers of observation, and prevents us from reasoning rashly from appearances. It also promotes manual dexterity, and trains the hands to work in subordination to the head.

Perhaps in no other science is the student so deeply impressed with the order and economy of Nature, the immutability of her laws, and the exactness of her operations. These impressions will, no doubt, in after life impart seriousness to his character, and save him from the adoption of many a wild theory.

I come now to the effect of original work on the character. Many virtues are necessary to the chemist—courage, resolution, truthfulness, and patience. He is often obliged to perform experiments which are attended with great

danger, and no man can hope to fight long with the elements without carrying away many a scar. Sometimes fatal accidents occur. Many years ago, Mr. Hennel, of the Apothecaries' Hall, London, lost his life by the explosion of a fulminating powder which he was preparing for the East India Company. And many of us recollect the sad death of young Mr. Chapman, a distinguished chemist whom I had the pleasure of knowing, who was literally blown to atoms while working in the Hartz Mountains on a new dynamite which he had himself discovered. I must tell the ladies, however, that accidents are not always so disastrous, but that often one may escape with merely the loss of an eye. But the chemist must not be discouraged by fear of accident, neither must he be disheartened by the temporary failure of his experiments, nor at the slowness of his processes. Bunsen was obliged to evaporate 44 tons of the waters of the Dürcheim springs in order to obtain 200 grains of his new metal, Cæsium. It took Berthelot several months to form, by a series of synthetical operations, an appreciable quantity of alcohol from water and carbon, derived from carbonate of baryta. Many years ago, in the laboratory of Wurtz—my honoured master—a poor student, whom I knew, was carrying from one room to another a glass globe, which contained the product of a month's continuous labour, when the bottom of the globe fell out, and the contents were lost. Nothing daunted, he re-commenced his month's work, and brought his research to a successful issue.

Above all things, the chemist must be *true*. He must not allow his wishes to bias his judgment or prevent him from seeing his researches in their true light. He must not be satisfied that his results appear true, but he must believe them to be true; and having faithfully performed his experiments, he must record them faithfully. He may often be obliged to chronicle his own failures and describe operations that tell against his own theories, but this hard test of his truthfulness he must not shrink from.

But I must not weary you with the virtues of the chemist. If I have succeeded in showing that the pursuit of this Science tends largely to develop the intellect and discipline the character, I think I have done something for Chemistry. We are told by Bishop Butler that "habits of virtue acquired by discipline are improvement in virtue, and improvement in virtue must be advancement in happiness."

I am glad to see that the importance of original research as a part of higher education is at last beginning to be recognised in this country. The Royal University Commission at Oxford has recently recommended that candidates for the higher degrees in science shall in that University be required in future to work out an original investigation. In Germany, where education has been so long and so well understood, original work has been, for at least the last half century, a *sine qua non* for a degree. Another admirable rule exists in that country, the adoption of which in Great Britain might go far to wash out the stain from our islands, of not having contributed our fair quota to the advancement of human knowledge. It is this—the Germans make a point of securing invariably that their scientific chairs shall be filled by men who have already distinguished themselves by their discoveries. The Professor, on his appointment, naturally desires to continue his investigations, and endeavours to secure, and usually succeeds in securing, the assistance of his pupils. This is a mutual advantage. The Professor is able to do more work for Science, and the student, on his part, learns to conduct for himself an original investigation. Hence there is always a rising generation of original workers in Germany, who turn out papers, more or less meritorious, with the rapidity of a Walter's press. They are stimulated by the hope of one day arriving themselves at a Professor's chair, the path to which they are well assured is only through the toilsome field of original work. But I must not wrong the German student by the implication of a purely selfish motive in his work. His labour is one of love, and his ambition, for the time at

east, is bounded by the desire to *do something* for science. And from a multitude of such enthusiasts the great Professors come. Great mountains are only found in mountainous countries.

I find myself insensibly led to speak of the encouragement of research in this country; and although it has been very largely discussed in scientific circles, I will venture to add a few words. To promote original work here, I believe it is indispensable that our Professors should be well paid. It would save them from the necessity of supplementing their incomes by commercial analyses, and thus enable them to devote their spare time to original work. And to secure that they shall have spare time, I would like to see in every laboratory a competent assistant, who would occasionally be able to take up the Professor's lectures should he be engaged in important work. There are many around me who know how very exacting original investigation is, and how necessary it is, at times, to be able to work on without interruption; bits and scraps of time being of no value. I am glad to see that the Oxford Commission also recommends the appointment of well-paid assistants. Well-paid Professorships and well-paid Assistantships would be attractive prizes for our students to work up to; and if it were clearly understood that the only way to these prizes was through original investigation, we should very soon have an army of zealous and competent workers.

The plan of appointing a staff of original workers unconnected with teaching has been proposed; but I do not approve of it. The original worker is, as a rule, the best teacher, and the rising generation of students should not be deprived of the advantage of his instruction. Moreover, as I said before, the Professor may be greatly assisted by his pupils.

No doubt the Government Grant Fund does a good deal for science, but the field of its operations is, under present conditions, limited. Professors, as a rule, are so occupied with teaching that they cannot avail themselves of the fund; and of those students who might be competent and willing, very few can afford to do so. Instead of trusting to the precarious and insufficient support of the fund, they must endeavour to settle themselves permanently in life.

It is much to be regretted that the Universities of Oxford and Cambridge, with such splendid revenues at their disposal, should contribute so little to the advancement of Physical Science. I hope the day is not far distant when the Fellowships—or at least a few of them—which now go to reward young men for merely passing a good examination, shall be given *without examination* to men who shall have advanced human knowledge in any department. At present a Fellowship of £250 or £300 a-year, lasting ten or twelve years, and in some cases for life, may be obtained on showing proof of a good memory—or, at most, a capacity for assimilating other men's ideas. To make discoveries—to follow out a new train of thought, and establish it by experiments specially devised to that end—has been left not only without reward, but almost without recognition, in our two principal seats of learning. Is it to be so always? The world at large, ignorant as it is, has a sounder instinct on this subject, and the man who makes the humblest addition to the stock of knowledge in the world rarely fails to receive the world's respect and honour.

The suggestions I have ventured to make could not, of course, be well carried out, unless the Government take into its own hands the appointment to all Scientific Chairs. Of this I think I see indications. I believe that sooner or later the Government will assume the supreme direction of education in this country. It has already taken Primary Education under its control, and quite recently, here in Ireland, Intermediate Education to a great extent. And does the appointment of so many University Commissions not show a disposition on the part of the Government to assume the direction of Higher Education also?

## NOTES FROM THE PARIS EXHIBITION.

## A METHOD OF ECONOMICAL EVAPORATION.

AMONGST the many curious and interesting machines exhibited at the Paris Exhibition of 1878, one for the cheap evaporation of salt solutions is well worthy of notice. It serves for the separation of salt from water in places where fuel is difficult to be obtained, and better still where there is a waterfall.

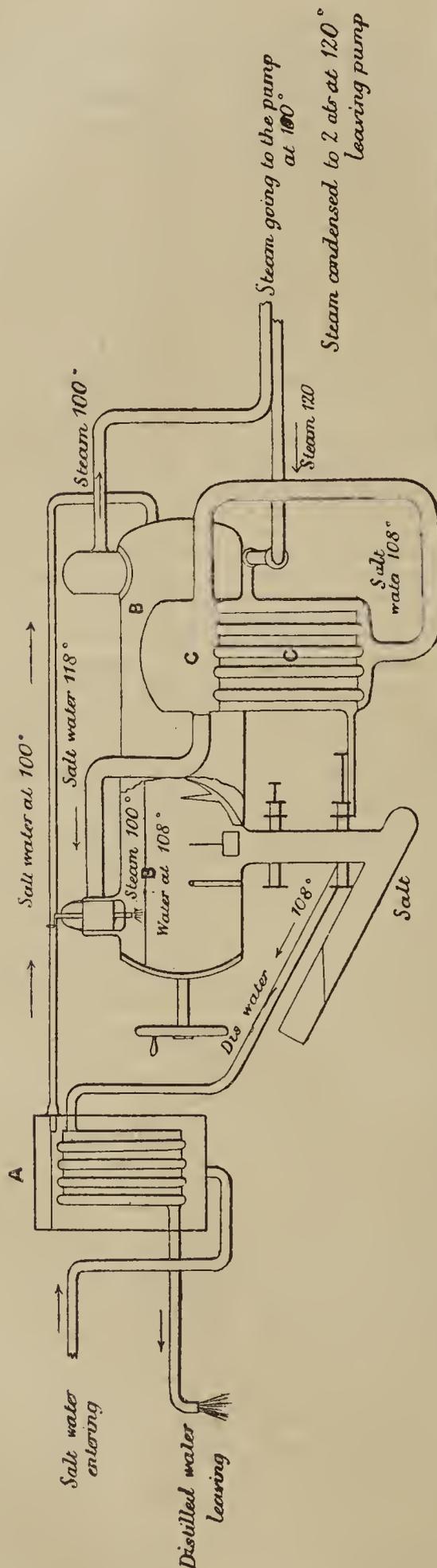
It is well known that to raise the temperature of water from  $0^{\circ}$  to  $100^{\circ}$  C. it is necessary to use up 100 calorific units for each litre; and further, to transform this water at  $100^{\circ}$  into steam at  $100^{\circ}$ , 530 more units have to be expended, so that altogether 630 units will have been used. The first 100 units give specific heat to the water, the other 530 give latent heat to the steam. Now nearly all this heat, which is produced by a large consumption of fuel, escapes in the steam; but if by some contrivance the ultimate result came out as cold water which had left its heat in the apparatus, there would be no further need of a fire to carry on the evaporation, and thus a great item of expense—viz., of fuel—would be saved.

Now an apparatus to do this work must be hermetically closed, so that no air can get mixed with the steam inside; and also, although closed, it must be so constructed that the precipitated salt can be withdrawn regularly. Admitting that these conditions could be fulfilled, let us see how the heat of the steam could be utilised.

If the steam is taken by means of a pipe to the water which is to be evaporated, the steam will be condensed if the water is colder than the steam, and the latent heat of the steam—viz., 530 calorific units—will be transferred to the water. There are two ways in which this can be accomplished:—First, when there is an hydraulic force at hand, the steam formed in the boiler is compressed by means of a pump; this raises its temperature; it then suffices to pass it back into the boiler in which it has been produced, to condense it entirely: thus the latent heat absorbed by the steam in forming is made to pass back into the salt water. Secondly, when there is not an hydraulic force at hand, the temperature of the steam cannot be raised by compression; but it is made to pass into a second boiler a little colder than the first, where it is condensed; then the steam from the second is made to pass into a third, still colder, and so it is continued. This latter method has been employed for some time in distilleries and sugar-factories,—therefore it is needless to enlarge upon it here.

I now come to the description of the apparatus, a general view of which is here given. The salt water on arriving passes through a wooden tank, A, furnished with tubes inside; it then enters the principal boiler, B, where it is partly heated by the steam there; then it goes into a second boiler, C, where it is heated under pressure: from there it returns to B, where, the pressure being taken off, causes some of the water to turn into steam by means of the extra heat it gives out. From B the steam passes to the pump, where it is compressed; then back again to C, which is furnished with tubes inside like A; but in this instance the steam passes through the tubes instead of, like the water, going through the tank itself. After having traversed all the tubes in C it is carried along back to A, where it passes through the tubes, and at last escapes from A in the state of cold water. Let us now return to the principal boiler, B. It is a long cylinder, having several tubes connecting it with other parts of the apparatus. At one end it is joined to C by means of a small iron cylinder, which is fitted with valves worked so as to keep the water in C under slight pressure, and therefore a little lower than in B. At the opposite side of C there is another tube which conducts the water into B again, where, as before mentioned, it is turned into steam; thus there is a constant stream flowing between B and C. At the bottom of B there is a long curved tube, shaped something like the letter J, which is

## Elevation and Part Section



fitted with two valves, one above the other. When the salt is precipitated in B it is pushed over the edge of the tube by means of revolving arms inside. The upper valve being open, the salt falls on to the lower one: the upper one is then shut and the lower opened, and the salt falls into a bag placed to receive it. The valves are then put into their former positions for the next lot of salt. As the tube is a curved one, and the level of the water is kept higher than the lower valve, no air enters the boiler. It will thus be seen that salt water going in cold comes out as salt and cold water; but, as perhaps it may not be understood how this takes place, I will go over the whole operation, giving the different temperatures.

The salt water enters A cold, but as the effluent about to escape from the tubes in A is at  $100^{\circ}$ , it loses its heat and the water round the tubes acquires it. The water then heated to  $100^{\circ}$  enters the boiler B; from thence it goes into C, where it is under slight pressure. The steam already in B is sucked out by the pump, and is forced into the tubes in C under the pressure of two atmospheres. This pressure raises its temperature to  $120^{\circ}$ ; but as the water surrounding the tubes is colder, viz.,  $108^{\circ}$ , the steam loses  $12^{\circ}$  of its heat, some of which passes into the water, which is raised to  $118^{\circ}$ . From C the water passes into B, where the water is at  $108^{\circ}$ ; and owing to the greater heat of the newly-arriving water a quantity of salt is precipitated, and is taken out as explained above. The steam which was in the tubes in C is condensed into water by losing some of its heat, and passing along a tube it enters the tubes of A at the temperature of  $108^{\circ}$ , and there transfers its heat to the cold water which is continually arriving, and, as before mentioned, the water leaves the tubes cold and free from salt.

From the facts here stated it can easily be understood that when the boiler is once heated there is no further need of a fire, as the heat is always kept inside. However, to prevent as much as possible any loss of heat from radiation, the whole apparatus is encased in sawdust, and, as a further precaution, the steam is put under a little more pressure than is necessary, and thus it is a little hotter than need be; but to prevent the heat gradually increasing, a small quantity of steam is allowed to escape occasionally, therefore the apparatus is kept as nearly as possible at an invariable heat.

M. Piccard, the inventor of this machine, has calculated that to produce 1000 tons of salt in a year, counting 300 days, the condenser or large boiler B must have 40 square metres of surface, and the force of the machine should be equal to thirty horses. Even if a small engine was used to work the pump there would be a great saving of fuel; but if (as I mentioned at the commencement) the works are situated near a waterfall, there will be no need of one, as the pump can be worked by means of a turbine, and therefore the only need of a fire will be to heat up the boiler at the commencement of a new operation, or when the machine has to be stopped to be cleaned.

H. C.

ON SOME  
SIMPLE LABORATORY MANIPULATIONS.By Dr. P. TOWNSEND AUSTEN, F.C.S.,  
Assistant Professor of Analytical Chemistry in Rutgers College.

## FOURTH PAPER.

*Removing Precipitates from Folded Filters.*

THE ease with which a folded filter is made, and the rapidity with which it filters, are more than counterbalanced by the difficulty with which the precipitate is removed from it. If a spatula is used the paper is quite sure to break. Making a hole in the paper and washing

the precipitate down through it is a slovenly operation, and takes time and much water.

By the use of the following method\* it can be removed easily. After washing the precipitate down to the point, remove the filter, and place it on a round flat glass† somewhat larger than the paper. Carefully pull the paper out on the sides, when it will be found that the folds will come out, and the wet paper will adhere closely to the glass. The precipitate can now easily be removed by means of a spatula; or by holding the glass plate nearly vertical, and manipulating a small stream of water against it, it can be washed completely off the paper, and, with a little care, into a vessel with a small mouth—a test-tube for example.

#### Washing Glass.

Such a subject may seem *too* simple, but yet the more I see students at their work the more I am impressed with the fact that but few know how to wash a beaker glass clean.

Some time since I took beakers from various students in my laboratory (which they had washed and put away), and held them under a powerful stream of water until they were thoroughly wet. On taking them from under the spout, in almost every case the water ran off the glass in spots, showing that the glass was greasy.

The best thing to wash beakers, &c., with (according to my experience) is sand-soap. Naturally, the sand must not be sharp. The soaps containing infusorial earth are most excellent for this purpose. Borax soap is also very efficacious. A piece of board about 20 c.m. long, 15 c.m. wide, and 4 c.m. thick, should be screwed on to the right (inside) of the sink. In this block a rectangular hole, about 2 c.m. deep and 1 c.m. smaller than the section of the soap when stood on its long end, is to be cut. The bottom of the cake of soap is then whittled away so that it fits tightly in the hole. It is now moistened and pushed into the aperture, where it remains tightly fixed. By wetting the right hand thoroughly and rubbing on this soap ridge a good lather is made. With the soapy hand the glass is rubbed and washed until, on taking it from under the stream, no oily spots appear, the glass appearing wet all over. The beaker is then dried with a good towel ("glass towel"), and finally polished with a piece of chamois or kid leather. The final polish with kid is necessary, since the best towel leaves fibres on the glass. In cleaning test-tubes it is only necessary to rub the probang on the soap.

#### A Simple Matrass Holder.

Of the numerous forms of instruments for holding matrasses, &c., Bunsen's wire clip is undoubtedly the best. In blowpipe analysis I have lately used the following simple device, which is at once very convenient and inexpensive:—

On the points of a lady's hair-pin, about 8 c.m. long and 1 c.m. wide, small corks are fixed. The insides of the corks are then cut away, so that by pressing them together the wires may be brought within about 5 c.m. of each other. With this simple clip matrasses, open tubes, and even small test-tubes can be securely held and easily manipulated.

Another device, and just as good, if not better, is the following:—Take a wooden spill or lamp-lighter, such as are sold everywhere, about 30 c.m. long, 1 c.m. wide, and 1 m.m. thick, and break it in the middle. Almost all of these spills are made of wood tough enough to form a flexible joint. With this the matrass or test-tube is easily grasped and firmly held. I usually keep a quantity of the spills in one of the divisions of a drawer.

\* This method is mentioned in the last German edition of Fresenius's "Quantitative Analysis." I wish merely to draw attention to the great saving of time resulting from its general use in qualitative analysis.

† A piece of ordinary window-glass will do.

## CORRESPONDENCE.

### PRINCIPLES OF COMMERCIAL CHEMISTRY.

To the Editor of the *Chemical News*.

SIR,—Can anybody with brains enlighten an ignoramus on the "Principles of Commercial Chemistry?"

The great bulk of sulphate of ammonia sent into the market is sold as "grey" sulphate guaranteed to contain 24 per cent of ammonia. As its present price is about £20 12s. 6d. per ton, and each unit of ammonia is therefore worth over 17s., the experienced maker (by working with very acid liquors) does his best to keep down the strength to 24 per cent. He knows that under present selling arrangements if he were to make it with 24.75 or 25 per cent (dry, too, and free from liability to soak the bags with acid liquor) he would not get a farthing more for it. For what occult reason does the stolid German farmer, who uses it to feed his sugar-beets, prefer to pay the extra carriage involved by this lower percentage article, to say nothing of the disputes about drainage, or the frequent rotting and rupture of the bags?

An additional, though considerably less, quantity of this great manure enters the market as "white" sulphate, and this article—though involving an extra process in manufacture, and the employment of a higher priced acid, and turned out though it is at a strength of 25 per cent—fetches only 5s. to 10s. more per ton than "grey" sulphate. In other words, its additional unit of ammonia brings 5s. to 10s. instead of 17s.

Most of this white sulphate is understood to be produced and sold on these excellent terms by managers of Corporation Gas Works. Can it be that these enterprising gentlemen are usually as bad chemists as they are supposed to be good engineers? Certainly the merchant who buys their nice cheap product cannot be said to be

IN A FOG.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Biedermann's Central-blatt*,  
Heft 3.

Laws of Exchange of Ammonia Between the Sea, the Atmosphere, and the Land.—Th. Schlösing.—An abstract of the author's papers in the *Comptes Rendus*.

Observations of Temperature under Ground, in the Air, under Turf, and under a Bare Surface Soil.—MM. Becquerel, E. Becquerel, and Morin.—An abstract from the *Comptes Rendus*.

The Silicates of Shelly Limestone and their Importance in the Formation of Soils.—Dr. G. Weise.—The alkaline silicates, such as orthoclase and mica, are changed by the prolonged action of water charged with carbonic acid, so that on the one hand silicic acid is liberated in the soluble state, and on the other alkaline carbonates are formed.

Manurial Experiments with Phosphate of Alumina and Quick-lime on Summer Barley.—Prof. F. Haberlandt.—The phosphate of alumina used was in a very fine state of division, and was applied in varying proportions, both alone and along with quick-lime. No beneficial result was obtained; indeed, where the phosphate of alumina was used alone, the crop obtained was smaller than on a corresponding unmanured plot.

**Influence of Strong Nitrogenous Manures upon the Development of Barley.**—Dr. W. Hoffmeister.—The author concludes that manuring with nitrogenous salts increases the absolute weight of the barley, both green and dry. Ammoniacal salts are more effective than nitrates, and act most advantageously when dissolved in small portions, and given frequently. They delay, however, though slightly, the ripening of the crop. The relative percentage of ash remains constant, and is only effected by the periods of vegetation, possibly by the weather, but not by manuring. The absolute amount of nitrogen is greatly increased by manuring with ammoniacal salts, but much less by nitrates.

**Influence of Varying Intensity of Light on the Growth of the Vine.**—Prof. J. Macagno.—The decrease of the intensity of light hinders the formation of sugar; the formation of the other products of assimilation is directly proportionate to the intensity of the light.

**Phosphoric Acid in Wines.**—Dr. R. Kayser.—Phosphoric acid in combination is present in all natural wines. In 100 c.c. the quantity varies from 0.058 grm. in Malaga, 0.037 in Pedro Ximenes, and 0.028 in select Tokay, down to 0.005 in claret, 0.004 in a petit vin from the Rhone, and 0.003 in a red wine from the south of France.

**Attempts to Neutralise Sour Wines.**—F. Kurmann.—The author is of opinion that where small quantities only of acetic acid have been formed, the addition of sodium or potassium carbonate is not to be condemned. But the evil is by no means removed, and the acetification is very likely to continue.

**Spurious Colouration of Wines.**—W. Bachmeyer.—The author has observed that all the known colouring matters used in the sophistication of wines, such as alizarin, magenta, madder, mallows, bilberries, carrots, peach wood, cochineal, extract of indigo, if added to white wine, are more readily destroyed by nitric acid of spec. grav. 1.2 than the genuine colour of wine. Five c.c. of the suspected wine are mixed with an equal volume of the acid, stirred up with a glass rod and let stand. If the wine is spurious the colour will disappear within an hour, often in a few minutes; whilst, if genuine, it remains for days.

**"Turning" of Red Wines.**—A. Schultz.—Clear, sound wines sometimes become dull, and assume a faint and ultimately acid flavour. Gas is then evolved, and the red colour of the wine passes into a reddish brown. This change is due to a decomposition of the tartar, which is attacked by a ferment, which has been examined by Pasteur.

**Chemical Investigation on the Action of Wine upon the Common Metals.**—L. A. Magnien.—The action of wine upon the metals with which it is liable to come in contact has been little studied. The author finds that if the quantity of cast-iron dissolved by wine = 100, that of wrought-iron in an equal time is 97.87, zinc 92.07, lead, 6.26, tinned iron 2.90, tin 1.59, bronze 0.72, copper 0.46, and brass 0.28.

Heft 4, 1878.

**Determination of the Proportion of Ammonia in the Air and in Atmospheric Waters.**—A. Levy and M. Allaire.—From the *Comptes Rendus*.

**Conduction of Heat in Dry and Moist Soils.**—Prof. F. Haberlandt.—The author's conclusions are that the heat conductivity is greater in moist earth than in dry. The effect of the greater conductivity at higher air temperatures is concealed by the greater evaporation from moist soils, the difference in temperature between moist and dry soils to the disadvantage of the latter being so much the greater the more heat is lost by evaporation, *i.e.*, the higher the temperature of the air. At low atmospheric temperatures (+1° to +8°) the better conductivity of the moist soil comes into play. The limit of tempera-

ture at which the action of the increased heat conduction equals the effect of the continuous cooling by evaporation is not alike for all kinds of soil. It is highest in sandy soils and lowest in moor soil. The differences of temperature between dry and wet soil are very trifling (up to 1.5°), and a wet soil can therefore scarcely be characterised as cold.

**Evaporation of Water from the Soil.**—Prof. F. Haberlandt.—The evaporation increases with the proportion of water in the soil and is also very much increased by increased atmospheric heat, even in the absence of direct solar irradiation. Sand and arable soils, even after small additions of water, lose more by evaporation than an open water-surface. The behaviour of moor-soil is different. The quantity of water near the surface evaporates rapidly, and the process becomes slower with increasing depth.

**Influence of Potassic Manures upon the Vine.**—Prof. A. Andoynaud.—Sulphate of potash and chloride of potassium have a marked influence upon the growth of the vine. Nitrate of potash, however, is far preferable, and the carbonate inferior in its efficacy. Weak vines seem to require as much manure as strong ones. An excess of nitrogenous matter is rather injurious than beneficial. Potash must enter into the composition of vine-manures, as that in the soil is generally in a state not well adapted for assimilation.

**Synthesis of Albuminoids in the Animal Organism.**—M. Rudzki and Dr. E. Oertmann.—Rudzki draws from his observations the general conclusion that the organism effects the synthesis of albuminoids from the carbohydrates and extractive matters or uric acid. He considers the albuminoids as amides or nitriles of the carbohydrates, and supposes that the synthesis is effected by the liver. Oertmann having undertaken a careful re-investigation of the question finds that the nutritive value of an insufficient diet is not increased by uric acid.

**What Influences Determine the Sex of Hemp Plants?**—Prof. F. Haberlandt.—The supposition that it is possible by external influences to determine a preponderating development of male or of female individuals is unfounded. In the case of hemp plants the number of females almost invariably exceeds that of males, not probably because originally a greater number of female germs are developed, but because a greater mortality takes place among the male plants. Male plants, like male insects (and unlike male mammalia), attain maturity earlier than the respective females. The sex of the future hemp plants is præ-determined in the seed.

**Recent Communications on Insects Destructive to Plants, and on their Extirpation.**—Dr. N. Dimitriewiaz, Dr. A. Sempolowski, Leo Pribyl, &c.—An account of various insects noxious to crops, and of the means proposed for their destruction.

**Remarks on the Inversion of Saccharose During the Process of Refining.**—Prof. J. W. Gunning and L. Serrurier.—In opposition to Girard, Gunning maintains that a portion of cane-sugar is reduced, not by the presence of reductive sugar, but by free acids.

**Adulteration and Examination of Beer.**—Prof. Reichardt, Prof. Holzner, Dr. Hager, and R. Hofstedt.—For the detection of incipient acidity the taste of an experienced judge and microscopic examination are preferable to the alkalimetric determination of free acid, or the distillation of volatile acids. In the first place titration is difficult in a coloured liquid like beer, whilst the complete removal of free acid by distillation is difficult. The microscope shows very distinctly the changes which the yeast granules have undergone as soon as a tendency to acidification is perceptible. Bottom-yeast consists of top-yeast mixed with more oval particles, but when the beer turns sour these are interspersed with a greater or less number of longish granules, whilst in decidedly sour beer long branching threads are present resembling the

lactic acid ferment. In normal beer glycerin is found only in small proportions, 0.27 to 0.28 per cent. Buxin, the bitter alkaloid of the common box-tree, has been detected in beer by Hager. Hofstedt has detected a case where absynthin was introduced into beer by means of hops adulterated with the extract of wormwood.

**Preservation of Wine by the Addition of Aluminium Phosphate.**—Bogdan Hoff.—The author added to twelve bottles of turbid wine respectively a variety of substances, among which was aluminium phosphate to the extent of  $1\frac{1}{2}$  to 1 per cent. The bottles were then allowed to stand open from December 15 to April 14. The bottles containing this addition remained perfectly good, and tasted older by six years. The others were either covered with mould or had passed into the acetic fermentation. In the wine treated with phosphate of alumina the acidity had diminished.

**On Testing Milk.**—Prof. A. Kaiser and Prof. E. Schulze.—The untrustworthy character of the indications afforded by the "cremometer" is pointed out. They place the greatest reliance upon the "stall-proof." If the seller of a suspicious milk maintains that it is normal, the cows are milked the next day by persons in the employment of the authorities, and the sample thus obtained is compared with the one seized. (This method would be of course utterly inapplicable in England, where much of the milk sold could not be traced back to the animals from which it has been obtained.)

*Gazzetta Chimica Italiana.*  
Fasc. iv., 1878.

**Electrolytic Determination of Zinc, Lead, Antimony, and Iron in their Ores and in Artificial Products.**—G. Parodi and A. Mascazzini.—Reserved for more extended insertion.

**Prismatic Sulphur from the Alcoholic Solution of Ammonium Sulphide.**—The cause determining the crystalline form of sulphur is not fusion or solution; not the quality of the solvent, but the temperature at which the crystals are formed.

**A Lecture Experiment.**—T. Brugnatelli.—Into a two-litre bottle, half full of cold water and saturated with carbonic acid, is put ether, enough to form a stratum of a centimetre in depth. The bottle is closed with a caoutchouc stopper and violently agitated. When the space filled with compressed gas becomes transparent and the liquid tranquil the stopper is opened, when suddenly there is produced a dense cloud, and the sides of the bottle are covered with a copious dew. The cloud and the liquid are the proof of the fall of temperature.

**Certain Derivatives of Tetrachloric Ether.**—E. Paterno.—A claim of priority in reference to a paper by J. Busch inserted in the *Berichte der Deutsch. Chem. Gesell.*, v., p. 415.

**New Researches on the Aldehydic Derivatives of the Organic Bases and of Urea.**—Ugo Schiff.—Not capable of useful abstraction.

Fasc. v., 1878.

**Identity of the Usnic and Carbonusnic Acids.**—E. Paterno.—The author concludes that the acid extracted by Hesse from *Usnea barbata* (Hoffmann) and that obtained by Salkowski from *Usnea barbata* (Fries.), *florida* (Hoffmann) are usnic acid identical with that which he has studied and extracted from *Zeora sordida*. Usnic acid,  $C_{18}H_{16}O_7$ , is an anhydride, and its monometallic salts correspond to the formula  $C_{18}H_{17}MO_8$ .

**Preparation of the Oxychloride of Carbon.**—E. Paterno.—The author passes the mixture of chlorine and carbonic oxide through a glass tube of about 15 m.m. in diameter and 40 centimetres in length, filled with fragments of animal charcoal. In presence of this substance the combination of the two gases takes place with great rapidity and without the need of the action of solar light.

It is accompanied with a considerable evolution of heat, which makes it necessary to cool the tube with flax soaked in cold water, which is renewed from time to time.

**Process for Detecting Nitric Acid in the Lemon Juice of Commerce.**—F. D. Scribani.—To detect nitric acid in crude lemon juice it is sufficient to pour a small quantity into a test-tube, adding ferrous chloride in aqueous solution, strongly acidulated with hydrochloric acid, boiling the liquid for a few minutes, and testing the solution with an aqueous solution of potassium sulphocyanide. If the juice in question contains nitric acid the liquid will take a blood-red colour, more or less intense according to the proportion.

**Chemical Researches on the Minerals and Rocks of the Island of Vulcano.**—Prof. Alfonso Cossa.—In this first section of what promises to be a bulky memoir the author treats of potash-alum, containing alums of thallium, rubidium, and cesium.

**Carbothialdin and other Sulphuretted Compounds.**—Prof. Icilio Guareschi.—Not suitable for abstraction.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 11, July 11, 1878.

**Discovery of a Third Acid in the Reaction of Sugar and Potassium Permanganate.**—M. Maumené.—Diehic acid,  $C_4H_4O_8$ , is easier to obtain, especially as a neutral potassic salt, than the two others, the discovery of which has been previously announced by the author, hexipic acid,  $C_{12}H_{12}O_{16}$ , and triejic,  $C_6H_6O_{10}$ . The diehate of potassa is perfectly crystalline, forming large and well-defined prisms. The solution scarcely precipitates any metallic solution, not even neutral plumbic salts; it reduces the solutions of gold and silver, forming double salts. The discovery of this new acid completes the study of the reaction of sugar with permanganate, no other product than the following being possible.

1. Hexipic acid,
2. Triejic "
3. Diehic "
4. Oxalic "
5. Carbonic "

**Certain Consequences of the Constitution of the Solar Spectrum.**—M. A. Cornu.—The author speculates on the probability of direct magnetic action upon the sun, of an internal terrestrial magnet, and of the electric origin of the light emitted by the solar protuberances.

**Scientific Instruments at the Paris Exhibition.**—A copiously illustrated description of scientific instruments, most of them exhibited by MM. Ducretet.

*Chemiker Zeitung.*  
No. 30, July 25, 1878.

Prof. Liebreich recommends hydrogen peroxide for the preservation of milk.

Among the papers to be read at the Congress of German Naturalists and Physicians, which will be held at Cassell from the 18th to the 24th of September, may be mentioned—"On Colour-sense and Colour-blindness," by Dr. Stilling; "On the Relation of Darwinism to Social Democracy," by Prof. Oscar Schmidt; "On William Harvey's Life and Activity," by Dr. Baas, of Worms.

The pollution of rivers in the Kingdom of Saxony has been investigated. The textile manufactures are debited with 49 per cent of the contamination; the leather trades with 16; mines with 8; the production of illuminating agents with 4. In the districts of Dresden and Bautzen there are complaints concerning the waste-waters from flax-steeping.

A brewer of Lindau, who had obtained from a Berlin a hectolitre cask of glycerin and 1 kilo. of salicylic acid, and introduced them into his beer, was condemned to twenty-one days imprisonment for fraud and to a penalty of 4000 marks (£200) for an evasion of the malt-tax. The vendors of the chemicals were fined £5 in each case.

## MISCELLANEOUS.

**Society of Public Analysts.**—The next General Meeting of this Society will be held at Dublin on Monday, the 19th instant, at 3 p.m., at the Royal College of Surgeons, Stephen's Green. The following Papers will be read:—"On the Inconstant Composition of Well Waters," by C. A. Cameron, M.D.; "On the Solubility of Plumbic Iodate," by C. A. Cameron, M.D.; "Notes upon the Desirability of Fixing by Analysis some Standards of Value for Beer based upon the Qualities usually sold in Large Towns," by C. Estcourt, F.C.S.; "On the Nitrogen Compounds present in the Cereals" (third paper), by G. W. Wigner, F.C.S.; "On the Distinctive Tests for Carbolic Acid, Cresylic Acid, and Creosote," by A. H. Allen, F.C.S.

## NATURE for August 15 contains:—

The Coming Eclipse. By J. Norman Lockyer, F.R.S.  
Our Natural History Collections.

## The British Association:—

Inaugural Address of William Spottiswoode, M.A., F.R.S., LL.D., D.C.L., President.

Section C.—Geology.—Opening Address by the President, John Evans, D.C.L., F.R.S., F.G.S., &c.

Section D.—Biology.—Opening Address in the Department of Zoology and Botany, by Prof. W. H. Flower, F.R.S., President of the Section.

## Notes of the Week.

The Norwegian North Atlantic Expedition. By Dr. H. Mohn.

The Eclipse of the Sun.

Our Astronomical Column.

Letters to the Editor:—A New Mineral—Prof. N. S. Maskelyne, F.R.S. The Colouring of Birds' Eggs—H. C. Sorby, F.R.S. The Limbs—Prof. G. M. Humphry, F.R.S. The Darkness of Caverns—Prof. Salvador Calderon. Scent and Colour in Flowers—G. S. Boulger.

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Prospectuses of the several Departments may be obtained from Mr. Cornish, Piccadilly, and other Booksellers in Manchester, and at the College.

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Botany } .. .. . { Prof. L. KIRSCHBAUM,

Zoology } .. .. . { Ph.D.

Mineralogy .. .. . F. HENRICH.

Microscopy, with exercises in micro- } H. THIELENIUS, M.D.

scopic work .. .. . }

Practical Instruction in the Labora- } Prof. R. FRESENIUS, Ph.D.,

tory .. .. . { H. FRESENIUS, Ph.D., and

two Assistants.

The next Session commences on the 15th of October. The Regulations of the Laboratory and the Syllabus of Lectures will be forwarded gratis on application to C. W. KREIDEL'S Verlag, at Wiesbaden, or to the undersigned.

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 978.

ON THE  
AMOUNTS OF SUGAR CONTAINED IN THE  
NECTAR OF VARIOUS FLOWERS.\*

By ALEX. S. WILSON, M.A., B.Sc.,  
Fellow in Natural Science, Glasgow University.

NECTAR is the term applied by botanists to the sweet-tasted fluid which is secreted within the cups of insect-fertilised flowers; and the object gained to the plant by its presence is that insects, induced to visit flowers for its sake, are useful to the plants by effecting a cross-fertilisation. Mr. Darwin has shown what an amount of additional vigour is thus conferred on the seeds which subsequently result; in contrast with the evil effects produced by continuous inbreeding. In many instances this sweet liquid is exuded from special glands, but in other cases from portions of the flower that do not seem to have been specially adapted for this purpose. Morphologically, nectaries may represent very different structures, but not unfrequently they are of the nature of an aborted organ—such as a petal or stamen. It is a point in dispute among biologists whether this saccharine matter is a true secretion or simply an excretion of effete matter from the vegetable cells—a by-product of the chemical changes taking place within these cells. The latter view seems to be favoured by the fact that a similar sweet-tasted fluid, much sought after by insects, is exuded on different parts of some plants quite unconnected with the flower, as in the laurel, brake fern, lime tree, acacia, &c. As to the use of such exudation of sweet fluid, various suggestions have been made by those who are disposed to regard it as a true secretion; as, for instance, that it serves as an attraction to certain insects to frequent the plant, these insects rendering service by keeping off animals to whose attacks the plant may be subject. Probably this is to some extent true, but it cannot be said to hold universally. Nectar is of course the source whence the bee derives honey, but it also affords food to many kinds of insects which do not possess the habit of storing up. A division of the humming birds is named Melliphagi on account of living on this substance; but it is probable that in some cases the small insects seeking the nectar, and not the nectar itself, may be the object of the visits of these birds to nectar-producing flowers. The bright colours, as shown by Sir John Lubbock's experiments, serve to guide insects to the flowers, and the odours which they emit fulfil the same end. The markings on a flower's petals, it is to be noted, always converge towards the nectar, as in the violet. The importance of these guides to insects will be apparent from the following estimations, which show how indispensable it is that as little time as possible should be lost by an insect collecting honey. It must also be remembered that the nectar is usually contained in the most secure and best covered part of the flower, the object being to prevent the access of rain, which, owing to the extreme solubility and diffusibility of sugar, would speedily cause it to be transferred to parts of the plants where insects could reach it without being of any service in the way of cross-fertilisation. The chief purpose of the flower would in this way be frustrated. The formation of nectar is observed to take place most freely in hot weather, and to be prevented by cold or wet. So great economy is exercised by the plant that it is only formed at the time when insects'

visits would be beneficial, *i.e.*, when the anthers are ripe and shedding their pollen, or when the stigma is mature and ready to receive pollen. By biologists the visits of bees, butterflies, and other insects are believed to have exercised in past time an important influence in modifying the size, shape, colour, &c., of flowers, and the following experiments, in spite of their incompleteness, are of interest as showing to what an extent this action takes place in nature, and as helping to determine the value of this factor. These estimations are only the first of a series, and the writer regrets that he has been unable to give them the desirable completeness, but hopes to continue them.

The nectar was extracted with water, and the sugar determined before and after inversion by means of Fehling's copper solution. Many of the estimations were done in duplicate, and gave results that agreed perfectly. In the case of fuchsia—which is not deprived of its nectar by any insects in this country, the nectary being inaccessible to native species—we have probably the whole amount formed, but in the other cases the visits of bees, &c., may have reduced the amounts considerably. In this case it is a clear colourless liquid, having an acid reaction and an intensely sweet taste; that of many others has the strong characteristic odour of honey:—

	Sugar in Flowers.		
	Total. M.m.g.	Fruit.	Cane? (as Fruit.)
1. Fuchsia, per flower ..	7.59	1.69	5.9
2. <i>Claytonia Alsinoides</i> , do.	0.413	0.175	0.238
3. Everlasting pea, ditto..	9.93	8.33	1.60
4. Vetch ( <i>Vicia Cracca</i> ) per raceme .. .. .	3.16	3.15	0.01
5. Ditto, per single flower	0.158	0.158	—
6. Red clover, per head ..	7.93	5.95	1.98
7. Ditto, per floret .. ..	0.132	0.099	0.033
8. Monkshead, per flower	6.41	4.63	1.78

Approximately, then, 100 heads of clover yield 0.8 gm. sugar, or 125 give 1 gm., or 125,000 1 kilo. of sugar; and as each head contains about 60 florets (125,000 × 60), that is, 7,500,000 distinct flower tubes must be sucked in order to obtain 1 kilo. sugar. Now as honey, roughly, may be said to contain 75 per cent sugar, we have 1 kilo. gm. equivalent to 5,600,000 flowers in round numbers, or, say, two and a half millions of visits for one pound of honey. This shows what an amazing amount of labour the bees must perform, for their industry would thus appear to be indispensable to their very existence. Another point worth notice in these results is the occurrence of what appears to be cane-sugar, and that in the case of fuchsia in the proportion of nearly three-fourths of the whole. This is remarkable, as honey is usually supposed to contain no cane-sugar, its presence being usually regarded as certain evidence of adulteration. The question therefore arises whether this change, which takes place while the sugar is in the possession of the bee, is due to the action of juices with which it comes in contact while in the honey-bag or expanded oesophagus of the insect, or whether the process of inversion goes on spontaneously, as may perhaps be the case.

ON A SIMPLIFICATION IN GRAPHIC  
FORMULÆ.\*

By OLIVER LODGE, D.Sc.

IN a graphic formula the atoms of a compound are ordinarily represented by its chemical symbol (a capital letter), and the connections between the atoms are represented

\* Read before the Chemical Section of the British Association, Dublin, 1878.

\* Abstract of a Paper read before the Chemical Section of the British Association. Dublin, 1878.

by straight lines joining the letters. Now graphic formulæ are of most use in organic chemistry where the principal compounds consist only of the elements C, H, O, N, whose atomicities are 4, 1, 2, and 3 or 5 respectively. In any formula, therefore, 4 bonds always radiate from the letter C; N is the meeting-place of 3 or 5 bonds, according to circumstances; 2 bonds meet at each O; and a single bond terminates at every H. Suppose now that the letters were omitted and the bonds joined up together, the position of the atoms would still be apparent as the meeting-place of a definite number of bonds; and therefore the letters are unnecessary.

The simplification I propose, then, is the omission of the usual symbols used to denote the atoms, and the joining of the bonds in such a way as clearly to define the atomicities (and therefore the natures of the several atoms. [Formulæ so drawn become reduced to a sort of geometrical diagram; and conversely, any geometrical curve represents some real or imaginary chemical compound.]

NOTES OF WORK BY STUDENTS OF  
PRACTICAL CHEMISTRY  
IN THE  
LABORATORY OF THE UNIVERSITY OF  
VIRGINIA.  
No. VII.

Communicated by J. W. MALLET,  
Professor of General and Applied Chemistry in the University.

(1.) *On Silver Arsenite Insoluble in Aqueous Ammonia.*  
By J. R. SANTOS, of Guayaquil, Ecuador.

In the text-books it is usually stated that the light yellow precipitate of silver arsenite is soluble in excess of ammonia. Thus, Fresenius says\* that a yellow precipitate of tribasic silver arsenite is produced when a solution of a neutral arsenite is decomposed by silver nitrate:—"The precipitate dissolves easily in nitric acid, as also in ammonia; it is also not insoluble in ammonium nitrate." Claisen† says of an aqueous solution of arsenious acid, "silver nitrate, after neutralisation of the free acid with a little ammonia, throws down light yellow silver arsenite, soluble in ammonia, nitric acid, and ammonium nitrate." Watts‡ says—"Nitrate of silver added to aqueous arsenious acid produces a scarcely appreciable yellow turbidity, and on cautiously adding ammonia, a canary-yellow precipitate of arsenate of silver, which dissolves with great facility in nitric acid, acetic acid, and excess of ammonia." Odling|| says—"Ammonio-nitrate of silver, added to aqueous arsenious acid, throws down an opaque yellow precipitate of arsenite of silver, soluble in ammonia and in dilute nitric acid." Gmelin§ says silver arsenite "is insoluble in water, but dissolves in acids—in nitric acid, for instance—and when recently precipitated, also in ammonia (Marcet). It dissolves in acetic acid more readily than the phosphate of silver oxide (H. Rose)." In Bloxam's paper¶ on the arsenites, the composition of silver arsenite is examined, but there is no mention of its solubility.

Having noticed that the yellow precipitate obtained by mixing solutions of silver nitrate and sodium arsenite, if washed several times by decantation, did not dissolve (at any rate completely) in aqueous ammonia, but assumed a well-marked crystalline character, and a darker yellow colour, I proposed to Mr. Santos to analyse this crystalline residue, and to examine the general question of the rela-

tion of the original precipitate to ammonia. His results were as follows:—

Solution of sodium arsenite (obtained by boiling sodium carbonate solution with excess of arsenious oxide) was added to solution of silver nitrate, the yellow precipitate was thoroughly washed with water, and strong solution of ammonia added. A part of the precipitate dissolved, and a part remained, the latter deepening in colour, and tending to become crystalline. The greater the relative amount of silver nitrate used the larger the proportion of the precipitate which remained undissolved, while using more of the arsenite, a larger proportion was taken up by the ammonia. Owing to the readiness with which the yellow crystalline residue darkens on exposure to light, it could not be dried and weighed in an unchanged state. It was therefore carefully washed, proved to be free from ammonia; and an undetermined amount of it (still moist) having been digested with nitric acid, the silver was thrown down as chloride, and the arsenic as ammonio-magnesian arseniate. 2.3221 grms. of silver were obtained for 0.4989 grm. of arsenic, showing that the salt was probably normal tribasic silver arsenite, although there was a little silver in excess of this, the ratio Ag:As being 2150:665, or 3.23:1. A solution of sodium arsenite was mixed with one of silver nitrate in the proportion of 1 atom of arsenic to 3 atoms silver, with a little nitric acid, just enough to prevent precipitation, and then sodium carbonate added in excess. The same bright yellow precipitate as above was formed, tending to become crystalline when thrown down slowly. The filtrate from this precipitate was free from silver, and contained but a trace of arsenic; hence the salt thrown down was the tribasic arsenite. The precipitate itself was quite free from silver carbonate: it turned dark with great rapidity, even in dim diffuse light; was only partially soluble in aqueous ammonia by itself, but dissolved readily in the same when containing alkaline nitrates, and was but slightly dissolved by cold acetic acid. When this experiment was repeated, using 2 molecules or 1 molecule of silver nitrate in place of 3, the precipitate obtained dissolved readily in ammonia free from alkaline nitrates, and in cold acetic acid. The same crystalline yellow salt, but gradually and imperfectly dissolved by pure aqueous ammonia, was also produced by mixing solutions of sodium arsenite (1 atom arsenic) and silver nitrate (3 mols.), containing free nitric acid enough to prevent immediate precipitation, and then adding sodium acetate in excess.

Hence it appears that the normal tribasic arsenate of silver is not as such soluble in ammonia, but becomes readily soluble by the presence at the same time of alkaline nitrates; that it is slowly and imperfectly decomposed by the continued action of ammonia, forming perhaps an argent-ammonium salt; and that a silver arsenite containing in combination or admixture a larger proportion of arsenic than that of the tribasic salt is at once soluble in ammonia by itself; a corresponding difference of solubility in acetic acid being under these conditions observable in each case.

(2.) *Analysis of Lamp-black made from the Natural Hydrocarbon Gas of the Ohio Petroleum Region.*  
By J. R. SANTOS.

This material is described in the following passage from my portion of the "Report of the Judges on the Philadelphia Exhibition of 1876" (Group III., Chemical Manufactures):—"One of the more interesting among the minor American exhibits consisted of the fine lamp-black which has for about two years past been made at Gambier, Ohio, by imperfect combustion of the natural gas which occurs throughout the petroleum region, and which frequently escapes in such quantity from borings, yielding little or no mineral oil, as to give rise to the term 'gas-well.' There are two such wells in Knox County, Ohio, near the junction of the Kokosing and Mohican Rivers, affording very large quantities of hydrocarbon gas, which Mr. Peter Neff, of Gambier, has utilised in the manufac-

\* *Anleit. zur Qualit. Chem. Analyse*, II Aufl., S. 155.

† *Grundr. der Analyt. Chemie.*, I Th., S. 27.

‡ "Dictionary of Chemistry," vol. i., p. 361.

|| "Practical Chemistry for Medical Students," 3rd ed., p. 158.

§ "Handbook of Chemistry" (Cavendish Society's Trans.) vol. vi., p. 187.

¶ *Journal of the Chemical Society*, July, 1862, p. 290.

ture of lamp-black, which he calls 'Diamond Black.' He has patented and uses several kinds of apparatus for burning the gas [of which two are described and figured in the Report]. In the building used, 1800 burners are at work, consuming about 275,000 cubic feet of gas per twenty-four hours, being about one-fourth of the available supply. The composition of the gas by volume is given as—

Marsh gas .. .. .	81.4
Ethyl hydride.. .. .	12.2
Nitrogen .. .. .	4.8
Oxygen .. .. .	0.8
Carbon monoxide .. .. .	0.5
Carbon dioxide .. .. .	0.3
	100.0

"No mention is made of free hydrogen, though from the experiments of Prof. Sadler on samples of natural gas from Western Pennsylvania, it probably is present in small quantity. The lamp-black is at present manufactured to the extent of about 16 tons per annum. It is very fine and smooth, free from coarse or gritty particles, and of an intense blue-black colour. The absence of oily matter is very strikingly shown by mixing it with water. Although from the large amount of air in the mass of loose powder most of it floats at first upon the surface, stirring soon mixes it in large quantity with the water, rendering the whole black and opaque: in this behaviour it contrasts strongly with common lamp-black. It does not colour ether, and the liquid, when evaporated, leaves but a trace of residue, while ordinary lamp-black, presumably from rosin, gives a deep yellow solution, leaving an orange-brown tar on evaporation. On burning a quantity of the diamond-black sufficient to fill a large platinum dish, a barely visible trace of ferruginous ash was left, derived, no doubt, from the scraping of the metallic surfaces (on which the material was deposited and collected). This material is sold to makers of fine printing and lithographic ink in the United States, and has been sent in small quantity to Europe. It deserves to become more widely known."

I have used this lamp-black for a number of laboratory purposes requiring an artificial form of carbon of very high degree of purity. Mr. Santos has analysed it, with the following results:—

Sp. gr. at 17° C., after complete expulsion of air, equals 1.729. The air-dried lamp-black lost by exposure at ordinary temperature over sulphuric acid 2.30 per cent of moisture, and a further loss of 0.40 per cent was experienced by heating to 100° C. Continued heating to 200° and then to 300° under atmospheric pressure gave rise to no further loss, but a minute amount of water was expelled by subsequently heating in a Sprengel vacuum.

The material dried at 200° C. gave in two combustions—

	I.	II.
Carbon .. .. .	96.041	96.011
Hydrogen .. .. .	0.736	0.747

The occluded gases, driven out by heating to low redness in a Sprengel vacuum,\* represented, on calculating weight from volume,—

Carbon monoxide ..	1.378	p.c. by weight
Carbon dioxide.. ..	1.386	" "
Nitrogen .. .. .	0.776	" "
Vapour of water .. .	0.682	" "

There was also expelled, and condensed on the cooler part of the tube, 0.024 of a solid light yellow hydrocarbon, soluble in alcohol, fusible, and volatilising rapidly under atmospheric pressure between 215° and 225° C. (impure naphthalene?)

\* See similar results obtained by Wright and Luff for carbon prepared from sugar and from carbon monoxide.—*Chem. Soc. Journ.*, Jan. 1878, pp. 18 to 20.

Hence the composition of the lamp-black may be calculated as—

Carbon .. .. .	95.057	*
Hydrogen .. .. .	0.665	)
Nitrogen .. .. .	0.776	)
Carbon monoxide .. .. .	1.378	†
Carbon dioxide .. .. .	1.386	†
Water .. .. .	0.682	
Ash (Fe <sub>2</sub> O <sub>3</sub> and CuO) .. .. .	0.056	
	100.000	

(3.) Examination of the Products of Weathering of Allanite. By J. R. SANTOS.

The allanite found in large quantity in Amherst Co., Virginia,‡ presents itself for the most part in detached lumps, from a few ounces to three or four pounds in weight, showing rough crystalline faces as well as fractured surfaces, and often coated with a crust (the result of weathering), varying from a mere film to a fifth of an inch in thickness.

It seemed a matter of some interest to examine this crust in order to see how the mineral in question changes chemically when disintegrating by partial exposure to atmospheric influence in contact with decomposing felspathic rock. The crust where thickest was found to be composed of two layers, an outer one nearly white, and an inner one of brick-red colour: both were earthy and pulverulent in texture. The following were the results of the analysis of these layers, the third column giving the composition of the unaltered allanite as determined formerly by Mr. Cabell:—

	Crust.		Original Mineral.
	Outer Layer.	Inner Layer.	
Silica .. .. .	21.37	8.05	31.23
Alumina .. .. .	20.66	16.83	16.45
Ferric oxide .. .. .	12.24	37.14	3.49
Ferrous oxide .. .. .	—	—	13.67
Cerous oxide .. .. .	21.90	7.13	11.24
Lanthanum oxide .. .. .	—	—	9.90
Didymium oxide .. .. .	—	—	
Yttria .. .. .	—	—	1.65
Glucina .. .. .	1.95	0.94	0.24
Lime .. .. .	—	—	8.69
Magnesia .. .. .	—	—	0.22
Water .. .. .	21.37	29.55	2.28
	99.49	99.64	99.06

Hence it appears that calcium, magnesium, yttrium, and didymium have been entirely removed, the last named so completely that no absorption-bands could be seen with the spectroscope in a strong solution contained in a cell 6 inches through; lanthanum has almost disappeared; the quantity of cerium has been somewhat reduced, and then relatively much increased by removal of other substances; iron has been first peroxidised, and its relative amount largely increased by removal of other constituents, and has subsequently been itself in great part removed; alumina and glucina have resisted removal, and have therefore relatively accumulated; much silica has been withdrawn, but the more rapid removal of iron in the outer layer has led to an apparent increase again; and water has largely increased by formation of ferric hydrate, diminishing again as this latter has been removed in the outer layer.

(To be continued.)

\* Including the C and H of 0.024 solid hydrocarbon.

† These gases were doubtless partly formed from solid carbon and occluded oxygen by the heat applied in vacuo.

‡ See analysis (by Mr. J. A. Cabell) in this laboratory and description.—*CHEM. NEWS*, vol. xxx. p. 141.

|| Including a trace only of lanthanum oxide, obtainable by treatment with yellow mercuric oxide and potassium permanganate.

## ON THE PHTHALEINS OF PYROGALLIC ACID.

By M. DURAND.

GALLEIN and cerulein, new tinctorial derivatives from pyrogallie acid, were discovered by the chemist Baeyer, who published a description of their reactions in 1871. Since that epoch no important publication on the subject has taken place; indeed, M. Baeyer pointed out the preparations and properties of these compounds so fully that their study seemed at once completed.

Three years subsequently the firm of L. Durand and Huguenin, of Bâle, undertook the manufacture of these products, and placed their first results in the hands of M. Horace Kœchlin in June, 1874. The result of the researches of this chemist was that chromic oxide is the best mordant for gallein and cerulein, and that the latter, both for printing and dyeing, should be mixed with sodium bisulphite.

Gallein is obtained by the reaction of phthalic acid upon double its weight of pyrogallie acid. The mixture is kept at 190° to 200° C. till the mass hardens. The crude product of this reaction is treated with boiling water in order to extract such portions of the materials as have escaped transformation. The result is dissolved in an alkaline carbonate and precipitated with an acid, which throws it into the state of "carmination" necessary for its use as an application colour.

Gallein is slightly soluble in boiling water, to which, nevertheless, it imparts a vinous-red colour; it is substantially insoluble in cold water, but very soluble in hot alcohol, the solution having a fine mahogany colour. In caustic alkalies it dissolves with a blue-violet colouration. These solutions if concentrated are rapidly transformed if exposed to the air, losing their blue shade and producing brown substances.

Gallein is variously acted upon by metallic oxides, the chromic used as indicated by M. Horace Kœchlin giving the finest shades:—

- 40 litres gallein in paste.
- 20 litres gum water.
- 4 litres acetate of chrome at 18° B.

Care must be taken to print both gallein and cerulein upon cloth prepared with the sulpholeate of ammonia.

Gallein dyes both cotton and wool if previously impregnated with chromic oxide, which may be easily effected by mordanting the goods, either in solutions of chrome alum or by alternate passages through chromate of potash and sulphate of soda, or, in place of the latter, by exposure to free sulphurous acid.

Cotton mordanted with oxide of lead is dyed a very beautiful violet-grey shade. The dyeing, after mordanting, is begun as in the case of madder, adding to the bath the proportion of colour necessary for the shade intended, and raising the temperature gradually to a boil. After dyeing the colour may be developed by a hot soaping. These shades have a fastness rivalled only by madder and indigo.

Upon wool gallein gives in printing the tones of orchil extract, though somewhat less blue; exactly similar shades may be obtained by the addition of methyl-violet, or of alum. For the present the price of gallein is too high as compared with that of orchil extract; this substitution therefore presents no practical interest.

*Cerulein.*—This green colouring matter is a derivative of gallein; in its use and in its properties it presents the same features, requires the same mordants and the same precautions, both in dyeing and printing.

Its insolubility in water is still greater than that of gallein, and it becomes necessary to render it more soluble by a slight reduction, which M. Horace Kœchlin obtains by additions of bisulphite of soda, either in the dye-bath or in the printing colour. For the latter purpose he proposed the following formula:—

For wool—

- 10 litres cerulein.
- 30 litres gum water.
- 1½ litres glycerin.
- 1¼ litres bisulphite of soda (added at the moment of use).

For cotton—

- 20 litres gum water.
- 8 litres cerulein.
- 1 litre bisulphite of soda (added at the moment of use).
- 2 litres acetate of soda at 18° B.

With additions of alizarin and of Persian berries, or of any other yellow, or of catechu, these receipts may be converted into bronzes, olives, and mosses, which, as compared with the combinations of aniline green, logwood, &c., afford an advantage in point of solidity which the manufacturers of furniture-prints well know how to appreciate. These new colours are easily applicable to resist styles.

M. Horace Kœchlin recommends also for printing, as a mordant, yellow prussiate, employed in a maximum of ¼ kilo. per litre of cerulein. This proportion gives shades somewhat too blue, due to the simultaneous production of Prussian blue, which disappears on soaping, yielding a greyer tone but of an intensity proportionally greater than that of the shades fixed with chromic oxide.

For dyeing wool and cotton it is necessary to proceed exactly as above directed for gallein; only it is recommended, in order to obtain good results, to stir up 1 kilo. of cerulein with 2 kilos. bisulphite of soda at 40° B. This mixture may even be left for some hours before adding it to the dye-bath.

Cerulein can be reduced like indigo and re-oxidised on exposure to the air, upon tissues steeped in the reduction product, resuming its original colour. This method may be employed both in dyeing and printing. The most suitable reducing agent is zinc powder along with a little ammonia.

The shades dyed and printed with cerulein resist air and soap as well as do alizarin colours.

Cerulein is obtained by the action of concentrated sulphuric acid upon gallein, one part of which, previously dried, is heated to 200° with 20 parts of the acid. The product of the reaction is poured into water and washed till perfectly neutral.

Cerulein is neither affected by the caustic alkalies nor by acids. It may be regarded as the type of a fast colour, and it is the only green colouring matter, natural or artificial, which presents this precious quality.—*Bull. de la Soc. Indust. de Mulhouse.*

## ON THE ORIGIN OF ELEMENTARY SUBSTANCES, AND ON SOME NEW RELATIONS OF THE ATOMIC WEIGHTS.\*

(Continued from p. 69).

By HENRY WILDE.

JUST as silver and copper are analogues of each other, and are frequently associated in nature, and, just as their homologues, cadmium and zinc, are analogues and are also found together, so is yttrium the analogue of  $x=69$ , and will be found associated with it in nature. Now, if  $x=69$  be not the terbium of Mosander and Delafontaine, and the researches of Bahr and Bunsen render the existence of this element doubtful, it is probable that  $x=69$  is cerium, as this element and yttrium are nearly always found associated in the mineral species cerite and

\* A Paper read before the Manchester Literary and Philosophical Society, April 30, 1878.

yttrocerite. Moreover, it will be observed that  $x=69$  is just 1.5, or 0.75 the atomic weight of cerium, according as it is regarded as 46 or 92. Mendeleeff and other chemists have already proposed 138 as the atomic weight of cerium,\* which is double that of  $x=69$ . MM. Hildebrand and Norton have recently obtained cerium, lanthanum, and didymium in a massive state, and have thereby been able to investigate some of the physical properties of these rare metals.† According to these experimenters the specific gravities of Ce, La, Di range between 6 and 6.7. Bearing in mind that elements of approximately the same atomic weights and specific gravities generally belong to different series, and that the specific gravities of analogous members in each series increase in the order of their atomic weights, it would appear that cerium does not belong to the same series as lanthanum and didymium. Moreover, considering the important position which  $x=69$  occupies in relation to its analogues Al, Y, and the position which these three elements occupy in relation to their homologues Mg, Zn, Cd, and Na, Cu, and Ag, it may be doubted if  $x=69$  should, up to the present time, have remained undiscovered, especially as all its analogues of the series Th, E, Y, and Al are well known. If, therefore,  $x=69$  be cerium, the only element missing in the series  $H_{3n}$  is  $x=42$ , the analogue of Ga, In, and Tl. As these elements have been discovered by spectrum analysis, it is probable that  $x=42$  will also be found by the same means. It may, however, be observed, that the characteristic lines of the alkaline metals in the series  $H_n$ , and of their homologues  $H_{3n}$ , advance in the blue or violet end of the spectrum towards the more refrangible parts in the inverse order of their atomic weights. The spectral lines of  $x=42$  must therefore be sought for in the violet or ultra violet part of the spectrum. The high refrangibility of the lines which the missing element will have may be the reason why it has hitherto escaped detection, as from the wide distribution in nature of its homologues of position Ca and K, in relation to their respective analogues Sr and Rb,  $x=42$  ought to be more abundant in nature than gallium.

From the physical and chemical relations which subsist among the halogens F, Cl, Br, I, and the alkaline metals Li, Na, K, Rb, Cs, chemists have already justly considered these elements as positive and negative analogues of each other and of hydrogen. In accordance with this view, I have classified the halogens as negative forms of the series  $H_n$ . By assigning to these elements the positions shown in the table, it will be seen that besides the triad of atomic weights formed by Cl, Br, and I, there is a common difference of 4 between the atomic weights of the halogens and their positive homologues of position Na, K, Rb, and Cs. Now if the groups of oxygen elements O, S, Se, Te, be considered as negative forms of  $H_{2n}$ , homologous in character and position with the negative forms of  $H_n$ , it will be seen that besides the triad of atomic weight formed by S, Se, and Te, there is a common difference of 8 between them and their positive homologues Mg, Ca, Sr, and Ba; or double the common difference between the positive and negative members of the series  $H_n$ . The oxygen elements are multiples of 2, 4, 8, and 16, and may accordingly be considered as products of the first, second, third, or fourth power of  $H_{2n}$ . Whichever view be taken of the formation of the first negative member of the series  $H_{2n}$ , it is probable that both fluorine and oxygen were not formed direct from  $H_n$  and  $H_{2n}$ , but from members homologous in position with Li and Gl, but which have become extinct by absorption into F and O.

Another numerical relation subsisting among the halogens which it may be of interest to point out is, that the difference of a unit in their atomic weights will make them multiples of 3 and 9, and these numbers, commencing with Cl=36, are all respectively three times the atomic weights of the first three members of the series

$H_{3n}$ . These relations would indicate that the halogens, usually regarded as monatomic, are also built up in multiple proportions, and may also throw some light on the variable quantivalence which Wanklyn and other chemists have shown the alkaline metals and halogens to possess.

The recent researches of chemists leave no doubt that all the elements which I have classified as forms of  $H_{5n}$ , except boron, belong to the same group. Now, boron bears a greater resemblance to phosphorus in its combinations and occurrence in nature than it does to other elements, and whether the first three members of the series be considered as forms of  $H_{5n}$ , or  $H_{5n}+1$ , they form a triad as well defined as their homologues of position in  $H_{3n}$ ,  $H_{2n}$ , and  $H_n$ . Triads are also formed by antimony, arsenic, and phosphorus:—bismuth, antimony, and phosphorus:—tantalum, niobium, and boron:— $x=140$ , As=75, and B=10:— $x=140$ , Nb=95, and V=50. The atomic weights of boron, phosphorus, and vanadium have been so carefully determined by chemists as to preclude any doubt of their being represented by  $H_{5n}+1$  rather than  $H_{5n}$ ; but the fact that arsenic, antimony, and bismuth are better represented by the formula  $H_{5n}$ , and that Cu and Zn, in the series  $H_n$  and  $H_{2n}$ , exhibit the same constant minus difference from the classical atomic numbers, as B, P, and V, are further indications of some unknown property of the elements which conceals their exact multiple relations from view. If the discovery of two new elements of this group by Hermann,\* to which this chemist has given the names of neptunium, and ilmenium be confirmed, the former element will have an atomic weight of 140, and the latter element an atomic weight of 165, as shown in the table.

Although the numerical relations of the members of the series  $H_{5n}$  are very interesting, yet it will be seen that the ratios are not so simple as those of the series  $H_n$ ,  $H_{2n}$ ,  $H_{3n}$ , as multiples of the second member, minus the first, do not give the atomic weights of the other members of the series.

The series  $H_{4n}$ , besides being incomplete by reason of the absence of several of its members, the atomicity of lanthanum and didymium is not yet agreed upon by chemists. There can, however, be no question as to the position of titanium as the third member of this series, as there is no other place vacant where an element with an atomic weight of 48 would fit, while the isomorphism of rutile with cassiterite and zirconia indicate the relation of tin and zirconium with the same series.

The classification of uranium presents some difficulty on account of the fewness of its analogies with other elements, but there can be little doubt that the atomic weight assigned to U=120 until recently is much too small; as there are no elements with atomic weights so low correlated with specific gravities so high as that of U=183. From a study of the chemical combinations of this element, Mendeleeff has assigned to it the atomic weight of 240,† or double the number formerly received, and which number I have adopted. The admission of this high atomic weight, however, separates uranium from chromium, molybdenum, and tungsten, with which it has been classified, as there are no elements of approximately the same high specific gravities as tungsten=18.26, and uranium=18.3, correlated with so great a difference of atomic weights as U=240 and W=184. From the fact that the highest places in all the series, except that in  $H_{4n}$ , are filled up with their highest members, and that uranium is generally found in combination with the mineral species *yttrotalite*, *fergusonite*, *polykrase*, *pyrochlore*, *pyrrhite*, containing elements of the series  $H_{3n}$  on the one side, and in combination with minerals containing elements of the series  $H_{5n}$  on the other, I have classified uranium as the highest form of  $H_{4n}$ . The two lower forms of  $H_{4n}$ , as will be seen

\* *Ann. Chem. Pharm.*, Suppl. viii., 185—190.† *Chem. Soc. Journal*, 1876, vol. ii., 276.\* *Nature*, April 12th, 1877. *H. Kolbe's Journal für praktische chemie*. Feb. 1877, p. 103—150.† *Ann. Chem. Pharm.*, Suppl., viii., 178—184.

from the table, are missing; but, assuming that titanium is the highest member in a triad with the missing elements, the atomic weights of the latter are 16 and 32, isomeric with oxygen and sulphur. It may, however, be surmised that no elements now exist to fill the gaps in the series, as they may have become extinct by absorption into titanium and its analogues, or by transformation into the negative forms of  $H_{2n}$ .

The elements which I have classified as forms of  $H_{6n}$  are only three in number, and the atomic weight of chromium = 52.2 establishes its position as the third member of the series, and there is no other place for an element with the chemical and physical properties of chromium vacant in the table. For like reasons the positions in the series of molybdenum and tungsten (the analogues of chromium) are also determined. By assigning to chromium the constitution  $9H_6$ , it forms a triad with the missing element  $x=36$ , and  $x=18$ , which are within a unit the atomic weights of fluorine and chlorine.

In the arrangement of the elements which I have classified as  $H_{7n}$  little assistance is derived from known analogies when nitrogen and silicium are admitted in the same series with the iron and platinum groups of metals; yet, it might be expected that elements so abundant and so widely diffused in nature as nitrogen, silicium, and iron, would occupy important positions in any rational classification of elementary species. We have seen that the first three places in the preceding series  $H_n$ ,  $H_{2n}$ ,  $H_{3n}$ ,  $H_{5n}$  are all occupied by elements with atomic weights which exclude nitrogen, silicium, and iron, while the latter element is excluded from the series  $H_{4n}$  and  $H_{6n}$  by chromium and titanium. The atomic weight of N, Si, and Fe, besides being whole numbers, are exact multiples of 7. N and Si are, consequently, excluded from the vacant homologous positions in the series  $H_{4n}$ ,  $H_{6n}$ .

Since the investigation of the properties of silicium by Berzelius, who regarded silicic acid as a trioxide, much discussion has arisen as to whether the atomic weight of silicium be 21 or 28; or the formula for its oxide  $SiO_3$  or  $SiO_2$ . Chemists are now generally agreed upon the latter formula for silicic acid, and have accordingly classified silicium with titanium, as the oxide,  $SiO_2$ , agrees with titanic acid,  $TiO_2$ . Now, if silicium were the true analogue of titanium, the oxides of these elements should be isomorphous, whereas the crystalline form of quartz is hexagonal, while rutile, anastase, brookite, zirconia, and tinstone (similar oxides of members of the series  $H_{4n}$ ), are tetragonal: consequently, silicium does not belong to the series  $H_{4n}$ .

By assigning to silicium the atomic weight 35, it forms with nitrogen and iron a triad similar to the first three members of  $H_n$ ,  $H_{2n}$ ,  $H_{3n}$ ,  $H_{5n}$ . The position of  $Si=35$  as the second member of the series  $H_{7n}$  not only throws new light on the disputed atomicity of this element, but also explains the anomalous atomic heat which has been assigned to it.

Through the classical researches of Regnault the specific heat of silicium was found to be 0.176.\* The determination was made with specimens of the metal of considerable size, and in a state of compactness and purity, to receive a polish which formed a perfect mirror. The above number multiplied by 28, the highest atomic weight assigned to Si, gives the product 4.93, while the law of Dulong and Petit requires the value 6.25.

In discussing the cause of the anomalous atomic heat of silicium, Regnault pointed out that in order that it might enter into the law of the specific heat of other elements, it would be necessary to write the formula of silicic acid  $Si_2O_5$ ; it would then resemble that of nitric, phosphoric, and arsenic acids. The atomic weight of silicium would then be 35, and the product of this number and the specific heat would be nearly 6.25, which agrees with the analogous products which other simple bodies give. By assigning to silicium a higher atomic weight and a polybasic character like that of phosphorus

or nitrogen, Regnault remarked that it is easy to explain the existence of the great number of silicates which nature presents in well defined and beautiful crystals, and to understand the existence of the natural hydro-silicates.

Whichever view chemists may ultimately adopt in regard to the constitution of silicic acid, or whether its atomic weight be fixed at  $3H_7$ ,  $4H_7$ , or  $5H_7$ , silicium will still retain its positions as the second member of the series  $H_{7n}$ . The chief properties which distinguish the elements of the series  $H_{7n}$  are their high fusing point; their occlusive affinity for hydrogen; and their passivity in the presence of ordinary reagents, to which iron, under peculiar conditions, forms no exception. In regard to their occlusive affinity for hydrogen; the relation of nitrogen to iron and palladium may explain the existence of the ammonium amalgam, in which nitrogen and hydrogen are held together in the nascent state by means of mercury. The formation of silicium hydride by electrolysis, in a manner analogous to that of the ammonium amalgam, would also indicate for silicium a similar occlusive affinity for hydrogen to that possessed by nitrogen.

Although gold in some recent classifications of elements has been separated from the platinum metals, yet, in its primary qualities, it exhibits closer analogies with them than with the members of any other series, and there is no other place vacant in the groups which an element with the atomic weight and physical properties of gold would fit. The constant association in nature of quartz, hematite, and specular iron ores with gold and platinum is a fact fully recognised by chemical geologists,\* and confirms the positions assigned for Si, Fe, and Au in the table as forms of  $H_{7n}$ .

The remarkable resemblance which the members of the iron group have to one another, while their atomic weights are nearly if not exactly the same, has long been a subject of much interest to philosophical chemists, and if the views which I have enounced respecting the formation of elementary species by condensation be correct, the cause of these resemblances admit of a possible explanation. From the great abundance and wide distribution of iron in nature, it is probable that the vapour of this element would form a zone of considerable depth; the upper and lower regions of which, by differences of pressure and temperature might produce allotropic varieties before a definite change to the next higher members in the series occurred. When once varieties of an element were formed, these varieties would be propagated through successive condensations into the next higher members of the series, just as they are found in the palladium and platinum groups of metals. Chemists have already observed that each of the metals of the palladium group appears to be more especially correlated with some particular member of the platinum group, and all are found associated together naturally in the metallic state. If the four members of the platinum group be considered the analogues of the corresponding members of the iron and palladium groups, it will be seen that one of the members of the latter group is missing. M. Sergius Kern, a Russian chemist, has recently discovered a new metal which he classifies with the platinum group, and has given to it the name of davyum.† The specific gravity of the new metal was found to be 9.39, and preliminary experiments on its equivalent show that it is greater than 100 and supposed to be 150—154. Now the specific gravity and atomic weight of the new metal exclude it from the platinum group, and also from the iron group of metals; davyum is therefore the missing element in the palladium group, and will have a specific gravity of about 11, and an atomic weight of 105; or the same density and equivalent as the other members of the group. The state of aggregation of the small quantity of the new metal obtained by M. Kern may have prevented the same

\* Bischoff's Chemical and Physical Geology, vol. iii., 534. Cavendish Soc. Works. "Murchison's Siluria," chap. xvii., 435-439.  
† CHEM. NEWS, vol. xxxiv., pp. 4, 114, 155.

\* *Annales de Chimie et de Physique*, tome lxxiii., 24-31, 1861.

specific gravity being found for it as for the other members.

Although I have designated the highest members of the series  $H_{7n}$  as the platinum group, yet if the slight differences in their atomic weights and physical properties admit of explanation by the assumption of their being allotropic varieties of each other, then gold, palladium, and iron may stand at the head of their respective groups, and determine the species to which the varieties belong. It is no objection to the theory of the members of the respective groups being varieties of each other, that they cannot by any known power of analysis be resolved into their primaries, as the same objection would apply to the natural varieties of organic species determined by naturalists.

(To be continued).

## CORRESPONDENCE.

### WORKING UP NAPHTHALIN FOR USEFUL PRODUCTS.

*To the Editor of the Chemical News.*

SIR,—With regard to Mr. J. Marzell's letter in the CHEM. NEWS (vol. xxxviii., p. 58) I still adhere to the text of my former letter, because I cannot understand the value of descriptions of processes which are at variance with already ascertained fact and experience. Surely, too, in writing for non-chemists one cannot be too careful in this respect, and that they should be made aware of all that has been done practically. With respect to the latter part of Mr. Marzell's letter, I don't think it worth my while to reply to this gentleman's stigma on my results as "non-results," but leave these to the decision of the readers of my papers in the journals I quoted in my last, and also of such works as Schorlemmer's, Buchner's, Gorup-Besanez, and others on organic chemistry, where my results are accepted and recorded. Any sensible man reading my papers will see I lay no claim but to the products of the action of heat on naphthalin as the field of work which I discovered myself, after Berthelot had already worked at and given up the subject long before, stating his final results. Mr. Marzell says I wish to appropriate that "burning question," the "naphthalin theme," for my special leisure and use, and under cover of this accusation seeks to convince the readers of the CHEMICAL NEWS that as I claim unjustly so large a subject, so wide a field, he has as good a right to work in it as I. This were plausible if it were true. But the accusation is not true, and under its cover he would apparently strive to break in upon my *small corner of this field*, and by ignoring all I have previously done (see his paper, CHEM. NEWS, vol. xxxvii., page 258), would seem desirous of wresting it from me even, or appropriating it. I think "It may well be asked," then, how Mr. J. Marzell can conscientiously ignore the investigations of another man, and actually propose for himself the very problem solved by these investigations, endeavouring apparently to give his non-chemist readers the idea that no previous work worth naming had been done in this direction.—I am, &c.,

WATSON SMITH.

### THE WORD "LABORATORY."

*To the Editor of the Chemical News.*

SIR,—Will any of your learned readers give me some clue to the proper pronunciation of the word "Laboratory"? Among my English, Scotch, and Irish acquaintance there are scarcely two who say it exactly alike; and I know one gentleman, an eminent chemist, who pronounces it in two distinct manners—*i.e.*, sometimes one way and sometimes another.

There are persons who say *Lābōrātōry*; others, *Lābōrā-tōry*; and others, again, *Lābōrātōry*.

The French place the accent on the second syllable—*Labōratoire*; but the Latins laid it on the fourth—*Laboratōrium*: the Germans adopt the latter pronunciation, I believe.

I have consulted several Dictionaries, but they all shuffle out of the difficulty. Do, if possible, let us have the proper pronunciation determined once for all, and stick to it.—I am, &c.,

DIDYMIUM.

London, August 9, 1878.

### ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS.

*To the Editor of the Chemical News.*

SIR,—In the third report drawn up by Mr. Allen on behalf of the Committee appointed by the British Association to report on the estimation of potash and phosphoric acid in commercial products there occur some statements on which I should like to offer a few remarks. The report distinctly declares that the work of the Committee has been solely to collect such evidence as has been placed at its disposal, and not to make any definite series of experiments; but are the Committee quite sure that by this means they have been fully able to comprehend all the difficulties and sources of error to which the processes are liable? Each member (biassed probably in favour of the process which he himself could work best) would come with his opinion already formed, and would not very readily give credence to the statements of other chemists when they clashed with his preconceived ideas, and especially when he only had the warrant of their accuracy *on paper*. With the remarks on the molybdic acid method and the methods for the estimation of precipitated phosphates I entirely agree, but in the other processes it seems to me that they have entirely shirked the difficulty. In speaking of the oxalic acid method they say it is advisable to separate the iron and alumina before the precipitation of the phosphoric acid with magnesia mixture, and undoubtedly this would have the effect of making the estimation of the phosphoric acid remaining in the filtrate more accurate; but how about the phosphoric acid remaining with the iron and alumina? This precipitate is not a constant chemical compound, as we should be inclined to infer from the simple way in which the Committee appear to treat it. After the acetate of ammonium precipitate has been weighed it is necessary to analyse it if we want to get accurate results, and the very error which the Committee are desirous of guarding against is here introduced, unless the phosphoric acid be determined by Sonnenschein's method. It is not sufficient to only determine the iron and calculate the precipitate as consisting entirely of phosphates of iron and alumina, for even when precipitated in the cold it is sure to contain a greater or less amount of phosphate of lime. Further, all the iron and alumina does not appear to be in the state of phosphates, for on analysing the acetate of ammonium precipitate (as I have had frequent occasion to do) it will be found that the phosphoric acid very rarely exceeds one-third of the weight of the precipitate, whereas if it were all phosphate of iron it ought to be nearly one-half of the weight.

The only advantage of first separating the acetate of ammonium precipitate (at all events when the iron and alumina are not wanted) is that it gives the operator some idea of the quantity of citric acid required to keep the iron and alumina in solution, but for those who are constantly working with phosphatic materials and superphosphates this is superfluous, as by a mere glance at the sample it is not difficult to determine the amount of citric acid required; and, moreover, the previous separation necessitates two determinations of phosphoric acid instead of one. Of course, in the estimation of phosphoric acid

as ammonio-magnesian phosphate its solubility in strong ammonia water (1 in 4) must not be overlooked, although nothing is said on this head in the report.

The above remarks with regard to the acetate of ammonia precipitate apply with equal force to the uranium process as advised by the Committee.

Finally, when the amount of alumina is large, the oxalic acid and uranium processes are inapplicable, the only trustworthy method, so far as I know, being Sonnenschein's.—I am, &c.,

ALFRED SMETHAM:

1, Park Lane, Stoke Newington, N.,  
August 19, 1878.

### ROSS'S "PYROLOGY."

To the Editor of the Chemical News.

SIR,—In answer to the inquiry of Major Ross (CHEMICAL NEWS, vol. xxxviii., p. 45), I will state that I have very often heard of his work on "Pyrology," through his interesting contributions to the CHEMICAL NEWS, but never had any opportunity of seeing that work.

If Major Ross has a prior claim on the candle covered with tin-foil, I shall take great pleasure in communicating the fact to all those who have published my paper.—I am, &c.,

P. CASAMAJOR.

Brooklyn, August 8, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 4, July 22, 1878.

**Theory of Fermentation.**—M. Pasteur.—The author quotes from the papers of the late Claude Bernard the following passage condemnatory of his own theory of fermentation:—"Theory of Alcoholic Fermentation.—The theory is destroyed. (1.) It is not life without air, for in the air, as well as in its absence, alcohol is formed without yeast. (2.) The ferment is not derived from external germs, for in aplasmic or unfruitful juices (verjuice, &c.) the ferment is not evolved, though they are sweetened. If a ferment is added then they pass into fermentation. (3.) Alcohol is formed by a soluble ferment exterior to life in ripening or putrefying fruits; there is then a decomposition of the fruit and not a biosic synthesis of yeast or of vegetation. Air is absolutely necessary for this alcoholic decomposition. (4.) The soluble ferment is found in the juice extracted from the fruit; the alcohol continues to be formed in it and to increase. With the infusion of old yeast its demonstration becomes still easier. (5.) In fermentation there are two conditions to be studied:—*a.* Decomposition. *b.* Morphologic synthesis." He then seems to censure M. Berthelot for the publication of these notes. He declares "The existence of these notes and the enormous disproportion between the conclusions and the facts which support them seem to have an explanation very different from that which M. Berthelot has suggested to the readers of the *Revue Scientifique*, inviting them to believe, upon the faith of *on dits*, that the declarations of Claude Bernard, a few days before his death, were entirely conformable to the general affirmations of the Notes of Saint Julien" (*i.e.*, M. Bernard's country seat, where these notes were drawn up).

**Observations with Reference to the Researches of M. Rosenstiehl on the "Absolute" or "Ideal Black."**—M. Chevreul.—The author quotes a passage written in 1835:—"If the light falling upon a body is completely absorbed by such body, so as to disappear from view, as if falling into a hole perfectly dark, then the body appears to us black, and only becomes visible because it is contiguous to surfaces which reflect or transmit light. Among black bodies we know none which is perfectly so, and this is because they reflect a little white light by which they affect our sight. What proves this reflection of white light is that the blackest surfaces if polished reflect the images of illuminated objects placed before them."

**Electro-chemical Deposition of Cobalt and Nickel.**—E. Becquerel.—With reference to the recent paper on this subject by M. Gaiffe (*Comptes Rendus*, p. 100) the author states that the same methods had been pointed out in 1862 by his late father and himself.

**Variation of the Intensity of Currents Transmitted through Imperfect Contacts According to the Pressure Exerted upon them.**—Th. du Moncel.—With reference to the wonderful results obtained by Edison and Hughes by the use of currents of an intensity varying with the pressure exercised upon the contact-pieces of a circuit-joiner, the author calls the attention of the Academy to the researches which he has undertaken at different epochs on this kind of effects. Thus, in 1872, when commencing his great investigations on the conductive power of imperfect conductors he was led to measure the resistance of charcoal dust and of metal filings, which he found to vary according to the more or less brilliant state of their surfaces and the manner in which they are aggregated around the electrodes.

**New Earth of the Cerium Group with Remarks on a Method for the Analysis of the Natural Columbates.**—L. Smith.—The author has already communicated to the Academy (*Comptes Rendus*, lxxxiv., p. 1036) the discovery of two new columbates, and has published (*Annales de Chimie et Physique*, series 5, vol. xii., p. 253) a description of all the columbates hitherto found in the United States. In a future communication he will make known the analytical methods employed, and the true nature of the earths which enter into the composition of several of these minerals. The object of the present note is to call attention to the use made for their solution of concentrated hydrofluoric acid, whose action, especially upon the samarskite and euxenite of North Carolina, is as rapid and energetic as that of hydrochloric acid upon calcareous spar. If finely-powdered samarskite is taken, moistened with its own weight of water, and treated with twice its weight of fuming commercial hydrofluoric acid, the attack takes place in the cold in a few seconds, the mass heats with a slight effervescence, and the decomposition is effected in from five to ten minutes. If needful the action may be assisted by exposure to the heat of the water-bath for a few moments. The capsule is then kept at the temperature of boiling water long enough to expel the excess of acid. The contents of the capsule are then treated with 30 to 40 grms. of water (to 5 grms. of mineral), thrown upon a filter, and carefully washed, adding, if needful, one or two drops of hydrofluoric acid. The mineral is thus separated into two portions: the filtrate, containing all the metallic acids and the oxides of iron and of manganese; and the insoluble precipitate, containing all the earths and uranic oxide. In a following memoir complete details on the separation of these two portions will be given. The difficulty of the attack increases with the proportion of tantalic acid in the minerals. The most interesting constituents of samarskite are the earths. In the description already published of the North Carolina variety the author merely arranged the earths in two classes: the yttria group and the cerium group, remarking that the latter probably did not contain oxide of cerium, and that the thorina detected in the variety from the Urals was present in too small quantity to be

recognised in a satisfactory manner. He has since found that the earths of the yttria group consist of about two-thirds yttria and one-third erbia. That there is no cerium in the group to which it belongs, but that these groups comprise about 10 per cent of thorina—or rather less than 1 per cent of the entire mineral—a very small quantity of didymic oxide, and an earth (to the extent of 3 per cent) which he regarded as new, if it is not the hypothetical erbia of MM. Delafontaine and Marignac, admit the existence of terbia. At present the author inclines to the belief that the earth in question is new, and that if terbia exists in the samarskite of North Carolina it must be found among the yttria group. On comparing the atomic weight of the new earth, carefully separated from thorina and didymic oxide, with those of the oxides of cerium, lanthanum, and didymium, as determined by M. Marignac, we find (O = 16) :—

New earth .. .. .	109	(Smith)
Oxide of cerium .. .. .	110	(Marignac)
„ „ lanthanum .. .. .	110	„
„ „ didymium .. .. .	112	„

The new earth differs from those of the yttria group by its behaviour with the sulphate of potassa; from ceric oxide by its solubility in very dilute nitric acid and in an alkaline solution traversed by a current of chlorine; from didymic oxide by its colour and other peculiarities, especially the absence of absorption-rays as spectroscopically determined in its solutions; from lanthanum oxide by its colour, the readier decomposition of its salts by heat, their crystalline forms, and other characters. The author has discovered an exact method for separating thorina from the other earths. It consists, like the method employed for separating cerium from didymium and lanthanum, in placing the oxides recently precipitated in water containing four to five times their weight of caustic potassa or soda and in passing a current of chlorine into the liquid. All the oxides are dissolved save those of cerium and thorium, and as the former is not present in the samarskite of North Carolina, the residue is a white precipitate, gelatinous like alumina. He has also discovered a simple process for separating the greater part of the thorina in operations on a large scale, but not sufficiently exact for analytical purposes. He gives no name to the metal of the supposed new earth, being engaged with the examination of a group of oxides and acids—eleven according to some chemists—interposed between columbium and the new earth.

**Mosandrum; a New Element.**—J. L. Smith.—Having read the interesting communication of J. L. Soret to the Academy of Sciences as concerns the absorption spectra of the earths of gadolinite in the ultra-violet rays, the author communicates to the Academy that the earth designated X was discovered by him more than a year ago; the discovery was publicly announced in the *Transactions* of the Academy of Natural Sciences of Philadelphia, in May, 1877. The author then gives a detailed history of the discovery.

**Vapour Tension and the Congelation Point of Saline Solutions.**—F. M. Raoult.—The difference of vapour-tension as well as the lowering of the freezing-point varies considerably with the nature of the dissolved salt. As regards the power of diminishing vapour-tension or of reducing the congelation point, the different anhydrous salts may be approximately ranked in the same order. The power of the anhydrous salts in producing the one or the other effect is generally so much the greater as the atomic weight is lower.

**Presence of Lead in the Subnitrate of Bismuth.**—MM. Chapuis and Linossier.—The authors propose a method for the detection of lead, and remark that out of twelve samples examined three only contained lead in appreciable quantity.

**A New Non-saturated Hydrocarbide, Diallylen.**—L. Henry.—Diallylen, C<sub>6</sub>H<sub>8</sub>, is a colourless limpid liquid,

very mobile, of a strong and peculiar odour, and may be preserved indefinitely. It is insoluble in water, upon which it floats; soluble in alcohol, ether, sulphide of carbon, and petroleine. Its sp. gr. at 18° = 0.8579. Under ordinary pressures it boils at 70°, a temperature intermediate between the boiling-points of diallyl and dipropargyl. Its vapour-density is 2.79.

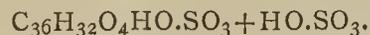
**Researches on the Presence of Lithium in the Soils and in the Thermal Waters of the Solfatara of "Pouzzoles" (Pazzoli?).**—S. de Luca.—In the trachytic earths and thermo-mineral waters of the Solfatara of Pazzoli a small quantity of lithium is found in the state of sulphate.

*Reimann's Färber Zeitung,*  
No. 29, 1878.

This issue contains nothing of general interest.

No. 30, 1878.

**Process for the Preparation of a Mordant for Turkey-reds as a Substitute for the So-called White Baths.**—Dr. A. Muller-Jacobs.—The invention relates to the preparation of a peculiar oil, named Turkey-red mordant, for the production of Turkey-red in dyeing, and printing upon yarns and tissues of all kinds, with madder, and all preparations of madder, including artificial alizarin, purpurin, and all analogous colouring-matters. A single passage through this oil along with a proper addition to the colour-baths supersedes in printing and dyeing the usual and oft-repeated white-baths, and yields a colour not inferior to ordinary Turkey-red in beauty and fixity, and if applied to common madder colours imparts to them a peculiar lustre. The Turkey-red oil is a mixture of the sulpho-ricinoleate of soda, and the sulphopyrotrebate of soda. The preparation is conducted as follows:—1. Sulpho-ricinoleate of soda. Castor oil, ordinary or purified, is mixed with 20 per cent of its weight of sulphuric acid, at 66° B., the acid being caused to flow into the oil in a thin stream. This operation is best conducted in iron vessels, lined with lead, on the bottom of which lie leaden tubes, in which ice-cold water is allowed to circulate, in order to prevent a rise of temperature in the syrupy mixture. After standing for two or three hours the mass is diluted with water at pleasure, and neutralised with a luke-warm solution of soda—2.8 kilos. soda crystals to every kilo. of acid employed. The alkaline liquid is added slowly and with constant stirring. The mixture is then allowed to stand over night. The next morning the sulpho-ricinoleate of soda is found separated, and after the removal of the water is ready for future use. If pure oil is employed the quantity of sulphuric acid may be reduced to 15 per cent. If impure castor oil is taken, 20 per cent will be needed, and in some cases even more. By sulpho-ricinoleic acid the inventor understands an acid of the formula—



*i.e.*, ricinoleic acid, conjugated with sulphuric acid, resembling sulpho-glyceric acid, or Fremy's sulpholeic acid, which latter is formed on treating olive oil with concentrated sulphuric acid in the cold. The acid itself, and its alkaline and ammoniacal salts are readily soluble in water, but on prolonged standing or on boiling are decomposed, taking up water, and forming a fatty acid, closely connected with oleic acid (metaoleic or hydro-oleic acid), and sulphuric acid or sulphates. The inventor has examined the mixture of castor oil and sulphuric acid. The analytic results show that a compound is formed resembling sulpholeic acid. The aqueous solutions are precipitated by metallic salts, and on the decomposition of the latter by heat, *e.g.*, the lead precipitate, there remains a quantity of lead sulphate tolerably in harmony with theory. The glycerin simultaneously liberated by the treatment of the oil forms sulpho-glyceric acid, and forms an aqueous solution with

excess of sulphuric acid, from which the sulpho-ricinoleic acid and its salts are readily separated, being insoluble therein. The compound obtained is naturally not of absolute purity. Whilst castor-oil soaps have absolutely no power as mordants, the action of this substance as a mordant is readily intelligible. On mere exposure to the air there are formed in textile fibres steeped in this mordant salts of sulphuric acid, along with those of ricinoleic acids, analogous to metaoleic and hydroleic acids—which are also mordants—insoluble in alcohol, and soluble only in ether. They are scarcely attacked by strong alkalies. The same compound can be formed from olive oil by slow oxidation. No acid is necessary, in order to separate the alkali from a sulpho-ricinoleate. The substance is decomposed spontaneously, and the sulphate of soda is washed out. 2. Pyrotterebate of soda is prepared by boiling, in enamelled iron vessels, 250 parts of rosin, which is powdered and added in small portions. After the lapse of 1½ hours the liquid is gradually concentrated, and the residue is heated for half an hour to 200°–250° in closed iron vessels. When cold the semi-fluid mass is treated with 20 to 30 per cent of sulphuric acid at 656° B., and after two or three hours it is neutralised with soda, and the sulpho-pyrotterebate of soda, which separates out of the solution of sulphate of soda, is reserved for use. To make up the mordant, equal volumes of the solutions of the sulpho-ricinoleate and of the sulpho-pyrotterebate of soda are mixed, and used at once in the preparation of Turkey-red. Experiments with chemically pure products show that the best proportions are 6 to 7 parts of the sulpho-ricinoleate and 3 to 4 of the sulpho-pyrotterebate. Instead of soda may be used potash, caustic alkalies, ammonia, alkaline earths, or their carbonates. Instead of the above-specified mixture, the inventor claims the use of a mixture of the sulpho-ricinoleate of soda or ammonia, with the mixture of sulpholeate and sulpho-margarate of soda or ammonia, formed by treating olive oil with sulphuric acid, and neutralising with ammonia.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 15, August 7, 1878.

According to the *Journal de Medecine et de Chirurgie Pratique* ergot of rye is of great service in typhoid fever.

## MISCELLANEOUS.

### British Association for the Advancement of Science.

—The following are the names of the Officers and Committee of Section B. (Chemical Science Section) of the Dublin Meeting of the British Association:—

*President*—Prof. Maxwell Simpson, M.D., F.R.S., F.C.S.

*Vice-Presidents*—Prof. Apjohn, F.R.S., F.C.S.; Wm. Crookes, F.R.S.; Prof. Dewar, F.R.S.; Dr. J. H. Gladstone, F.R.S.; Sir R. Kane, F.R.S.; Dr. Longstaff; Prof. J. Emerson Reynolds, M.D., Ph.D., F.C.S., M.R.I.A.; Prof. Roscoe, F.R.S.; Prof. Rowney; Prof. A. W. Williamson, F.R.S.

*Secretaries*—W. Chandler Roberts, F.R.S.; C. R. Tichborne, M.D.; J. M. Thomson, F.C.S.; T. Wills, F.C.S.

*Committee*—Captain Abney, R.E., F.R.S.; Prof. Attfield, Ph.D.; A. H. Allen; P. P. Bedson, D.Sc.; James Bell; H. B. Brady, F.R.S.; C. A. Cameron; W. Lant Carpenter, D.Sc.; R. C. Clapham; E. W. Davy, M.D.; Prof. J. Ferguson, M.A.; A. E. Fletcher; W. W. Fisher, M.A.; Colonel Gamble; J. C. Gamble; C. H. Gingham; W. E. Heathfield, F.R.S.E.; C. H. Hinton, M.A.; F. Hodges; F. Jennings; Dr. Lapper; Dr. Stevenson Macadam, F.R.S.E.; R. J. Moss; Dr. B. H. Paul; W. Thomson, F.R.S.E.; G. F. Schacht; H. Smyth; W. Ramsay; E. C. C. Stanford; W. W. Stoddart; Dr. William Wallace; R. Warrington; W. Weldon, F.R.S.E.; John Williams; W. Carleton Williams; Mattieu Williams.

The papers brought before the Section were as follows:—

*Dr. C. R. Alder Wright.*—Report of Committee on the Chemistry of some of the lesser known Alkaloids.

*Dr. Wallace.*—Report on the best means of Developing the Light from Coal-gas. Part I.

*A. S. Wilson.*—On the Amounts of Sugar contained in the Nectar of various Flowers.

*Dr. E. M. Davy.*—Action of Chlorine on the Nitroprussides.

*E. H. Cook, B.Sc.*—The Adulteration Act, in so far as it relates to the prosecution of Milk-sellers.

*Professor Roscoe, F.R.S.*—On some Fluor Compounds of Vanadium.

*Dr. J. H. Gladstone, F.R.S., and Mr. Tribe.*—Notes on Aluminium Alcohols.

*William Thomson, F.R.S.E.*—On the Estimation of Mineral Oil or Wax in the Mixture of either of these Substances with other Oils or Fats.

*C. A. Cameron, M.D., and E. W. Davy, M.D.*—On the Action of Heat on Ammonium Selenate.

*Louis Siebold.*—Application of Silver Nitrate and Hydrocyanic Acid in Alkalimetry.

*W. Lant Carpenter, B.Sc.*—Notes on Water from the Severn Tunnel Springs.

*Dr. E. A. Letts.*—On the Thetines.

*Dr. Johnstone Stoney and Prof. E. Reynolds, M.D.*—On the Spectrum of Chlorochromic Acid.

*Dr. W. Ramsay.*—Summary of Investigations on the Pyridine Series.

*Dr. W. Ramsay.*—On some Derivatives of Furfural.

*B. C. Molloy.*—Re-oxidation of the Peroxide and the Lower Oxides of Nitrogen, and their Conversion into Nitric Acid.

*Dr. Phipson.*—On some Substances obtained from the Root of the Strawberry.

*Dr. Phipson.*—On a New Mineral White Pigment.

*Oliver J. Lodge, D.Sc.*—On a Simplification of Graphic Formulæ.

*W. Chandler Roberts, F.R.S.*—On the Detection by means of the Microphone of Sounds which accompany the Diffusion of Gases through a thin Septum.

*Professor Emerson Reynolds, M.D.*—A Short Account of Baeyer's Synthesis of Indigo.

*Dr. Ramsay.*—To show Victor Meyer's Apparatus for taking Vapour Densities of Substances with High Boiling Points.

*Professor J. Dewar, F.R.S.*—On the Condensation of the Gases hitherto called Permanent.

*Professor Wanklyn and W. J. Cooper.*—On a Method of Elementary Organic Analysis by a Moist Process.

*Dr. C. R. C. Tichborne.*—On some Peculiarities of the Vartry Water, and on the Action of that Water upon Boiler Plates.

*W. Willis, jun.*—A New Process of Photo-Chemical Printing in Metallic Platinum.

The meeting of the British Association for 1879 will be held at Sheffield, and will commence on August 6. Dr. J. Allman, F.R.S., has been nominated President-Elect, and the Vice-Presidents chosen are the Duke of Devonshire, the Earl of Rosse, the Earl of Wharnccliffe, Prof. Huxley, and Prof. Odling. The meeting for 1880 will be held at Swansea.

**Research Fund of the Chemical Society.**—The following grants have lately been made from the Research Fund of the Chemical Society:—

£50 to Dr. Tilden, for an investigation into the chemical nature of the terpenes.

£50 to W. N. Hartley, Esq., of King's College, for apparatus and materials required in carrying on a research on the action of organic substances on the ultra-violet rays.

£30 to Dr. W. Ramsay, for determining the electric conductivity and resistance of solutions of salts at different temperatures.

£20 to W. Jago, Esq., for the purchase of apparatus required for carrying on a research on the organic matter in sea water.

£10 to W. A. Shenstone, Esq., for the examination of certain reactions of brucine and strychnine.

University of London.—The following is a list of the candidates who have passed the recent Examinations for Honours, First B.Sc., and Preliminary Scientific (M.B.) Examinations:—

(First B.A. and First B.Sc. conjointly.)

*Mathematics*—First Class; R. S. Heath, First B.Sc. (Exhibition), Trinity College, Cambridge; \*R. A. Herman, First B.A., King Edward's School, Bath. Second Class: T. Beck, First B.Sc., University College. Third Class: M. W. Richmond, First B.Sc., University College; J. C. Tregarthen, First B.A., private study.

(First B.Sc. and Preliminary M.B. conjointly.)

*Chemistry*—Second Class: F. L. Teed, First B.Sc., University College and private study; T. W. Williams, First B.Sc., University College and Royal College of Chemistry. Third Class: E. J. Onions, Prel. Sci., private study; G. B. Hoffmeister, Prel. Sci., Caius College and St. Bartholomew's Hospital; E. H. Rennie, First B.Sc., University College and Royal School of Mines; S. L. Hart, First B.Sc., St. John's College, Cambridge.

*Experimental Physics*—First Class: J. W. W. Waghorn, First B.Sc. (disqualified by age for Arnott Exhibition and Medal), private study; S. L. Hart, First B.Sc. (Arnott Medal), St. John's College, Cambridge. Second Class: G. J. Burns, First B.Sc., Birkbeck Institute and private study; S. C. Hill, B.A., First B.Sc., University College; D. W. Samways, Prel. Sci., St. Bartholomew's Hospital; S. G. H. Barfield, First B.Sc., private study; A. E. Laloë, B.A., First B.Sc., private study; J. H. Hichens, Prel. Sci., Epsom College; E. J. Onions, Prel. Sci., private study. Third Class: B. Hall, Prel. Sci., St. Bartholomew's Hospital.

*Botany*—First Class: A. King, Prel. Sci. (Exhibition), University of Edinburgh. Second Class: C. E. Stuart, First B.Sc., University College and private study. Third Class: W. D. Halliburton, Prel. Sci., University College; J. H. Champ, Prel. Sci., Guy's Hospital.

*Zoology*—First Class: W. Overend, Prel. Sci. (Exhibition), Royal School of Mines and St Bartholomew's Hospital; \*P. F. Frankland, Prel. Sci., Royal School of Mines and University College; A. G. Bourne, Prel. Sci., University College; J. J. Fletcher, Prel. Sci., University College and Royal School of Mines; J. R. Forrest, Prel. Sci., University College; W. D. Halliburton, Prel. Sci., University College; E. W. von Tunzelman, Prel. Sci., University College. Second Class: M. Parry-Jones, Prel. Sci., University College; E. Radford, First B.Sc., University College; J. H. Steel, First B.Sc., private study; W. F. R. Weldon, Prel. Sci., St. John's College, Cambridge. Third Class: J. Berry, Prel. Sci., St. Bartholomew's Hospital; E. Roberts, Prel. Sci., Guy's Hospital and Epsom College.

\* Obtained the number of marks qualifying for the Exhibition or for the Prize.

## TO CORRESPONDENTS.

*J. Newlands*.—Your paper on "The Periodic Law" is crowded out this week. It shall appear in our next number.

*H. G.*—Iodide of zinc and zinc-ethyl will be formed.

## NOTICE.

The STUDENTS' NUMBER of the CHEMICAL NEWS will be published on Friday September 7th. Gentlemen holding official positions in the Universities, Colleges, 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.

## OWENS COLLEGE, MANCHESTER.

Principal—J. G. GREENWOOD, LL.D.

### I. DEPARTMENT OF ARTS, SCIENCE, AND LAW.

Greek .. .. .	J. G. GREENWOOD, LL.D. (Camb.), (Fell. Univ. Coll. Lond.).
Latin .. .. .	A. S. WILKINS, M.A. (Camb.), (Fell. Univ. Coll., Lond.).
Comparative Philology ..	A. W. WARD, M.A. (Fell. St. Peter's Coll., Camb.).
English Literature .. .. .	T. NORTHCOTE TOLLER, M.A. (Late Fell. Christ's Coll., Camb.).
History .. .. .	THOMAS BARKER, M.A. (Late Fell. Trin. Coll., Camb.).
English Language.. .. .	BALFOUR STEWART, LL.D., F.R.S. THOMAS H. CORE, M.A.
Mathematics .. .. .	OSBORNE REYNOLDS, M.A., F.R.S. (Fell. Queen's Coll., Camb.).
Natural Philosophy .. .. .	ROBERT ADAMSON M.A.
Physical Laboratory .. .. .	ALFRED HOPKINSON, M.A., B.C.L. (Stowell Fell. Univ. Coll., Oxford).
Civil and Mechanical En- gineering .. .. .	H. E. ROSCOE, B.A., Ph.D., F.R.S. C. SCHORLEMMER, F.R.S.
Geometrical and Mechan. Drawing .. .. .	W. C. WILLIAMSON, F.R.S.
Logic, and Mental and Moral Philosophy .. .. .	ARTHUR GAMGEE, M.D., F.R.S. W. BOYD DAWKINS, M.A., F.R.S. CHARLES A. BURGHARDT, Ph.D.
Political Economy.. .. .	T. THEODORES.
Jurisprudence and Law ..	J. F. H. LALLEMAND, B. ès Sc.
Chemistry and Metallurgy ..	WILLIAM WALKER.
Organic Chemistry .. .. .	EDWARD HECHT.
Animal Physiology and Zoology.. .. .	With Assistant Lecturers and Demonstrators in all the principal Subjects.
Vegetable Physiology and Botany .. .. .	
Physiology and Histology ..	
Geology and Palæontology ..	
Mineralogy .. .. .	
Oriental Languages .. .. .	
German .. .. .	
French .. .. .	
Free Hand Drawing .. .. .	
Harmony and Musical Composition .. .. .	

### II. DEPARTMENT OF MEDICINE.

Dean of the Medical School—ARTHUR GAMGEE, M.D., F.R.S.

#### WINTER SESSION.

Physiology and Histology ..	ARTHUR GAMGEE, M.D., F.R.S.
Anatomy, Descriptive and Practical .. .. .	MORRISON WATSON, M.D., F.R.S.E.
Comparative Anatomy .. ..	W. C. WILLIAMSON, F.R.S.
Chemistry .. .. .	HENRY E. ROSCOE, B.A., Ph.D., F.R.S.
Organic Chemistry .. .. .	C. SCHORLEMMER, F.R.S.
Clinic I Medicine .. .. .	WILLIAM ROBERTS, M.D., F.R.S.
Principles and Practice of Medicine .. .. .	J. E. MORGAN, M.D., M.A., F.R.C.P.
Surgery .. .. .	EDWARD LUND, F.R.C.S.
Practical Surgery .. .. .	SAMUEL M. BRADLEY, F.R.C.S.
General Pathology and Morbid Anatomy .. .. .	HENRY SIMPSON, M.D. JULIUS DRESCHFELD, M.D., F.R.C.P.
Hospital Instruction .. .. .	The PHYSICIANS to the ROYAL INFIRMARY. The SURGEONS to the ROYAL IN- FIRMARY

#### SUMMER SESSION.

Practical Physiology and Histology.. .. .	ARTHUR GAMGEE, M.D., F.R.S.
Obstetrics .. .. .	JOHN THORBURN, M.D.
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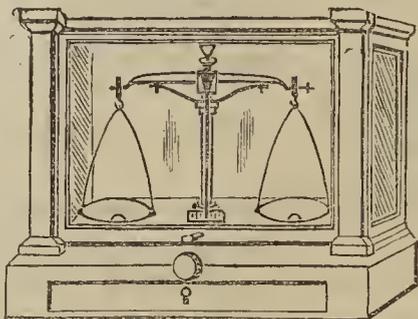
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# THE CHEMICAL NEWS.

VOL. XXXVIII. No. 979.

## ON THE ACTION OF CHLORINE ON THE NITRO- PRUSSIDES UNDER DIFFERENT CIRCUMSTANCES.\*

By EDMUND W. DAVY, A.M., M.D., M.R.I.A.,  
Professor of Forensic Medicine, Royal College of Surgeons, Ireland.

THE nitroprussides or nitroferricyanides, a class of salts obtained by the action of nitric acid on the soluble ferro- or ferricyanides, which were first studied by Dr. Lyon Playfair, have not received the attention that might have been expected from the interesting properties possessed by those combinations; and though it is now nearly thirty years since they were first investigated, still comparatively little has been added to the facts which were ascertained respecting them by their original investigator.

Having recently been engaged in studying the action of chlorine under different circumstances on those compounds, and the facts which I have noticed in connection with this enquiry being (as far as I can learn) hitherto unobserved, and as they tend to correct an erroneous statement which has been made respecting those salts, I thought it well to bring them under the notice of this Section of the British Association.

It is stated in the different standard works on chemistry, that chlorine exerts or has no action on the nitroprussides; but this I find is not the case, at least, as regards many of those salts which I have made the subject of experiment; for, although chlorine does not appear under ordinary circumstances to produce any immediate action (at least, on some of them), still when its operation is long continued, it effects a very slow decomposition of such compounds. If, however, its action is assisted by the agency of sun-light, it operates much more quickly, and soon produces the complete decomposition of those salts.

This combined action of chlorine and light on the nitroprussides being hitherto unnoticed, as far as I am aware, I have made it the subject of some research, and my experiments in this direction were chiefly made on the nitroprusside of sodium, it being the best known, and most easily procured of the nitroprussides.

When an aqueous solution of that salt was placed in a bottle of chlorine, and, after being well agitated with that gas, was exposed to the action of strong sun-light, it was observed soon to acquire a much deeper red colour, and that a small quantity of an oil-like matter floated on its surface, either in the form of a very thin film or in minute drops. By further exposure to such light the liquid gradually lost its red colour, and finally assumed a light yellow tint, whilst the oil-like matter increased in quantity, forming yellow globules, some of which sank to the bottom of the liquid.

The red colour of the solution having thus completely disappeared, it was examined, when it was found that after saturation with an alkaline carbonate, and separation of the oxide of iron formed, an alkaline sulphide no longer gave the slightest indication of the purple reaction characteristic of the soluble nitroprussides, showing that the sodium salt had been completely decomposed. On examining further the products of this complete decomposition of the nitroprusside of sodium, I was able to detect the presence of the following substances:—

The oil-like matter formed I found to possess all the properties belonging to the compound known under the name of chlorocyanic oil ( $C_6N_4Cl_{14}$ ), a substance which is produced when chlorine in conjunction with sunlight acts on several compounds of cyanogen; ferric chloride, chloride of sodium, and hydrochloric acid; and I should add that the chlorocyanic oil formed, by the further exposure to light, was in part resolved into what appeared to be the trichloride of carbon, some crystals of which were observed to attach themselves to the upper portion of the bottle. As to the cause of the liquids acquiring a darker red colour in the early stages of its decomposition, my observations lead me to conclude that this is owing to the liberation of the nitroprussic acid, which, by the continued action of chlorine, is afterwards gradually decomposed, and when its decomposition is complete, the solution loses altogether its red appearance, retaining only the yellow tint of the ferric chloride.

The following nitroprussides, viz., those of potassium, barium, calcium, zinc, iron, manganese, and silver, were found to be decomposed similarly to that in the case of the sodium salt, when they were exposed to the combined action of chlorine and sunlight, the same ultimate products, together with chlorides of the metallic bases, being produced. And it is probable that many other nitroprussides will be similarly affected when placed under the same circumstances. The only one of those compounds which I have observed as yet that appears able to resist this combined action of light and chlorine is that of copper, which has remained apparently unaffected after some weeks exposure to their influence.

From an experiment I made by passing chlorine through a solution of the nitroprusside of sodium kept at a boiling temperature, it would appear that heat, like light, aids the decomposing action of chlorine on the nitroprussides. I may further add that according to my observations chlorine, even without the assistance of either light or heat, will decompose more or less completely some at least of the nitroprussides; for I found that when the nitroprusside of iron was introduced into a bottle of chlorine, it was almost instantly acted on, and after a few moments forms, even in the dark, a deep red solution. The manganese salt is likewise soon decomposed with the separation of the manganese as the peroxide. The nitroprusside of sodium, too, when left in contact with chlorine for a considerable time excluded from light, was found to be partially decomposed, as was shown by its giving a deep blue reaction with the ferrocyanide of potassium, indicating that the chlorine had withdrawn more or less of the iron from the compound radicle of the salt.

The foregoing observations are sufficient to show that the statements which have been made and are generally received as to chlorine having no action on the nitroprussides are quite incorrect, and are contrary to the facts which I have ascertained.

There are many obvious matters connected with this enquiry still remaining to be investigated, which a number of circumstances have hitherto prevented my prosecuting, but I hope ere long to be able to do so.

## ON A NEW MINERAL WHITE PIGMENT.\*

By Dr. T. L. PHIPSON, F.C.S., &c.

FOR many years past attempts have been made by several chemists to discover some new mineral white of a less costly and less dangerous nature than white-lead, but very little success seems to have attended these researches until recently. Many years ago oxide of zinc, produced by the combustion of the metal in the air, was found to have certain properties which allowed it to be used as a substitute for carbonate of lead; but its production is very

\* A paper read before the Chemical Section of the British Association at Dublin, August 15, 1878.

\* Read before the Chemical Section of the British Association Dublin, August, 1878.

costly, and its "body" is not comparable with that of the latter. More recently an ingenious white or stone-coloured paint was economically produced from oxide of antimony, by Dr. Stenhouse, which appeared to answer very well in certain circumstances. During the last few years I have also made a great number of experiments in the same direction, hoping to utilise some of the artificial silicates which are remarkable for their brilliant white colour. To this effect I have submitted the silicates of zinc, magnesia, and lime, more especially, to a great variety of treatments, but have been hitherto unsuccessful in imparting to them anything like the "body" or covering power of lead carbonate. They all become more or less translucent when mixed with oil, and resemble in this respect pure silicic acid, whatever mechanical treatment they may have previously undergone.

Whilst occupied with these experiments I learnt that Mr. T. Griffiths, of Liverpool, had obtained a new mineral white, the basis of which was sulphide of zinc; and on submitting this new product to a careful examination I found, with astonishment, that it not only surpassed the old zinc white (oxide of zinc), but that it was superior in every respect to carbonate of lead itself. It is obtained by precipitating either chloride or sulphate of zinc by means of a soluble sulphide,—sodium, barium, and calcium sulphides have all been used for this purpose,—and precautions are taken lest any iron, that may be contained in small quantities as an impurity in the zinc solution, should be precipitated with the sulphide of zinc.

The precipitate, being collected and dried, is transferred to a furnace, where it is calcined for some time at a cherry-red heat, and carefully stirred, so as to bring all parts of it successively in contact with the air; it is then raked out, whilst quite hot, into vats of cold water, when it is levigated, and afterwards collected and dried. The result is a white pigment of exquisite beauty; its covering power when mixed with oil is greater than that of any substance hitherto discovered, being about 25 per cent higher in this respect than that of the same weight of the pure carbonate of lead.

According to my analysis of this new product, it consists of an oxysulphide of zinc, the composition of which varies somewhat according to the duration of the calcination and the exact degree of heat attained. Hence it is not an easy matter to get it precisely of the same composition at each successive operation. Nevertheless this point is attained quite closely enough for all practical purposes. The best product appears to correspond very closely with the composition  $5ZnS + ZnO$ . But occasionally a somewhat larger quantity of oxide is produced.

Of course a white of this nature is not liable to darken in colour by sulphuretted hydrogen emanations, as occurs with white-lead; but it has also the advantage of not proving prejudicial to the health of the workmen who manufacture it or who use it. I have compared it carefully with the old zinc white and with white-lead, as regards covering power, tint, and durability, and am perfectly surprised at the results of these experiments, which would be too long to record here; but knowing as I do, from the results of my own endeavours, how difficult it has been to discover a new white of these qualities, I look upon this oxysulphide of zinc white as one of the most interesting products hitherto derived from mineral chemistry.

**On Dehydro-mucic Acid.**—R. Heinzelmann.—The composition of this new acid is  $C_6H_4O_5$ . It is distinguished from mucic acid merely by the absence of 3 molecules of water. It is sparingly soluble in cold, but readily in hot water, and crystallises from the hot aqueous solution in long colourless needles of a silky lustre. In alcohol it is less readily soluble than in water, and in ether almost insoluble. If cautiously heated it may be sublimed almost without decomposition, and does not fuse. If quickly heated to a high temperature it is decomposed.—*Liebig's Annalen.*

## ON THE PERIODIC LAW.

By JOHN A. R. NEWLANDS, F.I.C., F.C.S.

As many articles have appeared in the scientific journals relating to the "periodic law," I feel justified in giving a short *resumé* of the papers connected with this law which were published by me long before M. Mendeljeff had printed anything upon the subject.

In a paper (CHEMICAL NEWS, vol. x., p. 59) I gave a list of all the then known elements in the order of atomic weight, which was the first ever published. Another table was appended giving a horizontal arrangement of the more important elements, also in order of atomic weight, with blanks corresponding to some of the missing members of various groups. Thus, in the trivalent group, commencing with boron, there was a blank next below zinc, since filled by gallium, and another blank immediately below cadmium, since filled by indium. It was also pointed out that in the group containing carbon, silicon, titanium, and tin, there was an element wanting having an atomic weight of 73, being, in fact, the same missing element which M. Mendeljeff has recently predicted under the name of eka-silicium.

In an appendix to this paper (CHEMICAL NEWS, vol. x., p. 94) I announce the existence of a simple relation or law among the elements when arranged in the natural order of their atomic weights to the effect that the eighth element, starting from a given one, was a sort of repetition of the first, or that elements belonging to the same group stood to each other in a relation similar to that between the extremes of one or more octaves in music. This was accompanied by a horizontal grouping arrangement.

In CHEMICAL NEWS, vol. xii., pp. 83 and 94, I published a full horizontal arrangement of the elements in order of atomic weight, and proposed to designate the simple relation existing between them by the provisional term "law of octaves." This law has since been called by M. Mendeljeff the "periodic law."

On March 1, 1866, I read a paper on this periodic law before the Chemical Society, and a notice of this appeared in the CHEMICAL NEWS, vol. xiii., p. 113, and also in many other journals. In the CHEMICAL NEWS, vol. xiii., p. 130, I wrote as follows:—"I have endeavoured to describe relations actually subsisting among the atomic weights of the elements at present known, but am far from thinking that the discovery of new elements (or the revision of the atomic weights of those already known) will upset for any length of time the existence of a simple relation among the elements when arranged in the order of their atomic weights. The fact that such a simple relation exists now affords a strong presumptive proof that it will always continue to exist, even should hundreds of new elements be discovered."

Years afterwards the brilliant researches of Roscoe showed that the atomic weight of vanadium was 51.2, instead of 137. This reduction in the atomic weight of vanadium at once placed that metal in the same line with the phosphorus group, thereby confirming the periodic law.

It may also be stated that in the CHEMICAL NEWS, vol. x., p. 95, I predicted that the atomic weight of indium might "prove to be identical, or nearly so, with those of zinc or cadmium."

In conclusion I claim to have been the first to publish a list of the elements in the order of their atomic weight, and also the first to describe the periodic law, showing the existence of a simple relation between them when so arranged. I have applied this periodic law to the following among other subjects:—

1. Prediction of the atomic weights of missing elements, such as the missing element of the carbon group = 73, since termed eka-silicium by M. Mendeljeff.
2. Predicting the atomic weight of an element whose atomic weight was then unknown, viz., that of indium.

3. Selection of Cannizzaro's atomic weights, instead of those of Gerhardt, or the old system, which do not show a periodic law (CHEMICAL NEWS, vol. xiii., p. 113).

4. Predicting that the revision of atomic weights, or the discovery of new elements, would not upset the harmony of the law—since illustrated by the case of vanadium.

5. Explaining the existence of numerical relations between the atomic weights (CHEMICAL NEWS, vol. xiii., p. 130).

6. Where two atomic weights were assigned to the same element, selecting that most in accordance with the periodic law; for instance, taking the atomic weight of beryllium as 9.4 instead of 14.

7. Grouping certain elements so as to conform with the periodic law instead of adopting the ordinary groups. Thus, mercury was placed with the magnesium group, thallium with the aluminium group, and lead with the carbon group (CHEMICAL NEWS, xiii., 113). Tellurium, on the other hand, I have always placed above iodine, from a conviction that its atomic weight may ultimately prove to be less than that of iodine.

8. Relation of the periodic law to physical properties—showing that similar terms taken from different groups, such as oxygen and nitrogen, or sulphur and phosphorus, frequently bear more physical resemblance to each other than they do to the remaining members of the same chemical group (CHEMICAL NEWS, x., 60.)

Laboratory, 9, Mincing Lane, London, E.C.,  
August 18, 1878.

#### ON THE ORIGIN OF ELEMENTARY SUBSTANCES, AND ON SOME NEW RELATIONS OF THE ATOMIC WEIGHTS.\*

(Concluded from p. 99).

By HENRY WILDE.

WE have seen that the quantivalence of most of the members of the preceding groups  $H_n$ ,  $H_{6n}$ , is in some way correlated or dependent on the construction of the typical molecules at the head of each series; but in the series  $H_{7n}$  the only element which is known to be septivalent is manganese; but the relation which this metal has to the iron group, and bearing in mind that the determination of the highest quantivalence of elements is limited by the knowledge of chemists at particular times, and is only arrived at after much research, the septivalency of manganese indicate a much higher quantivalence for the other members of the series  $H_{7n}$  than has up to this time been accorded to them.

I have hesitated to introduce hypothetical elements alternating with the iron, palladium, and platinum groups, as the regular sequence of elementary forms is broken by varieties, and from the density of the typical molecule  $H_7$ , it may be that the members of this series are limited to those shown in the table. The density of the typical molecule  $H_{6n}$  may also explain the absence of members alternating with Cr, Mo, and W, and I have therefore only introduced one hypothetical element in this series, the analogue of Cr with the atomic weight = 144.

Considering how nearly the numbers representing the molecular constitution and atomic weights of the members in homologous positions in the higher groups approximate, the idea occurs that the subsequent condensations of these higher groups are in some way influenced or determined by the antecedent condensation of homologous members of the lower groups, and may be the cause of

the departure in the higher groups from the simple ratios and multiple relations observed amongst the elements of the series  $H_n$  and  $H_{2n}$ . Such perturbations would appear to be similar to those which the planetary bodies exercise on each other to produce modifications in the forms of their orbits, but I leave this question to the further consideration of physicists and astronomers.

The complete parallelism of the halogens and oxygens to each other, and their intensely electro-negative character, point irresistibly to the conclusion that at one period of their history these elements existed in a state of isolation from all the others. How, and under what conditions, they acquired their electro-negative properties can in the present state of knowledge be only a matter of conjecture; but it may be conceived that these elements may have existed originally in the form of a zone or zones revolving within the moon's orbit, but high above the incandescent terrestrial surface—probably before the lunar substance changed from the annular to the globular form. These intra-lunar zones may have gradually acquired their electro-negative properties by lunar and terrestrial induction, and by the loss of their primitive heat by radiation into space. Their orbits being too near the earth to permit the zones to assume the spheroidal form, they would upon rupture become incorporated with the positive terrestrial elements, and remain dissociated till the temperature of the mass was sufficiently reduced to enable chemical combination to take place. If Draper's discovery of oxygen in the sun be confirmed, the hypothesis of the existence of an intra-mercurial zone of negative elements which subsequently united with the solar positive elements is at least as probable as the assumption of an intra-mercurial planet which has recently been discussed by astronomers. May not the sudden increase in the brightness of variable stars like *T Coronæ*, *Nova Ophiuchi*, 1848, and *Nova Cygni*, 1876, be due to the intense heat generated by the union of zones of negative elements with the central bodies round which they revolve, or by the condensation of lower into higher forms of elementary species?

All the positive forms of  $H_{2n}$ , except glucinum and lead, are well ascertained solar elements, and the remarkable relations which the members of this group have to those of  $H_n$  render it highly probable that, besides sodium and copper, other members of  $H_n$  are present in the solar atmosphere. From the fact that aluminium, titanium, chromium, and the irons are solar species, higher forms of these elements may also be expected to be found in the sun.

The numerical relations of the atomic weights to which I have directed attention, and the brief outline of a theory of the origin of elementary species which I have founded upon them, give new force to the doctrine of the transmutable nature of elementary substances. But when the synthetical formation of organic compounds is regarded as the greatest triumph of modern chemical science, the problem of building up the higher elements from the lower may well be deemed insoluble, as they have been formed under cosmical conditions of which we have little or no acquaintance. Very different, however, is the aspect of the problem of resolving the higher elements of each series into their respective types or into hydrogen. For just as by the application of heat, the higher members of homologous series are resolved, through their lower members, into their ultimates, so may it be expected that the elements themselves will, in their turn, give way to more powerful instruments of analysis.

When it is considered, that through the investigations of Dumas, Cooke, Odling, Mendeleeff, and others, nearly all the mathematical relations of the atomic weights to each other have been unfolded during the brief interval of thirty years, so that but few steps are now required to render the natural classification of the elements complete, the resolution of elementary species into their primordial ultimates would not appear to be far off.

\* A Paper read before the Manchester Literary and Philosophical Society, April 30, 1878.

1.	+ H <sub>n</sub> —	+ H <sub>2n</sub> —	H <sub>3n</sub>	H <sub>4n</sub>	H <sub>5n</sub>	H <sub>6n</sub>	H <sub>7n</sub>
2.	Li = 7	Gl = 8	C = 12	— = 16	B = 10	— = 18	N = 14
3.	Na = 23 F = 19	Mg = 24 O = 16	Al = 27	— = 32	P = 30	— = 36	Si = 35
4.	K = 39 Cl = 35	Ca = 40 S = 32	— = 42	Ti = 48	V = 50	Cr = 54	Fe = .56 56
							Mn = 56 55
							Ni = 56 58
							Co = 56 58
5.	Cu = 62	Zn = 64	— = 69	— = 72	As = 75		
6.	Rb = 85 Br = 81	Sr = 88 Sr = 80	Ga = 96	Zr = 92	Nb = 95	Mo = 96	
7.	Ag = 108	Cd = 112	Y = 123	Sn = 116	Sb = 120		
							Pd = 105 106
							Rh = 105 105
							Ru = 105 105
							Da = 105 —
8.	Cs = 131 I = 127	Ba = 136 Te = 128	In = 150	La = 140	— = 140	— = 144	
9.	— = 154	— = 160	E = 177	— = 165	— = 165		
10.	— = 177	— = 184	Tl = 204	D = 188	Ta = 185	W = 186	Au = 196 196
							Pt = 196 197
							Ir = 196 197
							Os = 196 198
11.	Hg = 200	Pb = 208	Th = 231	U = 240	Bi = 210		

NOTES OF WORK BY STUDENTS OF  
PRACTICAL CHEMISTRY

IN THE  
LABORATORY OF THE UNIVERSITY OF  
VIRGINIA.

No. VII.

Communicated by J. W. MALLETT,  
Professor of General and Applied Chemistry in the University.

(Concluded from p. 95)

(4.) *Analysis of a Remarkable Iron Slag.* By J. R. SANTOS.

A slag labelled "artificial obsidian—an accidental product from a puddling furnace at Herbert's Park Iron Works of David Jones and Sons, Bilston, Staffordshire—July, 1870," presented a jet black colour, was opaque in the thinnest splinters, of unusually high lustre between vitreous and pseudo-metallic, reflecting like a mirror the images of surrounding objects; with perfect conchoidal fracture and knife-like splintery edges; sp. gr. = 2.89, and hardness = nearly 7. It afforded on analysis—

Silica	.. .. .	47.67
Alumina	.. .. .	26.36
Ferrous oxide	.. .. .	21.99
Cupric oxide	.. .. .	0.19
Lime	.. .. .	0.79
Potassium monoxide	.. .. .	1.71
Sodium monoxide	.. .. .	1.12

99.83

These figures lead approximately to the formula of the di-silicate,  $Al_4Fe_3Si_6O_{21}$ , corresponding to  $H_6Si_2O_7$ . In composition, as in physical properties, this is quite unlike any ordinary puddling-furnace slag. The intensely black colour and complete opacity are specially remarkable in view of the low percentage of iron.

(5.) *Reduction of Magnesium from its Oxide by Metallic Aluminium, and Production of Artificial Spinelle.*  
By JAS. H. S. AUMANN, of Tazewell Co., Virginia.

Experiments of my own\* having shown that the oxides of barium, strontium, and calcium may be partially reduced by heating to a very high temperature along with metallic aluminium, the reduced metals being volatilised, it suggested itself to try a like experiment with magnesium oxide, which seemed likely to be more easily acted on. This has been done by Mr. Aumann.

He packed 25.46 grms. of pure and freshly ignited magnesia in a crucible of hard carbon, imbedding in the centre

a lump of aluminium representing 8.7 grms. of pure metal covered with a plate of the same carbon, and enclosed the crucible in a larger one of plumbago ware, filling the space between the two with well rammed lamp-black. Luting on the cover of the blacklead crucible, it was exposed for six hours to the highest temperature of a wind-furnace with coal-gas retort carbon as fuel. On opening the inner crucible after cooling, the magnesia was found much compacted together and hardened, but could be detached from the remaining rounded piece of aluminium. Shining specks could be seen on various parts of the mass, especially on the outside surface of the metallic regulus, which specks appeared under low microscopic power as minute crystals.

The whole of the aluminium, of the magnesia, and of the inner crucible and cover were now separately treated with moderately strong hot hydrochloric acid, and the solutions, after the action of the acid had ceased, were filtered. The solutions were mixed together, and in a definite fraction of the liquid aluminium and magnesium were quantitatively determined. The greyish residue left on the filters from the first two solutions was dried, ignited in a stream of oxygen to burn off some specks of carbon, and on being examined with the microscope was found to consist of minute, colourless, transparent crystals of two kinds—the one being thin elongated scales, hexagonal or the same with modified angles, quite like those I had formerly obtained by heating aluminium with sodium carbonate,\* and consisting of pure alumina; the other, regular octahedra, which scratched glass readily, and on fusion with acid sodium sulphate yielded (from analysis of 0.33 gm.) :—

Magnesia	.. .. .	28.99
Alumina	.. .. .	70.81

99.80

giving the ratio  $MgO : Al_2O_3 = 725 : 689$ ; so that it was evident that these little crystals were artificial spinelle,  $MgAl_2O_4$ . The examination of the crystalline residues, taken along with the results of the determination of aluminium and magnesium in the original hydrochloric acid solutions, showed that a little magnesium had disappeared, volatilised undoubtedly on reduction by the aluminium. Altogether, from the materials taken, 1.040 grms. of magnesium had been reduced and volatilised, 0.771 gm. of spinelle, and 1.024 grms. of crystalline alumina had been formed.

(6.) *Analysis of Tabasheer from Sumatra.* By JAS. H. S. AUMANN.

A specimen† of genuine tabasheer, the siliceous con-

\* *Chem. Soc. Journ.*, October, 1876, p. 350.

† Obtained from the Dutch Commission at the Philadelphia Exhibition of 1876, out of the very interesting collection of raw products from the Dutch East Indies.

cretion from joints of bamboo-cane, from Palembang, in Sumatra, presented the appearance of irregularly shaped fragments, from the size of a pea to that of half a walnut, generally bluish white in colour, some bits dark smoke-grey or brownish, easily broken between the fingers, finely porous, and strongly adherent to the tongue. Sp. gr. in mass, including air in the pores, equals about 0.5; after pulverisation and boiling in water to expel air, equals 1.96. Some of the whitest pieces picked out yielded on analysis—

Silica .. .. .	94.196
Ferric oxide .. .. .	0.098
Lime .. .. .	0.125
Sodium monoxide .. .. .	0.596
Potassium monoxide .. .. .	0.016
Ammonia .. .. .	distinct traces
Organic matter .. .. .	0.221
Water .. .. .	4.057
	99.309

The silica was easily soluble in solution of potassium or sodium hydrate. Of the water present 2.726 per cent was given off below 150° C., the remainder only on ignition.

This analysis, compared with that of Rost van Tonningen\* of tabasheer from Java, represents less water, and greater freedom from any other constituents than silica and water. The difference as regards the quantity of alkaline metals present is very marked. He obtained—

Silica .. .. .	86.387
Ferric oxide .. .. .	0.424
Lime .. .. .	0.244
Potassium monoxide .. .. .	4.806
Organic matter .. .. .	0.507
Water .. .. .	7.632
	100.000

(7.) *Analysis of Precious Garnet from the Cape of Good Hope.* By CHAS. KNAP, jun., of Washington, D.C.

Garnet fragments, said to be from the Cape of Good Hope, and sold by the pound, under the name "Cape rubies," for jeweller's use, presented themselves of fine deep red colour; clear, and for the most part free from flaws; of an average size, not exceeding about 0.2 or 0.3 grm. in weight; irregular in shape, sometimes exhibiting water-worn, rounded surfaces; very rarely any distinguishable crystal faces; for the most part splintery and conchoidal surfaces of fracture. Sp. gr. = 3.86. Analysis gave—

Silica .. .. .	39.06
Alumina .. .. .	21.02
Ferric oxide .. .. .	2.69
Ferrous oxide .. .. .	18.70
Manganous oxide .. .. .	0.58
Magnesia .. .. .	12.09
Lime .. .. .	5.02
	99.16

Giving the ratio  $M''O : R_2'''O_3 : SiO_2 = 660 : 221 : 651$ , and the usual ortho-silicate formula,  $M_3''R_2'''Si_3O_{12}$ .

(8.) *On the Chemical Character of "Silaonite" from Guanajuato, Mexico.* By H. D. BRUNS, of New Orleans, La.

In the journal *La Republica*, of Guanajuato, No. for December 25, 1873,† V. Fernandez and S. Navia described as a new mineral species a selenide of bismuth found with guanajuatite in the mine of Santa Catarina, and on the basis of an incomplete analysis of confessedly impure material attributed to it the formula  $Bi_3Se$ . The improbability of this formula suggests itself at once, since it assumes the presence of an odd number of perissad atoms; and in a little notice of the composition of guanajuatite‡

I have alluded to the possibility of a mechanical mixture of this species ( $Bi_2Se_3$ ) with native bismuth having formed the material described by Fernandez. Mr. E. S. Dana, of Yale College, has been kind enough to furnish me with an authentic specimen of the so-called silaonite, received by him directly from Senor Fernandez, and also with copies of *La Republica* containing both of the papers of the latter, and Mr. Bruns has examined the mineral in question with a view to ascertain whether it contains any free metallic bismuth in admixture or not.

The more compact portions of the specimen agreed as to appearance and physical properties with the description given by Fernandez, and also corresponded quite well to the supposition of an intimate mixture of Guanajuatite and metallic bismuth. On parts of the surface and in some little cavities a yellowish white powder was observable. A portion of this white powder was collected apart (a), and a portion of the thoroughly compact mineral, with distinct metallic lustre (b), free from the former; each of these was finely pulverised. A specimen of Guanajuatite, part of that received from Senor Bärkena, of Mexico, and analysed by me, was also reduced to a fine powder (c), as was finally a specimen of metallic bismuth (d). Strong nitric acid acted readily upon all of these, but it was found that by gradually increased dilution acid could be obtained which would not sensibly affect the bismuth selenide, while still attacking metallic bismuth. With acid containing 1 per cent of real  $HNO_3$ , left in contact with the above specimens for one, three, and six days respectively, shaking from time to time, filtering off, and testing with hydro-sulphuric acid, the following results were obtained:—

- (a) Well marked reaction, dark brown, after even one day.
- (b) Ditto.
- (c) No reaction, even after six days.
- (d) Well marked reaction, as for (a) and (b), even after one day.

On pushing the dilution even much further, as to 1-15th per cent, the same results were still obtained in each case.

There seems, therefore, sufficient reason for believing that the so-called silaonite is but a mixture, and not a distinct mineral species. It is to be noted that the results of the analysis given by Fernandez are not accurately represented by his formula,  $Bi_3Se$ , the atomic ratio of Bi : Se being 1665 : 621 or 2.68 : 1, and this he himself explains by assuming the presence of nearly 5 per cent of Guanajuatite. This latter species is in all probability the sole source of the selenium, and the surplus bismuth is present chiefly as native metal, but also in the white powder on the surface as carbonate and hydrate; which may have contributed to vitiate the analysis, since it shows the presence of foreign matter—gangue, &c.—to the extent of 20 per cent.

University of Virginia,  
July 24, 1878.

THE HISTORY OF ROTHAMSTED FARM.

THE founder of the Rothamsted Experimental Station is Mr. John Bennet Lawes, who began his experiments on different kinds of manures, natural and artificial, soon after entering into possession of his ancestral property at Rothamsted in 1834. Rothamsted is a small village in Hertfordshire, near Harpenden, about twenty-five miles from London. His first experiments were tried in pots; but Mr. Lawes very soon transferred his labours to the field, where, by applying neutral phosphate of lime to his crops, he obtained most striking results—so much so that they led to more extensive trials in 1840 and the following years. It was not, however, until 1843 that experiments in the open field were carried out upon anything like a systematic plan. The foundation of the Rothamsted Experimental Station, which has become famous wherever

\* Quoted in *Fahresberichte*, 1860, S. 531.

† Quoted in *Am. Journ. Sci.*, April, 1877, p. 319.

‡ *Am. Journ. Sc i.*, April, 1878, p. 296.

scientific agriculture is practised, may be said to date from this time.

The station has always been entirely disconnected from any external organisation, and has been maintained solely at the cost of Mr. Lawes, who has, further, set aside the sum of £100,000 and certain pieces of land for the continuance of the investigations after his death. In 1854-55 a new laboratory was built by public subscription amongst the farmers of England, and presented to Mr. Lawes in the latter year.

In June, 1843, Dr. Gilbert became associated with Mr. Lawes, and has had the direction of his laboratory ever since. The staff, which was at first very small, gradually increased, until within the last four-and-twenty years one, two, and even three head chemists have been employed, besides two or three general assistants, whose chief occupation it is to superintend the field experiments; that is to say, the making of the manures, the measurement of the plots, the application of the manures, and the harvesting of the crops. They also take part in the selection and preservation of samples for analysis or as museum specimens. They also superintend any experiments made with live stock. The museum specimens, which now amount to over 25,000 samples, consist chiefly of experimentally grown produce, animal products, ashes, and soils. A botanical assistant is also occasionally employed to assist one of the general assistants, who, under ordinary circumstances, undertakes this kind of work.

Two or three computers are also employed in calculating and tabulating the results obtained in the field and laboratory.

In addition to the work done in the laboratory by the permanent staff, Mr. R. Richter, of Berlin, has also been almost entirely occupied with the analysis of samples sent from Rothamsted; besides which, chemical assistance is frequently engaged in London. As may readily be supposed, the work done also involves the employment of a variable number of agricultural labourers and laboratory men.

The experiments carried on at Rothamsted may be divided into two classes—experiments on vegetation and experiments on animals. The first class includes experiments in growing the most important rotation crops separately year after year for many years on the same land either without manure at all, with farmyard manure, or with a great variety of chemical manures, the same kind of manure being, as a rule, used year after year on the same plot. Experiments on the rotation of crops with different manures have also been made, not only at Rothamsted, but in other localities where the soil is different. Some of these experiments have been carried on without intermission for five and twenty years.

Samples of all these experimental crops have been taken and brought to the laboratory, one portion being partially dried and preserved for future reference if necessary. The amount of ash in the remaining portion is then determined, one part being immediately analysed, and the rest preserved for future analysis. In a large proportion of the samples the amount of nitrogen is also determined. In the case of cereals, the influence of season and manuring on the yield of the different mill products has also been determined. With beetroot the amount of sugar contained in the roots has also been polariscopically determined.

Another important branch of this section is the mechanical and chemical analysis of the soils of the experimental plots, from time to time the samples being taken at depths varying from 9 to 54 inches.

Continual analyses of the rainfall and drainage-water have also been made almost from the very first. Experiments on the amount of water transpired by plants during their growth have given some very instructive results. Observations of a botanical nature have not been neglected, such, for instance, as the root, stem, and leaf development of different plants under varying conditions, the proportion of stubble to crop, &c.

Experiments were made for several years to determine whether plants assimilate free or uncombined nitrogen, and several collateral points. The experiments on animals have been made at intervals since 1847, with a view of determining the amount and kind of food consumed in relation to a given weight in a given time; the amount and kind of food necessary to produce a certain increase of weight in a given time; the relative development of the different parts of an animal under varying conditions, and a number of other collateral points of great interest. The rigid manner in which some of these experiments were conducted may be judged of by the following episode in the life of a pig that formed a subject of investigation:—

Individual male pigs were experimented upon for periods of three, five, and ten days respectively. Each pig was kept in a frame which prevented him from turning round. The bottom of his sty was made of zinc with an outlet for the liquid to run off into a bottle, and it was watched night and day, the voidings being carefully collected as soon as passed, which could be easily done as the animal never passed either *æces* or urine without getting up, in doing which he rang a bell and attracted the notice of an attendant, who immediately collected the deposit. The comparative characters of animal and vegetable food in human dietaries were also investigated, but we trust that the subjects of these experiments were not subjected to the same restrictions as the pig.

In conjunction with Prof. Way an extensive investigation into the application of town sewage to different crops was also undertaken. The chemistry of the malting process and the comparative feeding value of barley and malt were also investigated.

The above interesting details about the experiments made at Rothamsted are taken from a statement which precedes the yearly account of the work done on that farm for the year 1877, and published in May last. It was originally drawn up in answer to a circular letter issued by a committee appointed to arrange for the commemoration of the twenty-fifth anniversary of the establishment of the First Experimental Station, at Möckern, in Germany, which was held at Leipzig in September last. A valuable list of the titles of all papers hitherto published in connection with experiments carried on at Rothamsted, with full references to the journals in which they appeared, is appended to this report.

## NOTICES OF BOOKS.

*Elements of Chemistry, Theoretical and Practical.* By WILLIAM ALLEN MILLER, M.D., &c. Revised by CHARLES E. GROVES, Sec. I.C., F.C.S., &c. Part II., Inorganic Chemistry. Sixth Edition, with additions, London: Longmans and Co., 1878.

THE last edition of Part II. of Miller's "Elements of Chemistry" was published in the beginning of 1874, barely three years and a half ago, and the publishers have shown commendable promptitude in presenting the public with a sixth edition in so short a space of time. The present issue, which has been enlarged by some fifty pages, has been entrusted for revision to Mr. C. E. Groves, who, it will be remembered, assisted Professor McLeod in preparing the fifth edition.

Since 1874, beyond the discovery of gallium and the liquefaction of hydrogen, nitrogen, and oxygen, there has been but little done in the sadly neglected domain of inorganic chemistry. It really would seem that our rising chemists occupy themselves less and less every year with researches in inorganic chemistry, except there is something tangible in the pecuniary sense hanging to them. We mean such researches as those of M. Lecoq de Boisbaudran and MM. Cailletet and Picquet, or, in our own country, those of Professor Roscoe on vanadium, and

of Sir B. C. Brodie on the electrolysis of carbonic dioxide. A glance at any chemical periodical will show this at once, although England and America can lay claim to the privilege of a more extended cultivation of this branch of chemistry than either Germany or France. It is no doubt a proud day for a student when he has succeeded in squeezing one or more additional atoms of hydrogen or nitrogen into some almost unknown organic compound, but when so many simple every-day facts are crying out loudly for investigation it seems to us to be a misapplication of mental energy. We know, or at any rate we say we know, all about the constitution of meta-nitro-benzene-sulphonic acid, but we are utterly ignorant of what really goes on when iron rusts in damp air. To use Dr. E. J. Mills's words we would suggest to those students who are on the look out for subjects of investigation that their time would be more profitably employed in examining the commonest definite equations than in trying to find out the position of the third bromine atom in tribromobenzol.

Mr. Groves gives us excellent accounts of the most recent improvements in metallurgical and technological chemistry, thus preserving the practical character which Miller's "Elements" always possessed. Theory, however, has not been neglected, the bearing of the discovery of gallium (which is fully described in its proper place) on the periodic law of Newlands and Mendeljeff being fully explained. Strangely enough nothing is said about the liquefaction of hydrogen, nitrogen, and oxygen by MM. Cailletet and Pictet. Davyium is also described, as well as hydroxylamin and a number of other recently discovered bodies.

Mr. Groves has followed Professor McLeod's example in frequently giving us the constitutional formulæ of compounds suggested by Dr. Frankland. These views of the constitution of bodies, ingenious as they are, are far from being universally adopted in this country, and are entirely ignored on the Continent. It seems, therefore, to have been a pity to occupy valuable space with them; it would, in our opinion, have been much wiser and humbler to have confessed our ignorance on this important subject by using empirical formulæ. We are glad to see that Mr. Groves also follows the good example set by Prof. McLeod in not giving us those fertile sources of misprints in books and headaches in students—the Ho's, Ko's, and Nao's of the College of Chemistry.

Very little change has been made in the form of the book, indeed very little change was needed. The side-headings have been printed in bolder type, which with the cross-headings at the top of the page greatly facilitate reference. The references to recent researches are numerous and in most cases copious, and their dates have also been introduced in numerous instances. The index, which in all former editions has been very full, has now been made larger still, having been increased from eighteen to twenty-six pages. Both students and teachers will welcome the re-appearance of so old a friend.

*Practical Chemistry for Medical Students Specially Arranged for the M.B. Course.* By M. M. PATTISON MUIR, F.R.S.E., Prælector in Chemistry, Gonville and Caius College, Cambridge. London: Macmillan and Co., 1878.

MR. MUIR's little manual is a veritable *multum in parvo*, containing in about fifty small octavo pages all that it is necessary for a medical student to know in the way of quantitative analysis for passing the ordinary M.B. examinations. We must cordially endorse the author's opinion that the text-books which are at the present day put into the hands of the medical student frequently fail by attempting to teach too much; the consequence is that he loses half his time in separating the wheat from the chaff, the necessary from the optional. For this reason Mr. Muir gives explicit instructions for the testing and

qualitative analysis of simple salts, containing one acid radical and one base, nothing whatever being said on the more or less difficult separation of metals and acids. One peculiar feature of this little book is the table giving instructions for the detection of about a dozen of the organic acids which the medical student is most likely to meet with in his daily work. There is also a short table giving easy tests for the common alkaloids. The book may be used with advantage by all chemical students.

*The Outlines of Natural Philosophy for Young Children.*

By E. J. HOUSTON, A.M., Professor of Natural Philosophy in the Central High School, Philadelphia. Philadelphia: Claxton and Co., 1878.

PROF. HOUSTON's little manual is decidedly a step in the wrong direction. We had really thought that the wicked system of conveying instruction by catechisms had been long ago abandoned by all thinking teachers but this, and we are truly surprised to find that it still exists in America of all places in the world, where the modern methods of science-teaching are in many respects far beyond our own. Judicious and continual questioning must necessarily be the foundation stone of all scientific teaching, but both question and answer must necessarily be different in the case of almost every individual pupil. One child, for instance, will understand the drift of a teacher's question, and will show by his answer that he has already made that particular fact or question his own, while his neighbour, who may possibly be the more intelligent of the two, will return an answer which very plainly shows that he only has a very dim notion of what his master is talking about. Half an hour's visit to the first Board School will prove this assertion more fully than columns of writing. How is the book to be used? Are the answers to be learned off by heart and repeated as each question is asked, as in the bad old days of Pinnock, or is the book to be read aloud? In either case it affords a speedy fulfilment of Dr. Playfair's prophecy in the House of Commons in his speech on Sir John Lubbock's motion to render elementary science compulsory in Board Schools, which was to the effect that children could be made parrots with respect to magnets and steam-engines as well as with nouns and promontories.

## CORRESPONDENCE.

### PRINCIPLES OF COMMERCIAL CHEMISTRY.

*To the Editor of the Chemical News.*

SIR,—Your correspondent "In a Fog" may be a very clever theoretical chemist, but I doubt whether he knows much about "Commercial Chemistry;" nor does he himself, it seems, believe in his professed ignorance, or why should he argue a question which he states he knows nothing about?

All "good grey" sulphate ammonia contains 24.25 to 24.75 per cent of ammonia, except such lots as are allowed to leave the manufacturer's works in an *unmerchanted* condition, and these are very few, as they are liable to provoke heavy claims for loss in weight, &c. White sulphate only differs in so far that its analysis may on the average verge nearer the higher point, while 25 per cent, as stated by your correspondent, is the exception rather than the rule. To bring the sulphate ammonia up to 25 or 25.25 per cent it would be necessary either to allow it to be for a long time in the store-room or to dry it in a kiln, as in the States: the former means would require the manufacturer to provide ample store-room, and also put him to the inconvenience of having constantly a considerable amount of his working capital locked up, and the latter considerable labour and expense. It (the

kiln-drying) may suit the American sulphate manufacturers making shipments to Europe, when it has to remain in the packages for a much longer period than any English-made sulphate ammonia is required to. Another point in favour of guaranteeing only 24 per cent of ammonia is, that such a standard is easily attained, and thus disputes are rendered much less frequent than they would be with 25 per cent as the standard. In commerce this is a very important feature.

And in contradiction to your correspondent's assertion higher prices are obtained for the American kiln-dried sulphate, white or grey, than for English, on account of the higher percentage of the former.

The difference between white and grey sulphate is only small if the two be equally dry. The former is washed in its own liquor, and a purer acid being used than for the latter; but on account of the superior quality of the grey now made, consumers will not pay such a price for white as will induce manufacturers to produce it specially.

Your correspondent's assertion that most of the white sulphate is produced and sold by managers of Corporation gas-works is hardly correct. It is almost entirely produced by private firms, not one-hundredth part being made at gas-works.—I am, &c.,

J. H.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances. de l'Académie des Sciences.* No. 7, July 22, 1878.

Composition of the Milk of the Cow-tree (*Brosimum zylactodendron*).—M. Boussingault.—One hundred parts of the solids present in this milky juice contain—

Wax and fatty matters .. .. .	84.10
Inverted sugar .. .. .	2.00
Sugar capable of inversion.. .. .	1.40
Gum readily saccharifiable .. .. .	3.15
Casein and albumen .. .. .	4.00
Alkaline ash, phosphates .. .. .	1.10
Non-azotised substances not determined..	4.25

100.00

The juice in its original state contains 58 per cent of water and 42 of solids. Hence it resembles in its composition cream rather than milk. The fatty matters are easily resolved into fatty acids and glycerin.

Observations on the Discovery of a New Earth belonging to the Cerium Group, announced by Prof. Lawrence Smith.—C. Marignac.—The author does not yet see any sufficient reason for distinguishing the earth in question from terbia. It cannot in any case be confounded with the earth which the author and M. Soret consider as probably present in gadolinite, and which has been provisionally designated as X. Prof. Lawrence Smith considers his new base as forming part of the cerium group, which would indubitably remove it from terbia. But he takes, as distinctive character of this group, the fact that these earths are precipitated from their solutions by a saturated solution of potassic sulphate. This character is not very precise, as it depends on the degree of concentration of the liquids. Hitherto it has been admitted that the distinctive character of the two groups of earths consists in the circumstance that those of the cerium group form with potassic sulphate double salts completely insoluble in a solution of potassium sulphate. But the author finds that the sulphate of Prof. L. Smith's earth may be re-dissolved in an excess of this

solution, save traces of a residue, doubtless consisting of didymic oxide, the presence of which, easily demonstrated by the spectroscope, has been pointed out by the American chemist. It is true that the solubility is much slighter than that of yttria or erbia, but this is a characteristic of terbia, which has been long ago pointed out by M. Delafontaine.

New Process for the Analysis of Milk, showing rapidly the Butter, the Milk-sugar, and the Casein on one and the same Sample.—A. Adam.—The operation is executed by means of a very simple apparatus, which consists essentially of a glass tube, containing about 40 c.c., fitted at its upper end with a stopper, swelling out at its middle, and drawn out at its lower part, which terminates in a glass cock. Into this apparatus are introduced, first, 10 c.c. of alcohol at 75°, containing 1-200 of its volume of caustic soda; secondly, 10 c.c. of milk, which, if not neutral, must be neutralised (and in this latter case the increase of bulk due to the presence of soda must be noted); thirdly, 12 c.c. of pure ether. The alcohol, ether, and soda may also be mixed in the proportions indicated before being used. The tube is stoppered, the contents carefully mixed up, and allowed to stand for five minutes. Almost instantaneously there are formed two distinct strata, an upper limpid layer containing all the butter, and a lower opalescent layer containing all the lactose and the casein. The lower layer is run off to about 1 centimetre. The whole is then shaken up again and let settle once more for a few minutes in order to re-unite to the principal portion the small quantity of caseous solution which collects at the base of the apparatus. The buttry solution is then run into a tared porcelain capsule. The tube is rinsed out with a little ether to collect all the fatty matter, the ether is evaporated, and the capsule is weighed. The difference gives the weight of the butter augmented by 0.01 grm., due to a little lacto-caseous matter entangled among the fat. If the residue is re-dissolved in ether, which is poured into another tared capsule and evaporated, the foreign matter remains adhering to the first capsule, and the real weight of the butter is found at once. To effect the separation and determination of the milk-sugar and the casein, the liquid first drawn off from the tube is made up with distilled water to 100 c.c., and 10 drops of acetic acid are added. The casein immediately separates in curled flocks, like the nitrate of silver. It is allowed to stand for five minutes, and poured upon a very dry filter, which is covered after every addition to prevent concentration. In this manner from 94 to 96 per cent is collected of a limpid liquid containing merely the salts of the milk, the acetate of soda, and the lactose, which is determined by means of Fehling's cupro-potassic solution. If a known volume is evaporated to dryness the weight of the milk-sugar may also be found by two weighings, one before and one after incineration, taking care to deduct from the weight obtained that of the acetic acid attached to the soda. The casein is twice or thrice washed with distilled water, and the filter containing it is strongly pressed between folds of blotting paper, so as to flatten the substance as much as possible. A few minutes suffice to dry it. The difference between the weight of the filter before and after the operation gives that of the casein. Or it may be easily detached from the filter before desiccation, and after a few minutes in the drying-stove may be weighed. All these operations are easily executed in an hour and a half, and if on commencing the process 10 c.c. of milk mixed with 2 drops of acetic acid are set to evaporate we may find in addition the weight of the dry residue, of the water, and of the ash.

Chemical Researches on the Resolution of Cyclamin into Glucose and Mannite.—M. S. de Luca.—Cyclamin, either coagulated or in an aqueous solution, if left to itself for some months is decomposed into the two substances above mentioned. It is therefore a glucoside capable of yielding two sugars.

*Fustus Liebig's Annalen der Chemie,*  
Band 193, Heft 1 and 2.

Chloralid and Chloralidous Compounds. — O. Wallach.—A memoir extending to upwards of 60 pages, and not admitting of useful abstraction.

Communications from the Laboratory of the University of Halle.—These consist of a paper by W. Heintz, on benzal-diacetonamin, a memoir by E. Schmidt on methylamin, and an essay by E. Schmidt and R. Saftleben on isobutyl-formic acid.

Diphenylen-keton and Phenyl-benzoic Acid. — A Schmitz. — The author describes the behaviour of diphenylen-keton on oxidation, its conversion into phenyl-benzoic acid, the salts of the latter, the formation of nitro-phenyl-benzoic acid, and the behaviour of phenyl-benzoic acid with oxidising agents, and with hydrate of potassa at the melting-point.

Diphenic Acid. — Julius Hummel.—An account of the behaviour of diphenic acid with oxidising agents of di-nitro-diphenic acid and di-amido-diphenic acid.

On Diphenylen-methan.—R. Fittig and A. Schmitz. —Diphenylen-methan,  $C_{13}H_{10}$ , crystallises from alcohol in perfectly colourless shining leaflets, very slightly fluorescent. The strong fluorescence observed by Berthelot and Barbier in the hydrocarbon obtained from coal-tar, and which gave occasion to the name fluoren, is due to an impurity. Diphenylen-methan is sparingly soluble in alcohol in the cold, but readily with the aid of heat, as well as in ether, benzol, and sulphide of carbon. It melts between  $112^\circ$  and  $113^\circ$ . The boiling-point is constant between  $294^\circ$  and  $295^\circ$ , though Barbier places it about  $305^\circ$ , and Graebe between  $300^\circ$  and  $305^\circ$ . The authors then describe diphenylen-methan picric acid, dibrom-diphenylen-methan, an apparently dimorphous substance, and dinitro-diphenylen-methan.

On Fluoranthen: a New Hydrocarbon in Coal-Tar.—R. Fittig and F. Gebhard.—Fluoranthen,  $C_{15}H_{10}$ , is sparingly soluble in alcohol in the cold, but readily with the aid of heat, as also in ether, sulphide of carbon, and glacial acetic acid. From a concentrated alcoholic solution it crystallises in long thin needles, but from dilute solutions in large shining colourless tables. Its melting-point is constant at  $109^\circ$ . It stands between phenanthren (anthracen) and pyren, and probably bears the same relation to fluoren as does phenanthren to diphenyl.

Substitution-Products of Mesitylenic Acid and their Constitution.—H. J. Schmitz.—The author undertakes to prepare those substitution-products of mesitylenic acid, in which the atoms or atomic groups to be substituted are between the two methyl-groups, in order to employ them as points of departure for the preparation of the corresponding derivatives of metaxylo, and of the hitherto unknown third trimethyl benzol.

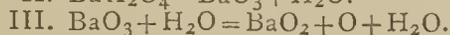
Contributions to the Knowledge of Quinic Acid.—R. Fittig and W. F. Hillebrand.—The authors consider it scarcely doubtful that quinic acid is the monobasic pentatomic acid of hexa-hydro-benzol,  $C_6H_{12}$ , and is closely connected with pentacid quercite.

Isomeric Nitro- and Amido-Benzoic Acids, and the Formation of Chloranil from the latter.—E. Widmann.—The author finds that on the nitration of benzoic acid by means of sulphuric acid and saltpetre, there are formed only meta-, ortho-, and para-nitro-benzoic acids, which cannot be separated in the free state, but only with the aid of their barium salts. Metanitro-benzoic acid has two distinct melting-points, which are not affected by superheating up to  $205^\circ$ . Ortho- and para-nitro-benzoic acid have only one melting-point. Mixtures of any two of the isomers in different proportions show occasionally definite melting-points, but which may fall below that of the most easily fusible component. The three isomeric amido-benzoic acids yield with potassium chlorate and hydrochloric acid, chloranil, and mixtures

of tri- and tetra-chlorquinon. The separation of the two chlorinated quinons is not practicable by Graebe's method, because, as Stenhouse correctly maintains, tetrachlorquinon is partially converted by sulphurous acid into trichlor-hydroquinon.

Band 192, Heft 3.

Experimental Researches on Hydrogen Peroxide. —Em. Schoene.—The author first examines the behaviour of hydrogen peroxide with the monoxides and dioxides of the alkaline-earthly metals. He considers that the mutual reaction of the peroxides of hydrogen and barium (or what amounts to the same thing, the "catalysis" of hydrogen peroxide by barium peroxide) may be explained by assuming that it consists of the following three reactions:—



This explanation is hypothetical in the second phase, only where the formation and transit existence of a barium trioxide — not known in the free state — are assumed. Whether in reality the latter stage of oxidation is formed, or a tetroxide, as in case of potassium, is not decided. There are grades of sulphurisation corresponding to both oxides,  $BaS_3$  formed in the dry, and  $BaS_4$  formed in the moist way. The separate reactions do not all take place in succession; rather the decomposition of the hypothetical trioxide or tetroxide runs chiefly parallel with its formation, so that whilst one portion of the polyoxide is being decomposed, another is forming, &c. Thus this case of catalysis, like the formation of ether, is explained by a series of normal chemical reactions, partly simultaneous and partly successive.

Action of Watery Vapour upon Ignited Wood Alcohol.—J. H. Long.—The author was unable to trace any simple proportion between the volumes of carbonic acid and carbonic oxide. The quantity of charcoal has a decided influence upon the formation of carbonic acid, which regularly decreases as the charcoal is oxidised. Hence it would appear that carbonic acid is first formed by the action of watery vapour upon the charcoal, and is then reduced to carbonic oxide by the further action of the excess of carbon. As soon as the carbonic oxide thus formed comes in contact with excess of watery vapour, a third reaction sets in:  $CO + H_2O = CO_2 + H_2$ , steam being known to be reduced by carbonic oxide.

Contributions to the Steric Law.—H. Schroeder.—The substance of this paper has already appeared in the CHEMICAL NEWS.

Separation of Antimony and Arsenic.—R. Bunsen.—The author points out as a source of error in the determinations of arsenic, that the ammonia-arsenate of magnesia retains its crystalline water a little below  $100^\circ$ , to the extent almost of an atom, but gives it up at temperatures between  $102^\circ$  and  $105^\circ$ . If this compound is to be used as a means of separation, it is preferably dissolved upon the filter in nitric acid, and the solution, after evaporation to dryness in a platinum crucible, is converted by heat into bibasic arseniate of magnesia, and weighed as such. Still all such determinations of arsenic cannot lay claim to an even moderately satisfactory degree of accuracy, since the ammonia-arsenate of magnesia, like the sulphate of baryta, obstinately retains salts from the precipitating liquids, and a prolonged washing with ammonia is impracticable since 30 c.c. of the latter dissolve about 1 milligramme of the precipitate. Many of the determinations of antimony as hypo-antimonic acid are also inaccurate. The temperature at which antimonic acid passes into hypo-antimonic acid, borders very closely upon that at which the latter begins to be resolved into oxygen and antimonious acid. The author, therefore, rejects these methods of determination, as well as the processes for the separation of arsenic and antimony hitherto in use, and proposes the following:

the sulphides of arsenic and antimony, while still moist, are dissolved upon the filter in an excess of solution of potassa, which must have been purified by means of alcohol. The solution, together with the concentrated washings, is introduced into a porcelain crucible, holding about 150 c.c., and a rapid current of chlorine is introduced into the liquid through a hole in the watch-glass, which serves as a cover till all the alkali is neutralised. The crucible, still covered with the watch-glass, is heated in the water-bath, and concentrated hydrochloric acid in great excess is dropped in by means of a pipette. The liquid is evaporated down to half its bulk, the loss is again made up with an equal volume of concentrated hydrochloric acid, and the liquid is again concentrated down to the half or the third, in order to expel all free chlorine. It can now be diluted to a perfectly limpid solution, by the addition of very weak hydrochloric acid, without tartaric acid, which interferes with the separation. To this solution there are now added for every decigramme of antimonious acid probably present, about 100 c.c. of a recently prepared and saturated solution of sulphuretted hydrogen, when penta-sulphide of antimony is precipitated immediately or after a short time, according to its larger or smaller proportion. As soon as this precipitate has separated itself, the excess of sulphuretted hydrogen is immediately removed from the solution, by forcing through it a violent current of air, filtered through cotton wool. This is easily affected by means of the blast of a glass-blowing table. To prevent loss by spiriting, the beaker must be kept covered with a perforated watch-glass, the air pipe entering through its aperture. In about 15 to 20 minutes the air is expelled, and the liquid becomes inodorous. The precipitate is then thrown upon a weighed filter and washed with the filter-pump, the filter being filled in succession eight or ten times with water, twice with alcohol, four times with sulphide of carbon, and finally three times with alcohol. The precipitate is dried at 110° in the salt-bath, at which temperature it remains for any length of time perfectly constant in weight. The washings even in not very experienced hands do not require more than an hour. The filtrate which contains the arsenic as arsenic acid does not retain the least trace of antimony. The antimonial precipitate may in certain cases retain quite insignificant traces of arsenic. But if after washing with water it is re-dissolved in hydrate of potassa, and the process of separation repeated, the antimony is obtained free from any trace of arsenic. The determination of arsenic in the filtrate and washings is no less simple. The collected liquid, after the addition of a few drops of chlorine, is heated on the water-bath, and treated with a prolonged current of sulphuretted hydrogen, both whilst hot and during cooling. The precipitate is allowed to settle for a day, at a gentle heat, and is then placed upon a weighed filter. If care has been taken to leave a sufficient excess of sulphuretted hydrogen in the liquid during its heating and cooling, the resultant precipitate consists of a little sulphur and arsenic penta-sulphide, without the least admixture of trisulphide. Before weighing, it is treated exactly like the antimonial precipitate. Its composition and weight are constant after drying at 110°.

Communications from the Laboratory of the University of Halle.—These consist of papers on amidotrimethyl-oxy-butyric acid, and on the products of the action of hydrocyanic acid upon hydrochlorate of diacetamin, both by W. Heintz.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 12, July 18, 1878.

Treatment of Hydrophobia among the Arabs.—M. L. Reiche has presented the following communication to the Entomological Society of France:—"I send you the Arab remedy for hydrophobia. It consists of two species of coleoptera, of which I forward you specimens.

They were given to me south of the Ouderna, by a man of the tribe of the Amernas, who possesses a dozen of them, which he preserves carefully. He gave me a detailed account of their virtues, and fully explained the manner of using them. On my return to Gabes, I spoke of this remedy to a very intelligent Arab, who affirmed that all I had heard was true; that I might read in their medical works that the *Derrona* cures madness if administered within twenty days from the bite; that the patient should take a piece of the size of a grain of wheat, in a morsel of meat. The insect is said to have very strong vesicating powers, and to increase the dose much would be dangerous to life. Its use occasions severe colic. Hence it appears to be an extremely violent remedy, which should be administered with great caution." The fragments of beetles received appear to belong to *Meloe tucius* and *Mylabris tenebrosa*, strongly vesicating insects whose congeners are common in France. It is to be remarked that the use of the *Meloe* was recommended as far back as 1856, in a communication made to the Society by M. L. Fermaire.

No. 13, July 25, 1878.

Variations of the Intensity of Weight in One and the Same Place.—A communication made to the Academy of Sciences by M. Plantamour, on the changes in the direction of the perpendicular, has recalled the attention of physicists to the analogous observations made by M. Bouquet de la Grye, with the seismograph, and by M. d'Abbadie, with the "Nadirane." The latter remarks that the displacements of the plummet can be due to two causes only—either to a change of the position of the earth's centre of gravity, or to a removal of the superficial layers of the soil.

English Pottery at the Paris Exhibition.—M. Louis Enault.—The author considers that the ceramic art has made incontestable progress since 1867. The only possible competitor with England is France.

No. 14, August 1, 1878.

The manufacture and sale of earthenware, whether French or foreign glazed, with a layer of lead oxide melted, or imperfectly vitrified, and consequently capable of yielding lead to weak acids, is interdicted in France.

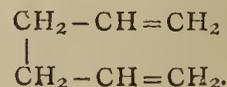
Extent and Principal Zone of the Aurora Borealis.—M. H. Fritz.—The appearance of local aurora is unfavourable to the hypothesis which places these lights among cosmic phenomena. The zone of maximum frequency and intensity of the aurora begins at Barrow's Point (lat. 72° N.), on the northern coast of America; thence it passes over lake Beoa towards Hudson's Bay, which it crosses in 60° N. lat., passing near Nain on the coast of Labrador, turning to the south of Cape Farewell, between Iceland and the Faroe islands; thence to near North Cape, round Novaya Zemlya and Cape Tscheljuskin, approaching the northern coast of Asia, in the longitude of Nischni Kolymsk, and returning thence to Point Barrow.

No. 16, August 15, 1878.

The two Institutes of Physiology and Physics at Berlin, constructed upon the plans of MM. Helmholtz and Du Bois Reymond, form an immense palace which has cost more than five million francs.

*Bulletin de la Societe Chimique de Paris,*  
Tome 30, No. 2, July 20, 1878.

Remarks on the Constitution of Diallyl.—Louis Henry.—The author considers the most probable formula of diallyl to be—



On Starch.—F. Musculus and D. Gruber.—The following bodies are produced at the expense of starch under the influence of diastase or of dilute boiling sulphuric acid:—Soluble starch, erythroextrin; achroodextrin,  $\alpha$ , a compound not coloured by iodine; achroodextrins,  $\beta$  and  $\gamma$ ; maltose and glucose. The authors consider starch as a polysaccharide of the formula  $n(C_{12}H_{20}O_{10})$ , in which the exact value of  $n$  remains to be determined.

*Chemiker Zeitung.*

No. 31, August 1, 1878.

Quantitative Analysis of the Products of the Prussiate of Potash Manufacture, with Remarks on the Rational Utilisation of the Residues.—A. Gawalowski.—For the examination of the finished cyanide the author recommends De Haen's method, at least in the absence of sulphides and sulphocyanides. The clear solution of the prussiate is evaporated down, ignited with sulphuric acid, the residue moistened with an alcoholic solution of nitrate of ammonia is ignited again, and dissolved in hydrochloric acid; the iron is precipitated with ammonia, washed, and ignited. The residue, minus the weight of the ash of the filter multiplied by 5.28, gives the quantity of actual ferrocyanide in the weighed sample. The products of a prussiate works are *crude salt*, containing 70 to 80 per cent of ferrocyanide, along with sulphocyanide, sulphide, and sulphate, and mechanically mixed with carbon. *Smear salt* is the residue from the evaporation of the mother-liquor of crude salt. Blue potash is a potash boiled down from the mother-liquor of smear salt, and contains 50 to 70 per cent carbonate of potash, 1 to 4 per cent ferrocyanide, and various impurities. The carbonaceous residue sometimes contains from 1 to 5 per cent of ferrocyanide.

The Elberfeld Chamber of Commerce complains that the alizarin manufacture suffers greatly from the import duty of 3 marks (3s.) per cwt. upon caustic soda.

The meeting of the Society of Swiss Naturalists took place at Berne on the 12th, 13th, and 14th of this month.

No. 32, August 8, 1878.

An explosion is announced as having happened in Kleinknecht's Chemical Works, at Brackenheim. Two men were wounded, one—the manager—severely.

Prof. Swanberg, of Upsala, the pupil, friend, and successor of Berzelius, died on the 16th of July, in his 73rd year.

At San Francisco the impure gases from cesspools, &c., are to be mixed with coal-gas and burnt in the street-lamps. In some preliminary experiments it was found that the light was not in the least injured by the admixture!

The oil of bankul-nuts (*Aleurites triloba*) is superior to colza for illuminating purposes.

According to Böttger, an aqueous solution of xanthogenate of potassa is an exceedingly sensitive test for salts of nickel. An intense yellow colouration—or with larger quantities a yellow precipitate—is produced, which does not disappear on the addition of a few drops of ammonia. Salts of copper yield the same colouration or precipitate with the same reagent, but the colour immediately disappears on the addition of ammonia.

## MISCELLANEOUS.

Thevenot's Globules.—M. C. Thevenot, of the Société de Pharmacie, of Paris, has invented a novel form of administration of medicine, which is, we consider, most valuable for medicines which deteriorate through exposure or which are of a nauseous nature. The case in which the medicine is enclosed is both soluble and digestible. Among other advantages the inventor claims that the most volatile substances can thus be accurately dosed and preserved for an indefinite period, and that the globule, unlike the pill, does not become stale, hard, and gritty.

Among the medicines which are thus administered are bromide of potassium, iodide of potassium, carbonate of iron, bromide of camphor, tar, gurana, turpentine, castor oil, reduced iron, hydrate of chloral, nitrite of amyl, &c. We have received specimens of these medicines from Messrs. H. K. Edge and Co., 34, King William St., E.C.

## TO CORRESPONDENTS.

*Student.*—The question appears to be a perfectly fair and proper one.  
*C. Estcourt.*—The name of this gentleman was omitted from the list of the Committee of Section B. of the British Association.

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From every other form inasmuch as ether and the most volatile matters can be dosed accurately, which can be done by no other method.—See "Report of Academy of Medicine, Paris."

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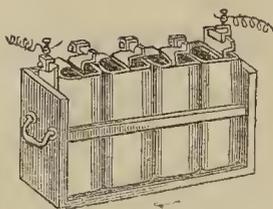
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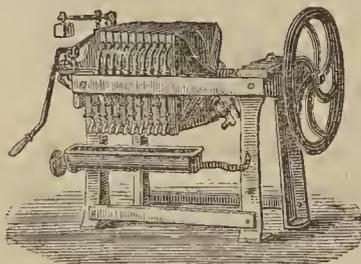
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## THE CHEMICAL NEWS.

VOL. XXXVIII. No. 980.

## ADDRESS TO STUDENTS.

WITHIN a short time after the publication of the following words of advice and warning the now happily numerous chemical schools and laboratories, both public and private, which have grown up of late years in every town and city of any importance throughout the kingdom, will once more throw open their doors to all who desire to enter.

Students of chemical science may be roughly divided into two great classes—those who study from the pure love of the thing itself, and those who study from compulsion. The latter class is undoubtedly the larger of the two, and may be dismissed in a very few words. It includes the vast majority of University students who cram up a certain amount of information, more or less sound, on chemical subjects under a clever coach, just as they cram up the "Agamemnon" of Euripides, the Offices of Cicero, or the properties of the parabola, the whole of which are forgotten the very moment that they possess the precious privilege of tacking the magic letters M.A. or B.A. to their names. With such as these, most of them victims to the present system of University examinations, we have nothing to do except indeed to sympathise with them; the few words which follow must therefore be taken as addressed more especially to the first class of students—the true seekers after scientific knowledge.

When the young student—after a couple of years desultory study in the school laboratory, or perhaps in the domestic back kitchen—says to himself "I will be a chemist," and enters upon a course of serious study under a competent teacher, he is at first somewhat confused at the numerous vistas that open up before him in his daily work. He is like a child in a garden of butterflies: he does not know which to run after first; the consequence most frequently is that he runs after several at once and catches none. During his reading hours he finds so many gaps in the investigations of others, even of our most eminent workers, that he fills his note-book with "mems." of fifty different subjects for future investigation, any one of which would take half a lifetime to follow up. The great danger to an ardent student of this kind is the desire to do too much—to be too ambitious. To such as these we say—Be patient; form no resolutions for the future, and fill your note-books with "mems.," not of what you are going to do many years hence, but of what you have done to day. All these ideas about future research are only so many Will-o'-the-wisps which will lure you from your daily work, and possibly procure you the honour of being "plucked" for not being able to answer some trivial question which your be-crammed and be-coached companion—who perhaps never handled a test-tube in his life—has at his fingers' ends. There is an old French saying to the effect that if you keep the company of wolves you must howl. By a parity of reasoning, if you wish to compete with the crammed you must cram. To many of our readers this will no doubt appear singular advice,

and diametrically opposed to the principles we have always advocated; but the guilt of the apparent inconsistency must lie at the door of those who control our University examinations, and who prefer book-learning to practical knowledge. The earnest student, however, has this advantage over his competitors who cram from books—he can not only follow their example, but he can make the knowledge that he gains part and parcel of his being by practical work. Leave future research to take care of itself, and concentrate all your powers on the present, and you will find that by the time you are in a position to laugh at the vagaries of examining bodies you will have been insensibly led to fall in love with some special object of research, which it will be at once your pleasure and duty to wed and live happy with for ever after, like the princes and princesses in the fairy tales. Take up the collected researches of our greatest men—Faraday or Graham for instance—and you will find them steadily pursuing a single object from the beginning to the end of their working life. Graham, perhaps, is almost a better example of this than Faraday, who from his official position was more than once obliged to take up subjects of research that were not his own. It seems a pity that the collected edition of Graham's chemical and physical researches should not be procurable by the general reader, having been printed for presentation only, but the work exists in most public libraries, and should be read by every student again and again, not so much for the scientific information contained in it, but for the sake of seeing how closely Graham followed one leading idea, from his first researches on the Absorption of Gases by Liquids to his last on the Metallic Nature of Hydrogen—of what is and how is matter composed. These two philosophers have left a greater mark upon the scientific history of their time than any half dozen of their contemporaries; but in spite of their both being D.C.L.'s of Oxford, we doubt if at any portion of their grand career they could have undergone the matriculation examination of any of our Universities without being hopelessly "plucked."

There are a couple of offshoots from the two great classes we have mentioned to whom a few words may be welcome—we mean medical and pharmaceutical students, who are apt to stray into the contrary extremes. The former looks on chemistry as a bore, and a subject to be crammed because no medical examiner has yet been found who has the knowledge or the courage to show by his questions that chemistry is as intimately related to medical science as anatomy itself. Most medical men look on chemistry as a kind of adjunct to pharmacy, a knowledge of which will prevent them from poisoning their patients or from puzzling their pharmacists by prescribing a series of incompatibles. To such as these we would put a simple question. How is it that although the chemist during the last ten years has discovered many thousands of definite compounds possessing the most multifarious chemical, physical, and presumably physiological properties, that not half a dozen of these have been applied to the relief of human suffering or the saving of human life? Is it possible, even according to the vulgar doctrine of chance, that there are no compounds lying perdu on the shelves of the chemist's laboratory that would prove as powerful weapons in the hands of the physician as chloroform, chloral, or amyl nitrite? The field open to the medical student in this direction is surely vast enough to content the hardest worker, and

would surely be fruitful enough to satisfy the highest ambition.

The pharmaceutical student is more in danger of running into the other extreme, and of devoting his time and energies to questions of too scientific a nature. The remarks made by Professor Attfield at the meeting of the Pharmaceutical Conference at Plymouth last year—remarks which we ourselves most fully endorsed in a review of the proceedings of that body—showed that pharmacists are too fond of exerting their abilities on questions which are outside their profession, while innumerable subjects are daily, nay hourly, cropping up in their own laboratories which require immediate investigation. We are not going to quote the mischievous old proverb about the shoemaker not going above the sandal—which, by the way, was applied to criticism and not to work—for if it were enforced all progress would be at an end; but we would advise the pharmaceutical student to try and gain his first laurels in his own profession before seeking to compete with the purely scientific chemist on his own ground. If he has time and opportunity let him by all means take up any branch of chemistry he may choose for private work; but we think he ought first to make a name as a pharmaceutical investigator before trying to gain fame as a purely scientific chemist.

These few remarks are made in no captious or fault-finding spirit, and we are sure that the three categories of students to whom they are addressed will take them in good part.

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The Examination will be held on Monday, January 13th, 1879. 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.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects:—1. Latin. 2. Any two of the following Languages:—Greek, French, German, and either Sanskrit or Arabic. 3. The English Language, English History, and Modern Geography. 4. Mathematics. 5. Natural Philosophy. 6. Chemistry.

The Papers in Latin and Greek will contain passages to be translated into English, with questions in Grammar and in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected. A separate paper will be set containing questions in Latin Grammar, with simple and easy sentences of English to be translated into Latin.

The Latin subjects for 1879 are—

For January, 1879:—*Cæsar*, De Bello Gallico, Books III. and IV.

For June, 1879:—*Cicero*, De Senectute, and the First Speech against Catiline.

Special stress is laid on accuracy in the answers to the Grammar questions, and on the correct rendering of English into Latin.

The Greek subjects for 1879 are—

For January, 1879:—*Homer*, Odyssey, Book XIV.

For June, 1879:—*Xenophon*, Anabasis, Book III.

Special stress is laid on accuracy in the answers to the questions in Greek Grammar.

Candidates may substitute German for Greek.

The papers in French and German will contain passages for translation into English, and questions in Grammar, limited to the Accidence. The paper in Sanskrit or Arabic will contain passages for translation into English, and questions in Grammar.

The examination in the English Language, English History, and Modern Geography includes Orthography; Writing from Dictation; the Grammatical Structure of the Language.

History of England to the end of the Seventeenth Century, with questions in Modern Geography.

That in Mathematics includes the ordinary Rules of Arithmetic; Vulgar and Decimal Fractions; Extraction of the Square Root.

Addition, Subtraction, Multiplication, and Division of Algebraical Quantities; Proportion; Arithmetical and Geometrical Progression; Simple Equations.

The First Four Books of Euclid, or the subjects thereof.

The Questions in Natural Philosophy are of a strictly elementary character; they include Mechanics, Hydrostatics, Hydraulics, Pneumatics, Optics, and Heat.

The Examination in Chemistry is—Chemistry of the Non-metallic Elements; including their compounds—their chief physical and chemical characters—their preparation—and their characteristic tests.

A Pass Certificate, signed by the Registrar, will be delivered to each Candidate who applies for it, after the Report of the Examiners has been approved by the Senate.

If in the opinion of the Examiners any Candidates in the Honours Division of not more than Twenty years of age at the commencement of the Examination possess sufficient merit, the first among such Candidates will receive an Exhibition of thirty pounds per annum for the next two years; the second among such Candidates will receive an Exhibition of twenty pounds per annum for the next two years; and the third will receive an Exhibition of fifteen pounds per annum for the next two years; such exhibitions are payable in quarterly instalments, provided that on receiving each instalment the Exhibitioner declares his intention of presenting himself either at the two Examinations for B.A., or at the two Examinations for B.Sc., or at the First LL.B. Examination, or at the Preliminary Scientific and First M.B. Examinations, within three academical years\* from the time of his passing the Matriculation Examination.

Under the same circumstances, the fourth among such Candidates will receive a prize to the value of ten pounds in books, philosophical instruments, or money; and the fifth and sixth will each receive a prize to the value of five pounds in books, philosophical instruments, or money.

Any Candidate who may obtain a place in the Honours Division at the Matriculation Examination in January is admissible to the First B.A. or to the First B.Sc. Examination in the following July. But such Candidate will not be admissible to the Second B.A. or to the Second B.Sc. Examination in the ensuing year, unless he has attained the age of eighteen years.

#### FIRST B.SC. EXAMINATION.\*

The First B.Sc. Examination will commence on Monday, July 15, 1879.

\* By the term "Academical Year" is ordinarily meant the period intervening between any Examination and an Examination of a higher grade in the following year; which period may be either more or less than a Calendar year. Thus the interval between the First Examinations in Arts, Science, and Medicine, and the Second Examinations of the next year in those Faculties respectively, is about sixteen months, whilst the interval between the Second B.A. Examination and the M.A. Examination of the next year, or between the Second B.Sc. Examination and the D.Sc. Examination of the next year, is less than eight months. Nevertheless, each of these intervals is counted as an "Academical Year."

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 embraces the following subjects:—Pure and Mixed Mathematics, Inorganic Chemistry, Experimental Physics, and General Biology.

*Examination for Honours.*

Any Candidate who has passed the First B.Sc. Examination in all its subjects may be examined at the Honours Examination next following the First B.Sc. Examination at which he has passed for Honours in (1) Mathematics, (2) Experimental Physics, (3) Chemistry, (4) Botany, and (5) Zoology; unless he has previously obtained the Exhibition in Pure and Mixed Mathematics at the First B.A. Examination, in which case he will not be admissible to the Examination for Honours in that subject; or unless he has previously obtained the Exhibition at the Preliminary Scientific (M.B.) Examination in either of the subjects which are common to it with the first B.Sc. Examination, in which case he will not be admissible to the Examination for Honours in that subject.

Candidates for Honours in Chemistry will be examined in Inorganic Chemistry, treated more fully than in the Pass Examination. In addition, they will be examined practically in Simple Qualitative and Quantitative Analysis. This Examination, which will consist of six hours' examination by printed papers and of six hours' practical work, will take place on Thursday and Friday in the same week with the Examination for Honours in Mathematics, commencing on each day at 10 a.m.

In the Examination for Honours, the Candidate, not being more than 22 years of age at the commencement of the Pass Examination, who most distinguishes himself in Chemistry or Experimental Physics, will receive an Exhibition of £40 per annum for the next two years.

SECOND B.Sc. EXAMINATION.

The Second B.Sc. Examination will commence on Monday, October 21st, 1878.

Candidates for this Examination are required to have passed the First B.Sc. Examination at least one academical year previously.

The Fee for this Examination is £5.

The regulations are framed with the view of allowing the candidate to bring up *any three* of the following nine subjects:—

1. Pure Mathematics.
2. Mixed Mathematics.
3. Experimental Physics.
4. Chemistry.
5. Botany, including Vegetable Physiology.
6. Zoology.
7. Animal Physiology.
8. Physical Geography and Geology.
9. Logic and Psychology.

It is understood the amount of proficiency expected in each of the three subjects chosen will be that which the candidate might attain by the steady devotion to it of about one-third of the sessional work of a diligent student.

*Examination for Honours.*

Any Candidate who has passed the Second B.Sc. Examination, and has not previously passed the Second B.A. Examination, may be examined at the Honours Examination next following the Second B.Sc. Examination at which he has passed, for Honours in (1) Mathematics, (2) Logic and Psychology, (3) Experimental Physics, (4) Chemistry, (5) Botany, (6) Zoology, (7) Physiology, (8) Physical Geography and Geology; provided that he shall have gone through the Pass Examination in the corresponding subject or subjects immediately before. And any Bachelor of Arts who has passed the Second B.Sc. Examination may under the same conditions be

examined for Honours in one or more of the above mentioned subjects, unless he have previously obtained a Scholarship at the Second B.A. Examination in either of the first two of those subjects, in which case he shall not be admissible to the Examination for Honours in that subject.

The examination for Honours in Chemistry will take place on Monday and Tuesday in the second week after the conclusion of the Pass Examination; on Monday by printed papers (chiefly on Organic Chemistry), and on Tuesday by practical exercises in Simple Qualitative and Quantitative Analysis.

The candidate, being not more than 23 years of age, who most distinguishes himself in Chemistry, will receive £50 per annum for the next two years, with the style of University Scholar.

DOCTOR OF SCIENCE.

The examination for the Degree of Doctor of Science takes place annually within the first twenty-one days of June, and the examination in each branch 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, unless he shall have passed the Second B.Sc. Examination in the First Division at least two Academical years subsequently to having passed the first B.Sc. Examination, in which case he shall be admitted to the examination for the Degree of Doctor in Science at the expiration of *one* Academical Year from the time of obtaining his B.Sc. Degree.

The Fee for this Examination is £10.

Every candidate for the degree of D.Sc. is examined in some one or more of the various branches of Physical, Biological, or Mental Science, to be selected by himself; and no candidate is 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. He 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. Candidates, when giving notice, must specify the branch or branches in which they desire to be examined.

BRANCH IV. OF PHYSICAL SCIENCE.  
INORGANIC CHEMISTRY.

Principal Subject—Inorganic Chemistry.

Subsidiary Subject—Either Organic Chemistry; or Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

BRANCH V., 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.

PRELIMINARY SCIENTIFIC (M.B.) EXAMINATION.

This examination commences on Monday, July 15, 1879.

No Candidate is admitted to this examination until he has completed his seventeenth year, and has either passed the Matriculation Examination\* or taken a Degree in Arts in one of the Universities of Sydney, Melbourne, Calcutta, or Madras (provided that Latin was one of the subjects in which he passed). The fee for this examination is five pounds.

\* Candidates who pass in all the subjects of the Preliminary Scientific (M.B.) Examination, and also pass *at the same time* in the Pure Mathematics of the First B.Sc. Examination, or who have previously passed the First B.A. Examination, are considered as having passed the First B.Sc. Examination. The attention of such candidates is directed to the fact that, under the new regulations for the B.Sc. Degree, this degree may be obtained by passing at the Second B.Sc. Examination in the three Biological subjects only.

Candidates for the degree of M.B. are strongly recommended by the Senate to pass the Preliminary Scientific Examination before commencing their regular medical studies; and to devote a preliminary year to preparation for it according to the following programme:—Winter Session: Experimental Physics; Chemistry (especially Inorganic); Zoology. Summer Session: Practical Chemistry (Inorganic); Botany.

Any candidate who has passed the Preliminary Scientific (M.B.) Examination, may be examined at the Honours Examination next following the Preliminary Scientific Examination at which he has passed, unless he has previously obtained an Exhibition in any one of the subjects at the First B.Sc. Examination, in which case he is not admissible to the Examination for Honours in that subject.

Candidates for Honours in Chemistry are examined in Inorganic Chemistry, treated more fully than in the Pass Examination. In addition they are examined practically in Simple Qualitative and Quantitative Analysis.

#### EXAMINATION IN SUBJECTS RELATING TO PUBLIC HEALTH.

A Special Examination is held once in every year in subjects relating to public health. It commences on Monday, December 9, 1879.

No candidate is admitted to this Examination unless he has passed the Second Examination for the Degree of Bachelor of Medicine in the University at least one year previously; nor unless he shall have given notice of his intention to the Registrar at least two calendar months before the commencement of the Examination.

The Fee for this Examination is £5.

Candidates are examined in the following subjects:—

*Chemistry and Microscopy*, in relation to the examination of Air, Water, and Food.

*Meteorology and Geology*, as far as they bear on the duties of Health Officers, viz.:—General knowledge of Meteorological Conditions; Reading and Correction of Instruments. General knowledge of Soils; their Conformation and Chemical Composition.

*Vital Statistics*, in reference to the methods employed for determining the Health of a Community; Birth-rate; Death-rate; Disease-rate; Duration and of Expectancy of Life. Present amount of Mortality, and its causes, in different Communities.

*Hygiene*.—General principles of Hygiene. Special topics:—Soil. Construction of Dwellings. Conservancy of Cities. Unhealthy Trades. Supply of Food to Cities, and Examination of Food. Disposal of Sewage. Water-supply.

*Medicine*, in reference to the origin, spread, and method of prevention of Diseases generally, but especially those of the Epidemic class.

*Sanitary Engineering*, as far as regards the arrangements connected with Water-supply, Sewerage, and Ventilation. A knowledge of the reading of Plans, Sections, Scales, &c.

*Sanitary Law*, as far as it relates to the duties of Officer of Health. A knowledge of the powers given under the various Sanitary Acts, as defined in the Instructions issued by the Local Government Board, and of the methods of procedure in special cases.

The Examination, which is both written and practical, extends over four days.

#### GILCHRIST SCHOLARSHIPS.

1. A Scholarship of the value of Fifty Pounds per annum, and tenable for three years, is annually awarded to the highest among those candidates at the June Matriculation Examination who have been approved by the Principal of University Hall as fit to be received into that Institution with a view to the prosecution of their studies in University College for Graduation in one of the four Faculties of the University of London; provided that such Candidate pass either in the Honours List or in the First Division.—Particulars may be obtained on applica-

tion to the Principal of University Hall, Gordon Square, W.C.

2. A similar Scholarship is annually awarded to the Candidate from the Royal Medical College, Epsom, who at the June Matriculation Examination stands highest among the Candidates approved by the Head Master of that Institution, and who passes either in the Honours List or in the First Division; on condition of his prosecuting his studies during the tenure of his Scholarship with a view to Graduation in one of the four Faculties of the University of London.—Particulars may be obtained on application to the Secretary of the Royal Medical College, 37, Soho Square, W.

3. A similar amount is annually offered to Candidates intending to pursue, at Owens College, Manchester, their studies for Graduation in one of the four Faculties of the University of London; a single Scholarship of Fifty Pounds per annum for three years being awarded to the highest of those Candidates at the June Matriculation Examination who shall have been previously approved by the Principal of Owens College, provided that he pass in the Honours Division; or, in case no Candidate should so pass, two Scholarships, each of Twenty-five Pounds per annum, being awarded to the two Candidates as aforesaid who shall stand highest in the First Division.—Particulars may be obtained on application to the Principal of Owens College, Manchester.

Particulars of the Colonial and Indian Scholarships may be obtained on application to the Secretary of the Gilchrist Educational Trust, University of London, W.

#### UNIVERSITY OF OXFORD.

*Waynflete Professor of Chemistry*.—W. Odling, M.A., F.R.S.

*Professor of Mineralogy*.—N. S. Maskelyne, M.A., F.R.S.

Every Student must reside in one or other of the Colleges or Halls, or in licensed lodgings, for a period of three years, passing at least two examinations in Arts, and one in either Mathematics, Natural Science, Law, Modern History, or Theology, when, if he obtain a first, second, or third class, he can take his B.A. Degree; if he do not gain such honour he has to pass a third examination in *Literis Humanioribus*.

Lectures by the Waynflete Professor on Mondays, and Thursdays at the Museum.

Lectures on Elementary Organic Chemistry will be given by the Aldrichian Demonstrator of Chemistry, Mr. W. W. Fisher, M.A., of Corpus Christi College, on Wednesdays and Saturdays, at 11 a.m.; and Lectures on Elementary Inorganic Chemistry by Mr. W. F. Donkin, M.A., of Magdalen College, on Tuesdays and Fridays, at 11 a.m.

The Laboratory of the University will be open from 10 a.m. to 4 p.m. daily, and instruction in Practical Chemistry will be given by the Aldrichian Demonstrator, and by Mr. John Watts, B.A., of Balliol College.

A Course of Practical Instruction in Organic Chemistry will be conducted by Mr. W. H. Pike, Ph.D.

The fee for students working in the Laboratory for three days in the week during the Term is £3; for students working every day, £5.

The new laboratories are nearly completed, and will probably be opened at the beginning of 1879.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other colleges, by competitive examination in Natural Science.

More detailed information may be obtained from the University Calendar; from the professors; from E. Chapman, Esq., M.A., Frewin Hall; and from the Sub-Librarian in the Radcliffe Library or the Museum.

#### UNIVERSITY OF CAMBRIDGE.

*Professor of Chemistry*.—G. D. Liveing, M.A.

*Jacksonian Professor of Natural and Experimental Philosophy*.—J. Dewar, M.A.

*Demonstrators.*—J. W. Hicks, M.A., W. J. Sell, B.A., and H. J. H. Fenton.

The Student must enter at one of the Colleges, or as a Non-collegiate Student, and keep terms for three years by residence in the University. He must pass the previous examination in Classics and Mathematics, which may be done in the first or second term of residence, or, through the Oxford and Cambridge Schools Examination Board, or through the Senior Local Examinations, before commencing residence. He may then proceed to take a Degree in Arts, either continuing mathematical and classical study, and passing the ordinary examinations for B.A., or going out in one of the Honour Triposes.

The scholarships, ranging in value from £20 to £80 a year, are chiefly given for mathematical and classical proficiency. Scholarships are given for Natural Science in Trinity, St. John's, St. Peter's, Clare, Christ's, Sidney, Pembroke, Caius, and Downing Colleges; the examinations being at Easter, and in June and October.

The Chemical Laboratory of the University is open daily for the use of the Students. The Demonstrator attends daily to give instructions.

Non-collegiate Students are allowed to attend certain of the College Lectures and all the Professors' Lectures, and have the same University status and privileges as the other Students. They are under the superintendence of the Rev. R. B. Somerset, Orford House, Cambridge, from whom further information may be obtained.

The following are the Lectures on Chemistry for the ensuing Academical Year:—

MICHAELMAS TERM, 1878.

General Course, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Oct. 14.

Spectroscopic Analysis, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 1.30 p.m. Begin Oct. 16.

Analysis, by the Professor and the Demonstrators of Chemistry. Daily. Begin Oct. 8. Also at St. John's College, by Mr. Main. Begin Oct. 15. Also at Caius College, by Mr. Pattison Muir; begin Oct. 16.

Metals, by Mr. Pattison Muir. Monday, Wednesday, and Friday, at 10. Begin Oct. 14.

Physical Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Oct. 15.

Elementary Organic Chemistry, by Mr. Main, at St. John's College, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Oct. 16.

Volumetric Analysis, by a Demonstrator, on Tuesdays, Thursdays, and Saturdays, at 10 a.m. Begin Oct. 15.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin Oct. 14.

Elementary Lectures on the more important Minerals, by the Deputy Professor of Mineralogy, on Mondays, Wednesdays, and Fridays, at 1. Begin Oct. 14.

LENT TERM, 1879.

General Course continued, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Jan. 31.

Analysis, by the Professor or Demonstrators of Chemistry. Daily. Begin Jan. 21. Also at St. John's College. Begin Jan. 29. Also at Caius College Laboratory. Begin Jan. 29.

Organic Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Jan. 30.

General Course, begun by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Jan. 31.

Non-metallic Elements, by Mr. Pattison Muir, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin Feb. 1.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin Jan. 31.

EASTER TERM, 1879.

Some Special Department, by the Professor of Chemistry, on Mondays and Fridays, at 12 noon. Begin April 25.

Analysis, by the Professor or Demonstrators of Chemistry. Daily. Begin April 23. Also at St. John's College. Begin April 24. Also at Caius College. Begin April 23.

Elementary Chemistry, by the Demonstrator of Chemistry, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin April 24.

General Course concluded, by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin April 24.

Elementary Organic Chemistry and Analysis, by Mr. Pattison Muir, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin April 23.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin April 30.

Crystallography, by the Deputy Professor of Mineralogy.

UNIVERSITY OF DUBLIN.—TRINITY COLLEGE.

The Chemical Laboratory will re-open on October 1st, 1878.

The University Professor of Chemistry, Dr. Emerson Reynolds, assisted by the Demonstrator of Chemistry, Mr. Early, conducts the undermentioned Courses of Laboratory instruction:—

*The First Course of Practical Chemistry.*—Michaelmas Term:—Qualitative Analysis and the Use of the Spectroscope. Hilary Term: Volumetric and Simple Gravitric Analysis. Trinity Term: Organic Preparations and Analysis.

Students can also attend the Professor's Lectures on General Chemistry, and repeat most of the experiments performed in the Theatre.

This Course terminates on the last day of June.

*The Second or Advanced Course* includes instruction in the higher branches of Experimental and Analytical Chemistry, and in Methods of Research. Students who take out this Course are free to devote their chief attention to the study of special departments of Chemistry as applied to Arts and Industries.

*Summer Course of Practical Chemistry for Medical Students.*—This Course commences on the first Monday in April and terminates on the 30th of June following. Students experiment in the Laboratory from 2 to 4 o'clock on Tuesdays, Thursdays, and Saturdays.

*Special Courses.*—Students can enter at any time throughout the academic year for short terms of Laboratory instruction in Medical or Pharmaceutical Chemistry, or in the Methods of Analyses of Water, Air, &c., for Sanitary Purposes.

*Lectures in Medical and Pharmaceutical Chemistry.*—Dr. Reynolds lectures at 2 o'clock on Tuesdays, Thursdays, and Saturdays, from the 1st of November to the 31st of March following.

All the classes are open to extra-Academic Students.

SCIENCE AND ART DEPARTMENT OF THE COMMITTEE OF COUNCIL ON EDUCATION, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. 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.

In order to place a science school or class in connection with the Science and Art Department, an approved committee, consisting of at least five well known and responsible persons, must be formed.

The following are the sciences towards instruction in which aid is given by the Science and Art Department:—Practical, Plane, and Solid Geometry; Machine Construction and Drawing; Building Construction; Naval Architecture and Drawing; Pure Mathematics; Theoretical Mechanics; Applied Mechanics; Acoustics, Light, and Heat; Magnetism and Electricity; Inorganic Chemistry; Organic Chemistry; Geology; Mineralogy; Animal Physiology; Elementary Botany; Biology, including Animal and Vegetable Morphology and Physiology; Principles of Mining; Metallurgy; Navigation; Nautical Astronomy; Steam; Physiography; Principles of Agriculture.

The aid is given in the form of—1. Public examinations, in which Queen's Prizes are awarded, held at all places complying with certain conditions; 2. Payments on results as tested by these examinations; 3. Scholarships and Exhibitions; 4. Building grants; 5. Grants towards the purchase of fittings, apparatus, &c.; 6. Supplementary grants in certain subjects, and special aid to teachers and students.

The examinations are held about the month of May under the superintendence of the local committees and local officers. The examination papers are prepared by the professional examiners in London. An evening is set apart for one or more subjects, so that the examination in each subject is simultaneous over the whole kingdom.

A packet of examination papers is sent to each local examination secretary, who opens it in the presence of the committee and candidates. The committee is held responsible that no unfair means of any description are used in working the papers, and that the rules of the Department are strictly complied with.

The examinations are of two kinds, but held together, viz.—

*a.* The Class examinations, of which there are two grades or stages; the first stage or elementary examination, and the second stage or advanced examination. The successful candidates in both stages are divided into 1st and 2nd class.

*b.* The Honours examination of a highly advanced character. In this there are also two classes.

Any person however taught may sit at any one of these examinations.

The Queen's prizes, consisting of books or instruments, are also given to all candidates who are successful in obtaining a first class in either stage of the class examinations.

The payments on results are made only on account of the instruction of students of the industrial classes, or on account of the instruction of their children. They are—£2 for a first class, and £1 for a second class, in each stage of the class examinations, and £2 and £4 for a second or first class respectively in honours. Special extra payments are made in attendance in organised Science Schools. Special payments are also made for Chemistry.

There are also two forms of scholarship in connection with elementary schools.

*a.* In the Elementary School Scholarship £5 are granted to the managers of any elementary school for the support of a deserving pupil selected by competition, if they undertake to support him for a year and subscribe £5 for that purpose. The payment of £5 by the Science and Art Department is conditional on the scholar passing in some branch of science at the next May examination.

*b.* In the Science and Art Scholarship, which is of a more advanced character, a similar contribution of £5 is required on the part of the locality, and a grant of £10 is made by the Department towards the maintenance, for one year, of the most deserving pupil or pupils in elementary schools who have passed certain examinations in science and in drawing.

In both these cases the scholar must be from twelve to sixteen years of age, and one scholarship is allowed per 100 pupils in the school.

There are also two forms of Exhibitions. These are:—

*a.* Local Exhibitions to enable students to complete their education at some college or school where scientific instruction of an advanced character may be obtained. Grants of £25 per annum, for one, two, or three years are made for this purpose when the locality raises a like sum by voluntary subscriptions. And if the student attend a State School, such as the Royal School of Mines in London, the Royal College of Chemistry in London, or Royal College of Science in Ireland, the fees are remitted.

*b.* Royal Exhibitions of the value of £50 per annum tenable for three years, to the Royal School of Mines, London, and the Royal College of Science, Dublin, are given in competition at the May examinations. Six are awarded each year—three to each institution. The exhibitions entitle the holder to free admissions to all the Lectures, and to the Chemical and Metallurgical Laboratories at those two institutions.

The competition for the Whitworth Scholarships, tenable for three years, is also in part determined by the results of the May examinations.

A grant in aid of a new building, or for the adaptation of an existing building, for a School of Science may be made at a rate not exceeding 2s. 6d. per square foot of internal area, up to a maximum of £500 for any one school, provided that certain conditions are complied with and that the school be built under the Public Libraries and Museums Act, or be built in connection with a School of Art, aided by a Department building grant.

A grant towards the purchase of fittings, apparatus, diagrams, &c., of 50 per cent of the cost of them is made to Science Schools. And where a school is furnished with a laboratory, properly fitted up, payments are made on account of students who during the year receive 25 lessons in laboratory practice.

Special extra grants in the form of capitation payments are made in fully organised Science Schools.

The following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are given at South Kensington:—

*Chemistry*, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Inorganic Chemistry, commencing October 2, 1878. A Course of Thirty Lectures on Organic Chemistry, commencing January 13, 1879. Fees—Lectures on Inorganic Chemistry, £4; Lectures on Organic Chemistry, £3; together, £6.

*Chemical Laboratories*.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Tuesday, October 1, 1878. The Laboratories at South Kensington Museum are now used for the instruction of the Pupils of the Royal School of Mines.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month.

*Physics*, by Professor Frederick Guthrie, F.R.S. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures.\* The Course will commence on October 1, 1878. Fee for Lectures and Laboratory work, £16.

*Metallurgy*, by Dr. Percy, F.R.S. The Course will consist of about Ninety Lectures, commencing on October 21, 1878.

*Metallurgical Laboratory*.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the Student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin,

\* A detailed account of the Laboratory Instruction in Physics will be found in the Students' Number of the CHEMICAL NEWS for 1875 (No. 824).

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.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accommodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

*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, Mining, and Applied Mechanics.

#### KING'S COLLEGE.

(DEPARTMENT OF ENGINEERING AND APPLIED SCIENCE.)

*Professor of Chemistry.*—C. L. Bloxam, F.C.S.

*Demonstrator.*—W. N. Hartley, F.C.S.

*Assistant Demonstrator.*—J. M. Thomson, F.C.S.

On Tuesday and Friday at 10.20 a.m. Students of the First Year 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 interval during the course at the usual Lecture hour.

*Second Year.*—Students attend in the Laboratory twice a week, on Tuesday and Thursday, at 10.20, and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this Department may be admitted to this Class at any period of his study on payment of an extra fee.

*Experimental and Analytical Chemistry in the Laboratory.*—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of extra Fees, at any time except during the vacation, and for a period of one, three, six, or nine months, as may best suit their convenience. The laboratory hours are from ten till four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory Fee, each Student defrays the expenses of his own Experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

Special hours and fees are arranged for the convenience of such Third Year Students as wish to study Analytical Chemistry.

Fees.—Chemistry per term, £3 3s. od.; per ann., £8 8s. od.; Practical Chemistry per term, £4 4s. od.; per ann., £8 8s. od.; Experimental and Analytical Chemistry—One Month (daily attendance), £4 4s. od.; Three Months (daily attendance), £10 10s. od.; Six Months

(daily attendance), £18 18s. od.; Nine Months (daily attendance), £26 5s. od. A student taking a month's ticket may attend daily during 1 month, or 3 days a week during 2 months, or 2 days a week during 3 months.

#### Rules as to Admission of Students.

I. The Academical Year consists of Three terms: Michaelmas Term, from beginning of October to the week before Christmas; Lent Term, from the middle of January to the week before Easter; Easter Term, from Easter to the beginning of July.

II. The days fixed for the Admission of New Students in the Academical Year 1878-79, are Tuesday, October 1, Tuesday, January 14, and Wednesday, April 23.

#### UNIVERSITY COLLEGE.

##### FACULTY OF SCIENCE.

*Chemistry.*—Professor Williamson, Ph.D., F.R.S.

##### I. GENERAL COURSE.

Lectures daily (except Saturday) from 11 to 12 a.m., up to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the whole Course of Lectures, £7 7s.; for the First or Second Half Course separately, £4 4s.; for the Second Half, when the first has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise Class, £2 2s.

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 an Assistant.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

*Organic Chemistry* commences in the second week in February, and occupies five Lectures weekly till about the end of March.

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 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.

##### II.—ANALYTICAL AND PRACTICAL CHEMISTRY.

###### A. Birkbeck Laboratory. (Men.)

*Chief Assistant.*—C. A. Bell, B.A., M.B.

The Laboratory and offices are open daily from 9 a.m. to 4 p.m., from the 3rd 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.

##### ELEMENTARY CHEMISTRY.

###### Chemical Theatre. (Women.)

Lectures—Wednesday and Friday, from 4 to 5.

A Class of Elementary Chemistry, including the subjects required for Matriculation, will be given during the Winter Session by the Chief Assistant in the Chemical Laboratory.

The instruction will consist partly of Lectures, partly of Laboratory Experiments performed by the Students.

Fees for the Course, including use of apparatus and materials, £4 4s.

B.—SUMMER PRACTICAL COURSES.

*Chemical Theatre.*

1. *Elementary Course.* (Men.)—About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May.

Fees—including the cost of materials and apparatus: for the Course, £5 5s.; for a Second Course, £3 3s.

2. *Senior Course.* (Men.)—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.

Fees—including the costs of materials and apparatus: for the Course, £5 5s.; for a Second Course, £4 4s.

III.—SUMMER MATRICULATION COURSE. (Men.)

C. A. BELL, B.A., M.B.

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. These lessons will begin on April 16th, 1879, at 11.

The Class will meet on Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12.

Fee, including cost of materials and apparatus, £4 4s.

*Chemical Technology.*

Professor CHARLES GRAHAM, D.Sc., M.I.C.

The Course of instruction in this Department is designed to afford to Students who propose to devote themselves to industrial pursuits in which Chemistry plays an important part, or to prepare themselves for the profession of Consulting Chemist, the instruction essential for their success in their future line of work. It will also be found of value in two of the branches (Organic and Inorganic Chemistry) in which the Degree of Doctor of Science can be taken at the University of London, and also an essential training for those Students who propose to qualify themselves for Membership of the Institute of Chemistry of Great Britain and Ireland.

Assuming that the Student enters for a three years' study, the following will give an idea of the nature of the work during the period:—

In the first year the Student will attend Lectures on Theoretical Chemistry, and work at Analytical Chemistry in the Chemical Laboratory, and will also attend Lectures on Mathematics, Mechanics, and Physics. The Mechanical Drawing Class should also be attended during the first year by all Students.

In the second year, the Student will again attend the Lectures on Theoretical Chemistry, and will begin his study of Applied Chemistry by attendance on the Lectures in this subject, and by practical work in the Laboratory on the applications of Chemistry.

The third year will also be chiefly occupied with attendance on the Lectures on Chemical Technology, and in practical work connected therewith in the Laboratory.

In the second and third years the Student will, in addition to the foregoing subjects, which are common to all, attend Lectures and work at such other branches of Pure and Applied Science as may be deemed advisable after consultation with the Professor.

Students entering the College with more advanced scientific knowledge will be able to shorten the Course described to two years, or even one year, as may be found advisable.

For the convenience of those already engaged in business, &c., it is arranged that they can attend a Course of Lectures upon any one subject of Applied Chemistry without being required to attend any other lectures, either in Applied Chemistry or in other subjects.

COURSES OF LECTURES.

*Chemical Theatre.* (Men.)

During first term—Course A, Monday, from 4 to 5, Chemistry of Brewing; Course B, Thursday, from 4 to 5, beginning October 10th, Chemistry of the Alkali Trade.

During second term—Course C, Tuesday, from 4 to 5, Soap, Glass, Pottery, Cements; Course D, Thursday, from 4 to 5, Agricultural Chemistry.

Fees—for each Course, £2 2s.; for the four Courses together, £5 5s.

In the Session 1879-80, it is proposed to treat of the following subjects:—

- (1) Heating and Lighting: Gas, Fuel, Furnaces.
- (2) Metallurgical Chemistry.
- (3) Dyeing and Calico Printing.
- (4) Paints, Oils, Varnishes; or Distilling, Vinegar-making, Bread and Biscuit-making.

Students desirous of working at subjects not included in the foregoing Courses, such as Photography and Photographic materials, Paper-making, Gas-tar products, the products of the Distillation of Wood, Tanning, and other Chemical industries, will receive individual instruction in the Laboratory.

*Chemical Laboratory.*

The instruction in the Laboratory in Chemical Technology, under the direction of the Professor, will consist of the examination and valuation of raw materials used, and of the final products obtained, in various manufacturing industries, and of experimental examination of the processes employed in the arts and manufactures.

The Laboratory is supplied with apparatus and utensils for such investigations.

Each Student works independently, and the Professor will arrange the course of practical work according to the requirements of the individual Student.

The Laboratories are open daily from 9 a.m. to 4 p.m., from the 2nd of October until the middle 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.

*Hygienic Laboratory.*

*Demonstrator.*—Mr. Charles E. Cassal.

UNIVERSITY COLLEGE, BRISTOL.

*Professor of Chemistry.*—E. A. Letts, Ph.D., F.R.S.E.  
*Assistant Lecturer.*—W. W. J. Nicol, M.A.

*Inorganic Chemistry.*

Monday, Wednesday and Friday, 10 to 11.

This Course will be continued during the First and Second Terms, and will be devoted to a consideration of the Theory of Chemistry, Chemical Physics, and Descriptive Inorganic Chemistry. In treating of the various substances under the latter heading, special attention will be given to their applications in the arts and manufactures. Tutorial Lectures will be given once a week by the Lecturer on those points in the course which require detailed explanation.

Fee for the Course, £4 4s.

For students who have paid Laboratory fees in the Session to the amount of £8 8s., this fee will be reduced to £3 3s.

*Chemical Analysis.*

A Course of about Twenty Lectures to be delivered during the First and Second Terms.

These lectures are recommended to all studying Practical Chemistry, and are intended to familiarise the student with the chief methods of Qualitative and Quantitative Analysis, and will partly take the form of demonstrations.

*Organic Chemistry.*

The Course will consist of about Twenty Lectures, and will be delivered in the Third Term of the Session. They will be devoted to the general consideration of the Carbon Compounds. Special attention (as in the Winter Course) will be given to the applications of Organic Chemistry to the Arts and Manufactures, more particularly to Dyeing and the Manufacture of Coal-Tar Products, &c. It is intended that the subject of the Summer Course of Lectures should be in sequence to that of the Winter Course.—Fee, £2 2s. for this course alone; £5 5s. for this and the Winter Course together.

*Practical Chemistry.—Laboratory Instruction.*

The Laboratory will be open daily from 10 a.m. to 5 p.m., except on Saturdays, when it will close at 1 p.m. Instruction will be given in the Laboratory in all branches of Practical Chemistry, including Qualitative and Quantitative Inorganic and Organic Analysis, the preparation of Chemical Products, and Inorganic and Organic Research. Special facilities will be afforded to those who desire to study Practical Chemistry as applied to the different processes employed in the Arts and Manufactures.

Fees—

	6 Days a Week.	3 Days a Week.	2 Days a Week.
Per Session .. ..	18 gns.	10 gns.	7½ gns.
„ Two Terms .. ..	13 „	7½ „	5½ „
„ One Term .. ..	7 „	4 „	3 „
„ Month .. ..	3 „	2 „	1½ „

In order that Students may have an opportunity of acquiring some knowledge of Applied Chemistry, excursions to some of the Mines and Manufactories of the neighbourhood will be made once a fortnight (on Saturdays) during the Summer Term. They will be conducted by the Professor or by the Lecturer. Past or present Students of the College desirous of taking part in these excursions are invited to apply to the Professor of Chemistry at the commencement of the Summer Term.

*Evening Lectures.*

*Lecturer.*—W. W. J. Nicol, M.A.  
Tuesday and Thursday, 8 to 9.

This course will consist of Two Lectures a week; they will be devoted to the consideration of the Principles of Chemistry and the Study of the chief Non-Metallic Elements. In treating of the various products under the latter heading special attention will be devoted to their applications in the Arts and Manufactures.

Fee, 8s. per Two Terms.

*Practical Class.*

*Professor.*—E. A. Letts, Ph.D.  
*Lecturer.*—W. W. J. Nicol, M.A.  
Wednesday and Friday, 7 to 9.

A Practical Class will be formed for instruction in Qualitative and Quantitative Analysis provided a sufficient number of Students enrol. The Fee for the course (extending over the first and second terms) will be £4 4s.

*Scholarships.*

The following College Scholarships, open to women as well as men, will be competed for in October:—

One Chemical Scholarship of the value of £25, tenable for one year.

Three General Scholarships of the value of £15 each, tenable for one year.

Four Scholarships for Women offered by the Clifton Association for Promoting the Higher Education of Women, will be competed for at the same time. Of these, two will be entrance Scholarships; that is, they will be open only to those women who have not already commenced systematic study at the College. The other two will be open to all women excepting past and present scholars. Each of the four will be of the value of £15,

tenable for one year, at University College, Bristol. Two of them may be augmented up to the maximum sum of £50 each, should such aid be necessary.

The Chemical Scholarship will be awarded principally by the marks obtained in Chemistry; but in case the best Candidates in it are nearly equal, account will be taken of their marks in other subjects.

ROYAL AGRICULTURAL COLLEGE,  
CIRENCESTER.

CHEMICAL DEPARTMENT.

*Professor of Chemistry.*—A. H. Church, M.A., Oxon.

*Assistant.*—Mr. C. Rawson.

The Collegiate year is divided into two Sessions, one beginning in February and ending in June, the other beginning in August, dividing in October, and ending in December.

During each Session the following Courses are given:—

- 36 Lectures on Inorganic Chemistry.
- 36 Lectures on Organic Chemistry.
- 36 Lectures on Agricultural Chemistry.
- 36 Laboratory Lessons in Chemical Manipulation.
- 36 Laboratory Lessons in Qualitative Analysis.
- 36 Laboratory Lessons in Quantitative Analysis.

The College Laboratory is open every day, except Saturday, from 9 a.m. till 5 p.m.

Advanced Students have the privilege of working at all times when the Laboratory is not occupied by other classes.

For the future the Collegiate year will be divided into three terms instead of two.

THE YORKSHIRE COLLEGE, LEEDS.

*Professor of Chemistry.*—T. E. Thorpe, Ph.D., F.R.S., F.C.S.

*Assistants.*—Mr. W. H. Wood, Mr. C. H. Bothamley.

*Lecture Courses.*

1. General Course on Inorganic and Organic Chemistry—Monday, Tuesday, Wednesday, and Thursday, at 4 p.m., from October to the end of March. Fee for the Course, £4 4s.

2. Lectures on Laboratory Practice and Chemical Calculations—Thursday, at 10 a.m., during the First and Second Series. Fee, £1 1s.

3. Lectures on the Chemistry of the Non-Metals—Saturday, at 12 a.m., during the First and Second Terms. Fee, 10s. 6d.

*Laboratory Courses.*

The College Laboratory will be open daily from 9 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it will close at 1 p.m.

Fees for the Session—Students working six days per week, £17 17s.; four, £13 13s.; three £11 11s.; two, £8 8s.; one, £4 4s.

*Class in Practical Chemistry*, Saturday mornings, from 9 to 12, during First and Second Series. Fee £1 11s. 6d.

*Practical Chemistry for Medical Students.*—On Monday and Wednesday, from 9 to 11 a.m., from May to the end of July.

*Evening Classes.*

A Course of twenty Lectures by Prof. T. E. Thorpe, F.R.S., on the Elements of Inorganic Chemistry (the Non-Metals) will begin during the first and second Terms, on Fridays, at 8 p.m., beginning October 12. Fee, 10s. 6d.

*Scholarships.*

The Cavendish Scholarship. Value £50 per annum, tenable for one year. Awarded for investigations made by the Candidates in any branch of Natural Science taught in the College.

The Salt Scholarship. Value £20 per annum, tenable for two years.

Akroyd Entrance Scholarships. Value £25 per annum,

tenable for three years. Intended for the encouragement of the study of Natural Science. One of these Scholarships will be awarded annually, if in the opinion of the Examiners any Candidate shall possess sufficient merit.

The Clothworkers' Company Scholarships. Four Scholarships, each of the value of £25 per annum, and tenable for one year. Each Scholar will be required to attend regularly the Lectures and Courses of instruction given in the First and Second Years' Course of the Department of Textile Industries at the discretion of the Instructor.

UNIVERSITY OF DURHAM.  
COLLEGE OF PHYSICAL SCIENCE,  
NEWCASTLE.

*Professor of Chemistry.*—A. Freire-Marreco, M.A.  
*Demonstrator*—J. T. Dunn, B.Sc.

*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, £5 5s. per term; alternate days, £3 3s.; one day per week, £1 1s.

Arrangements for Laboratory work in the evening and during vacation will be made.

*Courses of Study.*—Students will be distinguished into Regular and Occasional. Regular Students will be required to follow such a course of study in the subjects professed in the College as will enable them to pass the Examinations for the title of Associate in Physical Science. Occasional Students will attend such classes as they may select.

The Session will commence on the October 7, 1878.

Students in Physical Science who have completed their course are admissible by grace of the University to the Academical Rank of Associate in Physical Science of Durham.

No grace for admission to this rank is granted unless the Petitioner has passed two Public Examinations, which are conducted at Newcastle-upon-Tyne.

Associates in Physical Science, who, after their admission to this rank, have been engaged for three years, at least in some practical work of Mechanical, Mining, or Civil Engineering approved by the Council of the College of Physical Science, and have subsequently passed a further Examination having principally reference to the work in which they have been engaged, are admissible, by grace of the University, to the title of Mechanical, Mining, or Civil Engineer of the University of Durham.

Students who have obtained the Academical Rank of Associate in Physical Science, are admissible to the degree of Bachelor of Science, provided not less than two years have intervened from the time of their becoming Associates, after passing an Examination in not less than six of the following subjects, viz.:—(1) Mathematics (pure and applied); (2) Physics; (3) Chemistry; (4) Geology; (5) Engineering; (6) Biology; (7) Either Latin or Greek; (8) Either French or German. The last two of these subjects are compulsory.

A further degree of Master of Science is given by the University. Candidates for this degree must be of not less than two years' standing from the Degree of Bachelor of Science, and will be required to satisfy the Examiners appointed by the Senate of the University, in some branch of one of the Scientific Studies professed in the College of Physical Science.

OWENS COLLEGE, MANCHESTER.

*Professor and Director of the Chemical and Metallurgical Laboratories.*—H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

*Professor of Organic Chemistry.*—C. Schorlemmer, F.R.S.

*Demonstrators and Assistant Lecturers.*—Mr. W. C. Williams, F.C.S., Mr. Thomas Carnelley, D.Sc., and Mr. J. B. Hannay, F.C.S.

*Hon. Demonstrator in Metallurgical Laboratory.*—Mr. James Taylor.

*Lecture Courses.*

*Systematic Chemistry.—Junior Class.*—Tuesday, Thursday, and Saturday, from 9.30 to 10.30 a.m., during Michaelmas and Lent Terms. Comprising—(1) The laws of Chemical Combination; (2) a description of the physical and chemical properties and the mode of preparation of the Non-Metallic Elements and of their Compounds.

*Senior Class.*—Monday, Wednesday, and Friday, from 9.30 to 10.30 a.m., during the Michaelmas and Lent Terms, comprising—(1) The Chemistry of the Metals and of their most important Compounds; (2) Organic Chemistry.

The instruction in Systematic Chemistry is given by means (a) of Experimental Lectures and (b) of Tutorial Classes.

Fee—For each Class, £2 12s. 6d.; for both Classes, £4 14s. 6d.

A Tutorial Class, meeting in Sections, will also be held, which all members of the Junior and Senior Classes will be required to attend, unless specially exempted by the Principal and the Professor. Extra fee for this Class, 10s. 6d. This fee is not included in the composition fees payable by regular Students.

*Organic Chemistry.*—Professor C. Schorlemmer, F.R.S., Monday, Wednesday, and Friday, from 10.30 to 11.30 a.m.

*General Course* (from October to the end of March).—The subject of this course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general course in Systematic Chemistry.

*Extended Course* (from the beginning of April to the end of the Session).—This course is suited to the requirements of students preparing for the B.Sc. examination and for those who have previously attended the general course and wish to become more intimately acquainted with the subject. The course will treat of the History of the Old and New Theories, and of the most recent important discoveries in Organic Chemistry, &c.

Fee for the General Course, £2 12s. 6d.; for the Extended Course, £1 11s. 6d.; for both Courses, £3 10s.

*Chemical Philosophy.*—Prof. C. Schorlemmer, F.R.S., Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Law and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

*Technological Chemistry.*—Monday and Wednesday from 2.30 to 3.30 p.m. The following courses, treating of the chemical principles involved in the most important Chemical Manufactures, will be given during the Michaelmas and Lent Terms:—

1. Twenty Lectures by Dr. Carnelley, on Mondays, from 2.30 to 3.30 p.m., on Water, Air, and the Chemistry of Fuel and the Gas Manufacture.

2. Twenty Lectures by Prof. Schorlemmer, on Wednesdays, from 2.30 to 3.30 p.m., to commence after the Christmas vacation, on the Chemistry of Colouring Matters, Dyeing, and Calico Printing.

Fee for each course, £1 1s.

*Physical Chemistry.*—Mr. J. B. Hannay, F.C.S. One lecture a week, at an hour to be arranged as soon as a class is formed.

The students will be practically instructed in the use of the apparatus used in Physical Chemistry.

Fee, £1 11s. 6d.

*Analytical Chemistry.*—Mr. W. C. Williams, F.C.S. Thursday, from 10.30 to 11.30 a.m.

This Course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY COURSES.

The Chemical Laboratories will be open for Students daily from 9.30 a.m. until 4.30 p.m., except on Saturdays, when they will be closed at 12.30 p.m.

Fees for the Session—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s. Students entering the Laboratory Class at or after Christmas will be charged two-thirds of the fees for the whole Session.

Fees for shorter periods—For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s. Students entering under this scale are entitled to work on every day during the week.

Entrance Exhibitions.

- I. Victoria Exhibition (Classics), £15.
- II. Wellington Exhibition (Greek Testament), £15.
- III. Dalton Mathematical Exhibition, £15.

The Victoria and Dalton Exhibitions are renewable for a second year.

IV. Grammar School Scholarships, £15 per annum, tenable for three years; open to scholars of the Manchester Grammar School only.

V. Two Oxford and Two Cambridge Local Exhibitions, giving free admission to lecture classes in the College for one year, and renewable for two years further are awarded annually on the results of the Oxford and Cambridge Examinations held in Manchester.

VI. Gilchrist Scholarship, £50 per annum, tenable for three years; awarded on the results of the Matriculation Examination of the University of London, in June, 1879.

VII. Rumney Scholarships, £45 per annum, tenable for three years. The next competition will take place in 1880.

VIII. Ramsbottom Scholarship, £40 per annum, tenable for two years. The next competition will take place in 1880.

IX. Crace-Calvert Scholarships, £25 per annum, tenable for two years. The next competition will take place in June, 1880. This scholarship is open only to duly qualified members of the Evening Chemistry Classes.

X. Two Whitworth Exhibitions, giving free admission to certain Day Lecture Classes, which will enable the holders to prepare themselves for the competition for the Scholarships of £100 per annum founded by Sir Joseph Whitworth, Bart., will be offered for competition in June, 1879.

Scholarships.

The following (except the Shakspeare Scholarship) are open to the competition of students of the College only. The regulations prescribing the terms of competition and tenure will be found in the "Calendar."

I. Victoria Scholarship (Classics), £40 per annum, tenable for two years.

II. Wellington Scholarship (Greek Testament), £20 per annum, tenable for two years.

III. Shuttleworth (Political Economy), £50, tenable for one year.

IV. Shakspeare Scholarship (English Language and Literature), £40 per annum, tenable for two years.

V. Bradford History Scholarship, £45 per annum, tenable for one year, and renewable for a second year.

VI. Dalton Chemical Scholarships, two, each of £50 per annum, tenable for two years.

VII. Dalton Mathematical Scholarships, one Senior and one Junior Scholarship, of the value of £25 each, tenable for one year.

VIII. Platt Scholarships (Physiology), two, each of £50 per annum, tenable for two years.

IX. Heginbottom Physical Scholarship, £20 per annum, tenable for two years.

X. Ashbury Scholarships (Engineering), two, each of £25 per annum, tenable for two years.

Prizes.

I. Lee Greek Testament Prizes, one of £25 and one of £12 10s. value.

II. Classical Prizes, value £5. Junior Classical Prizes, value £5 and £2 10s.

III. Shuttleworth History Prize, value £5.

IV. English Essay and Poem Prizes, each of the value of £5.

V. Early English Text Society's Prizes.—A selection of the Society's publications offered to the competition of students in the Day and in the Evening Classes respectively.

VI. New Shakspeare Society's Book Prizes.

VII. Bryce Law Prize, value £10.

VIII. Cobden Club Book Prizes (Political Economy).

IX. Dalton Natural History Prize, value £15.

X. Engineering Essay Prize, value £5.

ROYAL COLLEGE OF SCIENCE FOR IRELAND,  
STEPHEN'S GREEN, DUBLIN.

Professor of Practical and Theoretical Chemistry.—R. Galloway, F.C.S.

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. 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.

A Diploma of Associate of the College is granted at the end of the three years' course.

ANDERSON'S COLLEGE, GLASGOW.

Professor of Chemistry.—William Dittmar, F.R.S.E.

Chief Assistant.—M. T. Buchanan.

Lecture Assistant.—Robert Lennox.

Junior Assistants.—James M. Bowie and William G. Johnston.

A Course of 100 Experimental Lectures on Chemistry: Daily, Saturdays excepted, from 10 to 11, commencing about the end of October. The Lectures up to the end of the year are devoted to the elements of Chemical Philosophy and to the Chemistry of the Non-metallic Elements. After the new year the Course divides into two branches, viz., the Chemistry of the Metals (on the Mondays and Tuesdays) and Organic Chemistry, select chapters (on the Wednesdays, Thursdays, and Fridays). Six written examinations are held during the Session, which all the members of the class are required to attend. Fee, £2 2s.

A Course of Tutorial Lessons in connection with the above Lectures will be given by the Class Tutor. Free to the members of the class.

The Laboratory for Practical Instruction in all branches of analysis, including technical assaying, and for original research is open daily (Saturdays excepted) during the Winter Session from 10 to 5, during Summer from 9 to 5: The teaching is conducted on the tutorial system, each student working by himself and on his own subject. The Laboratory is furnished with all the necessaries for chemical investigation.

Fee for the Winter Session, £10 10s.; Summer Session, £6 6s.; two sessions, if paid in advance, £15 15s., or £2 2s. per month.

THE  
"YOUNG" CHAIR OF TECHNICAL CHEMISTRY,  
ANDERSON'S COLLEGE.

*Professor.*—Edmund J. Mills, D.Sc. (Lond.), F.R.S.

*Senior Assistant.*—Mr. J. Snodgrass.

*Junior Assistant.*—Mr. J. Beckett.

This Chair has for its object the instruction of Students in Chemistry as applied to the various branches of industry in Chemical and other works, Metallurgy, Agriculture, &c.

*LECTURES.—Principal Course.*—A Course of Fifty Lectures will be delivered on Mondays, Tuesdays, and Wednesdays, at 9 a.m., commencing on November 4th. The Lectures will be illustrated with Experiments, Diagrams, and Models, as well as by the actual Inspection of Manufacturing Processes; and the progress of the Students will be tested by periodical Examinations. The earlier Lectures will have reference to units of weight and measure, to the calculations necessitated by Chemical operations, and to the nature and laws both of the Chemical process and its results. A particular subject will then be considered in comparatively minute detail, embracing for this session Fuel: the concluding lectures will have special reference to aerated waters, and the Bromine and Iodine Industry.

Fee for the Course, Two Guineas. Admission free to Laboratory Students.

*Subsidiary Course.*—A Course of Thirty Lectures will be delivered on Mondays, Tuesdays, and Wednesdays, at 9 a.m., commencing on May 1st. These Lectures are more particularly intended for Dyers, Colour Manufacturers, Brewers and Distillers, Tar Rectifiers, Drysalterers, and others interested in a knowledge of Technical *Organic* Chemistry.

Fee for the Course, Two Guineas.

*Technical Physical Chemistry.*—Mr. J. Snodgrass, Senior Assistant, has arranged to deliver a series of Thirty Lectures and Demonstrations on the Practical Applications of Physical Chemistry.

Fee for the Course, Half-a-Guinea. Laboratory Students, Half-a-crown.

*Laboratories.*—The Laboratories are open daily from 10 to 4, and on Saturday from 10 to 1 o'clock for practical working by the Students, under the superintendence of the Professor and his Assistants.

The Fee for attending the Laboratories is £18 per Session of Nine Months, £13 for Six Months, £7 for Three Months, or £2 10s. per Month. Students are supplied with a working table containing the ordinary reagents required for analysis, and such apparatus as retort-stands, gas jets, &c. Small articles—such as Berlin porcelain, evaporating basins, funnels, retorts, flasks, beakers, &c.—Students are required to provide for themselves. Larger and more expensive apparatus—such as large evaporating basins, retorts, flasks, bottles, funnels, thermometers, &c.—are lent for experiments. Students must have a fair acquaintance with elementary Chemistry.

The New Laboratory Buildings are in course of erection, and are expected to be ready for occupation during this Session.

*Memorandum as to Bursaries.*

The Trustees of the "Young" Chair have the superintendence of the Bursaries—regulating the appointment and terms on which they shall be held.

The Nominees of Donors to be appointed if they pass the necessary examinations.

The Bursaries are of the amount of £50 each per annum, tenable for three years, during which the Bursars shall be required to give their whole time and attention to the Lectures and Laboratory duties of the "Young" Chair, paying the ordinary fees. Candidates to have attained sixteen years of age on application, to be of good moral character, and to pass such examinations as may be prescribed by the Trustees in the ordinary branches of an English education and the elementary principles of

Chemistry. The Bursaries to be liable to forfeiture on the Bursars failing to exhibit approved progress under the Professor of the Chair, or being guilty of conduct, in the opinion of the Trustees, unworthy of their position. The Bursaries are only given to those whose means are limited, and who intend following some branch of Manufacturing Chemistry.

CHEMICAL LECTURES, CLASSES, AND  
LABORATORY INSTRUCTION.

CRYSTAL PALACE COMPANY'S SCHOOL OF ART, SCIENCE, AND LITERATURE. SCHOOL OF PRACTICAL ENGINEERING. *Principal*—Mr. J. W. Wilson, Assoc. Inst. C.E.—This school was established with the purpose of affording to Students of Civil or of Mechanical Engineering the advantage of thorough practical instruction in the rudiments of either profession, and in the manipulation of materials. The leading object is to prepare Students, by systematic practical instruction, for professional articles, so that on entering an Engineer's office or works the pupil may at once be useful to his Principal, and enabled to take advantage of the opportunities for learning open to him, because he has mastered the elementary details of the profession. The school is also available for Students already articulated, who desire instruction either in the offices or shops. The Colonial Section is designed particularly for gentlemen who are going to the Colonies or abroad, as explorers or settlers. The object proposed is to afford them so much practical knowledge of scientific and mechanical work and expedients as shall enable them best to utilise the means at their disposal, especially when entirely dependent on their own resources.

Special Courses of Lectures are delivered by independent Lecturers not on the Staff of the School, and are an addendum to the curriculum. These Special Courses will include a Course of Six Lectures on the Chemistry of Manufactures and Mines; a Course of Six Lectures on the Mechanics of Practical Mining; and a Course of Six Lectures, by Prof. H. G. Seeley, on the Physiography of the Principal Districts of the World.

In the Ladies Division of the Crystal Palace Company's School of Art, Science, and Literature, a Course of Lectures will be given during the ensuing term on Physical Geography, on Thursdays, at 10.15, a.m., by Mr. G. G. Butler, B.A., F.R.G.S. This subject belongs to Group C of the Cambridge Lectures. New Students can commence the Natural Science Group with this study. Students in Chemical Science of last Session are recommended to take this subject in succession. The treatment of it will aim at being both explanatory and descriptive. Fees: Twelve Lectures and Classes, £1 1s. Twelve Lectures, 10s. 6d. One Lecture, 1s.

BERNERS COLLEGE OF CHEMISTRY AND THE EXPERIMENTAL SCIENCES, 44, Berners Street, W.—Prof. E. V. Gardner, F.A.S., M.S.A. The Laboratory is open morning and evening throughout the year.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION, Southampton Buildings, Chancery Lane.—Inorganic Chemistry. Lectures:—Elementary, Tuesdays, 8.30 to 9.30; Advanced, Saturdays, 7 to 8. Practice:—Elementary, Saturdays, 4 to 6; Advanced, Saturdays, 8 to 10. Teacher, Geo. Chaloner, F.C.S. Organic Chemistry:—Course of Thirty Lectures will be given on Tuesday evenings, at 7 o'clock, by Mr. H. Chapman Jones, F.C.S., commencing on October 8th. Practical Organic Chemistry:—This Class will meet in the Laboratory of the Institution, under Mr. Chapman Jones's direction, on Saturdays from 4 to 6 and from 8 to 10 p.m., commencing on October 5th.

NEW CENTRAL SCHOOL OF CHEMISTRY AND PHARMACY, 173, Marylebone Road, London.—Mr. A. P. Luff, F.C.S., and Mr. J. Woodland, M.P.S.

ROYAL VETERINARY COLLEGE, Camden Town.—Professor of Chemistry, Mr. R. V. Tuson.

WORKING MEN'S COLLEGE, 91, Blackfriars' Road.—Teacher of Chemistry, Mr. J. D. Allen.

SCHOOL OF PHARMACY OF THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 17, Bloomsbury Square.—The school opens on Monday, the 1st of October. Lectures on Chemistry and Pharmacy, by Professor Redwood, on Monday, Tuesday, and Wednesday mornings, at 9 a.m. The Laboratories for Practical Instruction in Chemistry as applied to Pharmacy, &c., under the direction of Prof. Attfield, will be open daily at 10 a.m. throughout the Session. The Professors strongly advise all learners, both before and during attendance at the school, to avoid studying merely by way of "preparation for examination." For "examination" even by the most highly skilled "Board," with ample time at its disposal and a wide area from which to select questions, is admitted by all authorities on education, whether statesmen, teachers, or examiners, to be but a partial test of knowledge and an extremely imperfect test of education. The student who only seeks the kind of information which will enable him to pass an examination mistakes the means for the end. So far from examination being the end, and knowledge the means by which that end is accomplished, knowledge should be the end in view, and examination be regarded as a rough and partial test of the extent to which knowledge has been obtained. Not alone the knowledge which can be tested by examination, but that which cannot be so gauged, should, in all honour and in the highest self-interest, be the knowledge ever assiduously sought. The desire should not be for knowledge which, wanted only for the temporary purpose of examination, is rapidly gained and as rapidly lost, but for knowledge which will last. In short, the one desire should be *education*, that is knowledge accompanied by enlightenment of the understanding, mental training, mental discipline, and general elevation of the intellect. As for "examination," students of the School may rest assured that if they, guided by the Professors, work diligently, thoughtfully, deliberately, and thoroughly, they will with ease and pleasure pass any examination in the subjects in which they have thus been truly educated.

*Council Prizes.*—At the end of each of the five months' Courses of Lectures on Chemistry and Pharmacy, and Botany and Materia Medica, a Bronze Medal and Certificates of Merit, and at the close of the Session (ten months) a Silver Medal and Certificates of Honour and Merit, are offered for competition by the Council. In the Class of Practical Chemistry, the Silver Medal, two Bronze Medals, and Certificates of Honour and Merit, offered by the Council, are competed for at the end of the Session only.

SOUTH LONDON SCHOOL OF CHEMISTRY, 325, Kennington Road.—Dr. John Muter, F.C.S. Daily, at 10 a.m. Sixty Lectures on Theoretical Chemistry, and Junior and Senior Course of Practical Chemistry.

THE WESTMINSTER COLLEGE OF CHEMISTRY AND PHARMACY, Lambeth Road, S.E.—Messrs. Wills and Wootton. Daily, at 9.30 a.m. Theoretical and Practical Chemistry.

BIRMINGHAM.—MIDLAND INSTITUTE.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.; Friday, at 7; and Saturday, at 3.

BIRMINGHAM.—QUEEN'S COLLEGE.—Mr. A. C. Bruce, M.A.

BRISTOL MEDICAL SCHOOL.—Mr. T. Coomber, F.C.S.  
LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.—J. Campbell Brown, D.Sc. Lond., F.C.S.

SCHOOL OF TECHNICAL CHEMISTRY, 7 and 9, Hackin's Hey, Liverpool.—Mr. A. Norman Tate.

COLLEGE OF CHEMISTRY, LIVERPOOL.—Mr. S. H. Johnson, F.C.S.

LEEDS MECHANICS' INSTITUTION.—Mr. G. Ward, F.C.S.

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St. George's Hospital . . . . .	Mr. Wanklyn	Tu. Th. S., 11½	6 6	Mr. Wanklyn	Da ly, 10	4 4
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King's College and Hosp.	Mr. Bloxam, F.C.S., Mr. Hartley, and Mr. Thomson	Th. S., 10½	7 7	Mr. Bloxam and Mr. Hartley, & Mr. Thomson	M. W. F., 10½	5 5
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St. Mary's Hospital . . . . .	Dr. Wright	M. W. Th., 4	4 4	Dr. Wright	Tu. F. S.	3 3
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ABERDEEN SCHOOL OF SCIENCE AND ART MECHANICS' INSTITUTION.—Mr. Thomas Jamieson, F.C.S.

DUNDEE LITERARY INSTITUTION CHEMICAL AND PHYSICAL LABORATORY.—Lecturer on Chemistry, Mr. Frank W. Young, F.C.S.

UNIVERSITY OF EDINBURGH.—Prof. A. Crum Brown, F.R.S.E.

SCHOOL OF MEDICINE, EDINBURGH.—Dr. Stevenson Macadam, F.R.S.E., Mr. Falconer King, and Mr. Ivison Macadam.

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## CYANOGEN COMPOUNDS IN ALKALI MAKING.

By JAMES MACTEAR.

AN interesting method of *destroying* the cyanogen compounds formed in the black-ash process, patented by M. Pecheney has recently been introduced to the alkali trade by Mr. Weldon. It consists in the addition of a portion of sulphate of soda at the end of the usual reaction; this apparently oxidises the cyanogen compounds, and enables, in consequence, a much whiter quality of soda-ash to be produced.

The necessity for thus destroying the cyanogen compounds *can be altogether avoided by preventing their formation*, which, as shown by actual working, is a comparatively easy matter.

The formation of the cyanogen compounds takes place towards the end of the balling operation, at which point a high temperature of the mass prevails.

By reducing to the lowest possible point, the amount of mixing coal (even to under 29 per cent on the sulphate), and using as prescribed in my patented system of black-ash manufacture, barely one equivalent of carbonate of lime (say 70 per cent), the fusing-point of the charge is so much reduced that the decomposition of the sulphate can be perfectly attained at a temperature much lower than is usually employed. In such a case, however, the black-ash drawn from the furnace would be very "thin," and on cooling extremely dense and difficult to lixiviate, but the addition of caustic lime, either with or without a portion of coal or cinders (as is done in my system), increases as required the porosity of the black-ash, and renders the balls easily soluble, so that by careful attention the formation of cyanogen compounds can be reduced to at most a trace, with perfect decomposition of the sulphate and thorough lixiviation of the black-ash produced.

St. Rollox, Glasgow, Sept. 3, 1878.

## THE POLYTECHNIC SCHOOL AT AIX-LA-CHAPELLE.\*

THIS excellent institution is still maintained in a state of admirable efficiency. Of the 257 regular students who attended during the last term, 66 were devoting their attention to architecture, 60 to civil engineering, 61 to mechanical engineering, 36 to chemistry, 31 to metallurgy, and 3 to land-surveying. The number of students attending the lectures on experimental chemistry was 17; analytical chemistry, 18; practical work in the laboratory (analytical department), 34, (technological department), 12; attending lectures on technological chemistry, 28; attending practical lessons in designing, and arranging chemical works, 9.

An account of the station in life occupied by the fathers of the students contains some interesting facts: 107 were Government officials, 67 merchants, 35 manufacturers, and 28 working-men, all other occupations only amounting to 62. Whilst we cannot repress a smile at the number of officials, we recognise the exceeding importance of the fact that 28 working-men were able to procure for their sons a scientific training so practical and so thorough as the Polytechnic School of Aix-la-Chapelle offers. Such institutions, if opened in England and made as accessible, would do more for our national prosperity than any conceivable number of Board-schools. One painful fact, however, strikes us—among the Associations existing among the students, we find mention of what seems to be a Duelling Club!

## CORRESPONDENCE.

### STATEMENT OF THE RESULTS OF ANALYSIS OF COMMERCIAL PHOSPHATES.

To the Editor of the Chemical News.

SIR,—It is so highly desirable that a uniform system of stating the analysis of phosphatic materials should be adopted that I have thought it well to risk doing what I trust you will excuse me saying is, I think, usually a fruitless task, viz., writing to Editors.

The completion of the labours of the Committee appointed to enquire into the best methods of analysing and reporting commercial phosphates affords an opportunity, which I think should not be lost, for chemists to adopt simultaneously the most approved method of reporting at least.

Before remarking on this subject let me allude to a letter in the CHEMICAL NEWS, vol. xxxviii., p. 101, by Mr. Smetham, who does not agree with the recommendation of the Committee to reckon the acetate of ammonium precipitate as ferric and aluminic phosphates, because he has not usually found it to have that composition as actual analysis. I may just say that my experience confirms the findings of the Committee. I have analysed a large number of these residues and invariably find the phosphoric anhydride to be almost identical with the quantity found by reckoning as phosphate of iron.

The plan I adopt is:—Filter off the residue, wash well, ignite, and weigh. If the weight is not more than a half per cent, calculate it as iron phosphate, dissolve it in nitric acid, and add ammonium molybdate; the appearance of the precipitate affords a check, and the error, if any (which is unlikely), cannot exceed one-tenth per cent. If the residue exceeds a half per cent estimate by ammonium molybdate and magnesia as usual. With the small quantity the process is neither prolonged nor costly.

\* "Program der Königlichen rheinisch westfälischen Polytechnischen Schule zu Aachen für den Cursus 1878-79. Aachen: J. J. Beaufort.

NOTES AND QUERIES.

**Analysis of Artificial Manures.**—Will any of your readers oblige by giving me, through the medium of your columns, the titles of two or three good works on the analysis of artificial manures, as well as on the manufacture of sulphuric acid?—E. D. B.

Just published (London: J. and A. CHURCHILL). price 16s.

**A HANDBOOK OF MODERN CHEMISTRY.** By CHARLES MEYMOTT TIDY, M.B., F.C.S., Professor of Chemistry and of Forensic Medicine at the London Hospital.

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SAMPLES ON APPLICATION.

WHOLESALE—

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**THE CHEMICAL NEWS**

AND

JOURNAL OF PHYSICAL SCIENCE.

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Now, as to the statement of results. I presume it is not intended to take steps to get chemists to pledge that they will state results in a certain way. It will probably be a partial and gradual change, but the committee need scarcely expect that their recommendation will be adopted unless they propose a plan which commends itself as superior to all other methods by its simplicity, accuracy, sufficiency, and convenience. I do not think, however, that the plan proposed fulfils these conditions, and I beg to submit the following remarks:—

Nothing can suit the analyst better than to state as phosphoric anhydride, soluble or insoluble, and if it be said that the manufacturer and public are not well acquainted with the meaning of this term, much the same may be said of the terms commonly employed. On the other hand, nothing suits the manufacturer better than to state as insoluble phosphate of lime, because he knows the term and because it enables him to make use of the highest possible representation, and this statement would also remove all ambiguity from the consumer, who is often in doubt which phosphate is implied. I have long been in the way of reporting all phosphatic manures thus:—

Sol. phosphoric anhydride — = insol. phos. of lime —  
Insol. ditto ditto — ditto ditto —

I find this plan convenient and generally acceptable. Iron and alumina phosphate can also be shown, if desired, thus:—

Insoluble phosphoric anhydride { = to insol. phos. of lime —  
— { and to phos. of iron —

When the Committee have finally fixed upon what they consider the best plan, might they not send a circular to all analysts, asking them to agree to analyse if possible, but at any rate, to report, in a certain manner?—I am, &c.,

T. JAMIESON.

North of Scotland School of Chemistry and Agriculture,  
235A, Union Street, Aberdeen, August 29, 1878.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—I have before me Colonel Bolton's Reports to the Secretary to the Local Government Board for May, June, and July last. In them I find that the water of two Companies—the West Middlesex and Grand Junction—has been analysed by two different chemists, Drs. Tidy and Whitmore. The samples in either case were taken from the main. I know from Dr. Tidy's own lips that he does not himself place much trust in his figures, which I intend quoting; but pray compare the following results:—Reducing Dr. Tidy's figures to parts per million, the two gentlemen found of the so-called organic ammonia:—

	Dr. Whitmore.	Dr. Tidy.	
West Middlesex ..	0'07	0'14	May.
Grand Junction ..	0'07	0'13	"
West Middlesex ..	0'06	0'11	June.
Grand Junction ..	0'07	0'13	"
West Middlesex ..	0'05	0'14	July.
Grand Junction ..	0'07	0'14	"

It is clear that the difference between the results of the two analysts is due to some constant error of analysis. Could they not agree on this point, or is the "organic ammonia" method not capable of giving an absolute result, but only a result depending upon the individuality of the analyst? Surely Reports on the same water differing at the ratio of almost 1 to 3 can only cause a confusion in the mind of chemists and the public generally.—I am, &c.,

GUSTAV BISCHOF.

Analytical Laboratory, 4, Hart Street, Bloomsbury,  
London, W.C., August 28, 1878.

## St. Thomas's Hospital Medical School, ALBERT EMBANKMENT, S.E.

The WINTER SESSION will commence on October 1st, when an Address will be delivered by Mr. Nettleship, at 4 p.m. The fees may be paid in one sum or by instalments. Special entries may be made to any Lectures or to Hospital Practice, and there are special arrangements made for Students entering in their second or in subsequent years; also for Dental Students. Qualified Practitioners are admitted as perpetual Students, on payment of a small fee. There are special classes for the Preliminary Scientific and First M.B. of the University of London, not confined to Students of the Hospital.

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Two Entrance Science Scholarships, of £60 and £40 respectively, are awarded in October, after an examination in Botany, Chemistry, Physics, and Zoology, exactly similar to that for Honours in the Preliminary Scientific of the University of London. All First Year's Students who have entered during the Summer or Winter Sessions are eligible to compete.

First Year's Prizes.—The "William Tite" Scholarship of £30, and College Prizes amounting to £60.

Second Year's.—Either the College or the Musgrove Scholarships of Forty Guineas, tenable for two years, and prizes of £60.

Third Year's.—Second tenure of Scholarships and prizes of £45. There are also awarded the following medals, &c., viz., the "Cheselden," the "Mead," and the "Solly" Medal and Prize in money; the "Grainger" Prize, and the Treasurer's Gold Medal. The House Physicians and Surgeons and Resident Accoucheur are selected from Students who have obtained their Diplomas. An Ophthalmic Assistant is appointed twice a year, at a salary of £50. Clinical Clerks, Ward Clerks, and Dressers are selected from deserving Students without extra charge. Two Registrars at £100 per annum are appointed annually. There are numerous minor appointments of Anatomical Assistants, Prosectors, Obstetric Clerks, &c., open to all Students.

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The Glasgow Corporation are prepared to receive Tenders for the purchase of the Tar and Ammoniacal Liquor produced at the Dalarnock Gas-Works from and after 1st September, 1879. The Contract to be for such number of years as may be agreed upon. Forms of Tender, on which offers must be made, may be had, and further particulars obtained, on application to the Manager at the Gas Office, 42, Virginia Street, Glasgow, and offers endorsed "Tender for Residual Products" will be received by the subscriber up till Saturday, the 26th October next. Suitable ground for the erection of Chemical Works may be acquired in the immediate neighbourhood of the Gas-Works.

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J. D. MARWICK, Town Clerk.

City Chambers, Glasgow,  
September 3, 1878.

## SALE OF GAS TAR AND AMMONIACAL LIQUOR AT THE ROYAL ARSENAL, WOOLWICH.

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receive Tenders for the Purchase of such quantities of Gas Tar and Ammoniacal Liquors as may be for disposal during the period of three years from the 1st October, 1878, at the Royal Arsenal, Woolwich, where Forms of Tender and all information may be obtained, on application to the Commissary General.

The Tenders are to be delivered at the War Office, 5, New Street, Spring Gardens, S.W., by 12 o'clock noon, on Wednesday, the 11th day of September, 1878, addressed to the Director of Army Contracts, and marked on the outside, "Tender for the Purchase of GAS TAR, &c."

EVAN COLVILLE NEPEAN,  
Director of Army Contracts.

Army Contract Department, War Office,  
5, New Street, Spring Gardens, S.W.,  
30th August, 1878.

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# THE CHEMICAL NEWS.

VOL. XXXVIII. No. 981.

## ON THE ACTION OF HEAT UPON THE SELENATE OF AMMONIUM.\*

By CHARLES A. CAMERON, M.D., and  
EDMUND W. DAVY, M.D.,

The Professors of Chemistry and of Forensic Medicine, Royal  
College of Surgeons, Ireland.

THE study of the action of heat on the sulphate of ammonium under different circumstances, having, in the hands of Gladstone, Schweitzer, and other chemists, led to interesting results, we thought it desirable to institute some experiments on the selenate of that base, to ascertain whether any analogous products would be obtained on its exposure to that agency, selenic and sulphuric acids agreeing, as is well known, so closely in their properties, and this subject being, as far as we were aware, hitherto uninvestigated.

The salt which was employed in our experiments was obtained by saturating dilute selenic acid with carbonate of ammonium, and evaporating the product to dryness in a water-bath; and in its preparation it was found that though an excess of the carbonate, or even of caustic ammonia, had been added to ensure the neutrality of the resulting salt, still on evaporation to dryness it had always a more or less acid reaction; and this was observed to be the case, though it was again and again dissolved and rendered strongly alkaline by the addition of more of the carbonate or of caustic ammonia; thus showing that a temperature of 100° C., or even somewhat below it, was sufficient to decompose a portion at least of the neutral salt, and form more or less of an acid selenate of ammonium.

This observation is analogous to the results of Dr. Gladstone, who several years ago pointed out that when solutions of the sulphate, oxalate, phosphate, and citrate of ammonium (compounds of bi- and tribasic acid with that base) were boiled, they were partially resolved into free ammonia and acid salts.

It was further noticed in our experiments on the selenate that the application of heat was not necessary to produce this effect, for by simple exposure to the air a small quantity of an acid salt was produced (as was shown by blue litmus-paper moistened with the salt), which had even been made strongly alkaline by excess of ammonia, soon becoming red on exposure to the air. On making comparative experiments with the solutions of several other ammoniacal salts—some of which were even rendered alkaline by caustic ammonia—it was found that they all in like manner reddened blue litmus-paper under the same circumstances, indicating, apparently, the formation in some way of a small quantity of an acid or acid salt: but this curious observation, which we are not aware has hitherto been made, is a matter for our further investigation.

But to return to the selenate of ammonium. Thinking that it might be possible by the action of a higher temperature than that of 100° C., obtainable in the water-bath, to convert the whole of the neutral selenate into an acid salt (no such combination having hitherto been described), the thoroughly dried salt was heated in a bath of paraffin, the temperature to which it was exposed being indicated by a thermometer.

Under this treatment it was found that when the tem-

perature rose to about 180° C., the evolution of a minute quantity of ammonia could be detected by moistened turmeric or by reddened litmus-paper; and finding that the ammonia disengaged increased with the rise of temperature, the heat was gradually raised to 250° C., when its development became much more abundant, whilst at the same time water and selenium began to be separated.

This temperature was then continued as long as ammonia was evolved and till acid vapours made their appearance, when the heat was withdrawn. On examining the residue after this treatment we found that the selenate of ammonium had been completely decomposed, there being only selenium and selenious anhydride left. It should also be stated that the selenate of ammonium, before this final breaking-up, was found to possess a strong acid reaction, indicating the formation of an acid salt in the first stage of its decomposition by heat.

Having thus ascertained that when this selenate was strongly heated it yielded the following products, viz.—ammonia, water, selenium, and selenious anhydride—and wishing to determine whether these substances were the only products, we heated some of the selenate of ammonium in a tube filled with mercury, when a considerable volume of gas not absorbed by water was obtained, which was found to be nitrogen.

From the results of these and other experiments we have made, we have come to the conclusion that when selenate of ammonium is exposed to heat it first resolves itself into an acid selenate with the evolution of ammonia; and that this salt, on further heating, breaks up into selenium, selenious anhydride, water, and nitrogen, and that the reactions which occur in the process may probably be expressed by the following formulæ:—

1st stage.— $4[(\text{NH}_4)_2\text{SeO}_4] = 4(\text{NH}_4\cdot\text{H}\cdot\text{SeO}_4) + 4\text{NH}_3$ .

2nd stage.— $4(\text{NH}_4\cdot\text{H}\cdot\text{SeO}_4) = \text{Se} + 3\text{SeO}_2 + 10(\text{H}_2\text{O}) + \text{N}_4$ .

But as yet different circumstances have prevented our being able to confirm their correctness by actual results. The foregoing observations are interesting, as they show that in the first stage of the decomposition of the selenate of ammonium by heat there is an acid salt formed, like as in the case of the sulphate of that base when similarly treated, as was pointed out not long ago by Dr. Schweitzer; but in the separation of selenium in the second stage of the process there is no analogy in the case of the sulphate of ammonium.

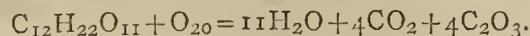
## ELEMENTARY ORGANIC ANALYSIS BY A MOIST PROCESS.\*

By J. A. WANKLYN and W. J. COOPER.

UNDER this title we describe the further development of the researches which were published from the Laboratory of the London Institution some ten years ago ("Historical Sketch of the Limited Oxidation").

We have continued these investigations by taking up the study of the oxidation of organic substances in alkaline solution by means of permanganate of potash, and have obtained the following results:—

*Cane Sugar.*—An aqueous solution of cane sugar is rapidly oxidised by excess of permanganate of potash in presence of some three times its weight of potash, and, if the materials be evaporated to dryness in the water-bath, is totally oxidised according to the following equation:—



We took—

Cane sugar	.. .. .	1.0 grm.
Solid potash	.. .. .	3.9 grms.
Permanganate of potash	.. .. .	7.0 "

\* Read before the Chemical Section of the British Association, Dublin, 1878.

\* Paper read before the Chemical Section of the British Association, Dublin, August, 1878.

and about 150 c.c. of distilled water, and heated the materials in the water-bath, continuing the evaporation almost to dryness. We then added a considerable quantity of distilled water, titrated the excess of permanganate, filtered from the brown hydrated binoxide of manganese, which is formed during the reaction, and submitted the entire filtrate to precipitation with chloride of calcium and excess of acetic acid. We washed, dried, and ignited the resulting oxalate of lime, and weighed the carbonate of lime thereby produced, which equalled 1.204 grms.

The oxygen consumed was found by titration to be 0.9351 gm. We have, therefore, experimentally,

Carbon as oxalate .. .. 0.289 gm.  
Oxygen consumed .. .. 0.9351 ,,

And the theory requires—

Carbon as oxalate .. .. 0.281 ,,  
Oxygen consumed .. .. 0.9356 ,,

which accords sufficiently well.

We have directed an evaporation of the material down to dryness in order that the experiment may be sure to succeed. If this point be neglected only about  $\frac{1}{10}$  of the theoretical quantity of oxygen may be consumed, and  $\frac{1}{2}$  of the correct quantity of oxalate be produced, as was illustrated in our earlier experiments, which we need not publish.

*Grape Sugar.*—Our experiments on grape sugar were made before we had discovered the secret how to get the oxidation complete.

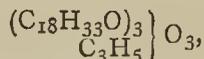
We obtained from 100 parts of grape sugar 20.7 parts of carbon as oxalate.

The theory  $C_6H_{12}O_6 + O_{10} = 6H_2O + 2CO_2 + 2C_2O_3$  requires carbon as oxalate 26.6. This experiment requires repetition with proper regard to the conditions.

*Glycerine.*—The experiment with this substance was likewise made before we had adopted the precaution of evaporating to dryness in the water-bath.

From 2.78 grms. of glycerine we obtained 0.535 gm. of carbon as oxalate.

*Train oil*, which we may take to be mainly oleate of glycerine,



behaves in a most interesting manner when subjected to the action of strongly alkaline permanganate.

We quote from our note-book:—

Train oil .. .. 3.184 grms.  
Solid potash .. .. 14.5 ,,  
Permanganate of potash .. 50.0 ,,  
Distilled water, 500 c.c.

These materials having been put together there was little action below 100° C., but on evaporation in the water-bath the action became very rapid at approaching dryness, and the permanganate was almost completely used up.

A large quantity of oxalic acid was produced and converted into oxalate of lime, which was burnt into carbonate of lime, yielding 5.248 grms. of carbonate of lime. It was from this and another experiment on almond oil that we learnt the importance of the evaporation to dryness. Both experiments are incomplete, but they show that such complex and stable substances as the animal and vegetable fats are amenable to this method of treatment.

*Benzoic Acid* was powerfully attacked on being taken to dryness in the water-bath with alkaline permanganate. It appeared to give a very little oxalate.

*Lactic Acid* was attacked even in the cold.

*Acetic Acid* resists most strongly, and apparently absolutely.

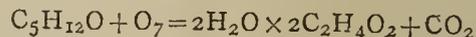
*Alcohol* behaves in a most interesting manner. In the cold there is conversion into acetic acid, without intermediate production of aldehyd; and the acetic acid so

produced is not subsequently oxidised on heating with excess of potash and permanganate.

The acetic acid was identified by being made into a baryta salt which yielded 53.75 per cent of barium. (Theory, 53.73.)

No oxalic acid was produced.

*Amylic Alcohol* is oxidised thus:—



and, no doubt, the different varieties of amylic alcohol give different products.

## ON A DIRECT METHOD FOR DETERMINING THE CALORIFIC POWER OF ALIMENTARY SUBSTANCES.\*

By J. A. WANKLYN and W. J. COOPER.

THE amount of oxygen consumed by an organic substance being the measure of its heat-producing force, the importance to physiologists of a direct and rapid method for measuring the consumption of oxygen in organic fluids is obvious. It is well known that an elementary combustion will effect this object, but, as is likewise well known, the great difficulties which beset it render it unavailable for physiological researches. The process by which we obtain all the results of an elementary combustion can be completed in about an hour, and in the course of our experiments on various organic substances we have been enabled to get an amount of oxygen absorbed which is equal to the theoretical quantity required by the substance operated upon. In point of fact, we have so modified Forchhammer's process as to make it work in a satisfactory manner.

Forchhammer's process, as hitherto practised, does not effect anything approximating to complete oxidation down to carbonic acid and water, as was illustrated by some experiments published by Frankland and Armstrong in 1868 (*vide Chem. Soc. Journ.*, vol. vi., p. 82), which we quote:—

Name of substance (30 parts dissolved in 1,000,000 parts of water).	Oxygen absorbed during six hours.	Oxygen required for complete oxidation.
Gum arabic .. ..	0.35	35.5
Cane-sugar .. ..	0.15	33.7
Starch .. ..	0.30	33.5

Showing that, as usually carried out, the oxidising process does not avail to accomplish more than about one hundredth part of the task set before it.

The modifications whereby we have completely altered the character of the Forchhammer process are as follows:—

Instead of simply mixing the standard solution of permanganate with the water to be examined we *distil* a given volume of the water (say, 1 litre) with a considerable excess of standard solution of permanganate, and thereby get more oxidising action than in the ordinary operation. We find advantage in having the liquid strongly alkaline during the distillation; but we render acid before titrating the residue.

The following are the working details:—

A standard solution of permanganate of potash (strength 0.4 milligramme of active oxygen per 1 c.c.) is prepared.

A standard *reducing-solution*, containing protosulphate of iron, and of such a strength that each c.c. exactly corresponds to the permanganate solution, is also prepared.

Solution of caustic potash, 5 per cent, is prepared.

\* Paper read before Section D. (Department of Anatomy and Physiology) of the British Association, Dublin, August, 1878.

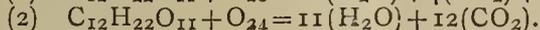
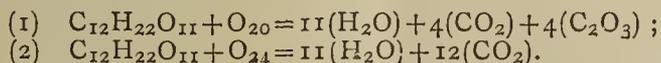
Diluted sulphuric acid (1 volume of oil of vitriol with 9 volumes of water) is prepared.

These solutions having been got into order the operator may begin.

A litre of the water to be examined is placed in a retort which is conveniently mounted, just as in the ordinary course of water analysis by the ammonia process. Into the retort the operator drops with a graduated pipette 5 c.c. of the solution of potash (to render the water alkaline), and then 5 c.c. of very carefully measured standard solution of permanganate; and then the contents of the retort are boiled by means of a large Bunsen burner, and the water is rapidly distilled off. After the distillation has advanced it will very often happen that the permanganate will show signs of having been used up: if that happens a second, and, if necessary, a third 5 c.c. of standard permanganate must be dropped into the retort, and the distillation continued until 800 or 900 c.c. have distilled over, and only some 200 or 100 c.c. of liquid remain behind in the retort. When the distillation is stopped, the observation that the contents of the retort still contain unacted-upon permanganate must held good; otherwise too little permanganate would have been employed in the operation.

The manner of finishing the operation is of a very obvious description. The operator acidifies the residue in the retort (*i.e.*, he adds 10 c.c. of the diluted sulphuric acid); then he adds a measured quantity of iron-solution, taking care to use a considerable excess; and finally he titrates back with the standard permanganate, and thus becomes provided with numerical data expressing how much oxygen has been used by the litre of water.

Experiments on dilute solutions of cane-sugar have given results approximating very well to theory. Cane-sugar, indeed, we have subjected to a course of oxidations ranging over a very varied scale—from 5 milligrms. to upwards of 10 grms. at a single operation. The reaction is precise, *viz* :—



Equation (1) is valid if the action be restricted to the alkaline solution; and equation (2) is valid when the oxidation has been carried forward so as to be finished in the acid liquid.

#### ON SOME SUBSTANCES OBTAINED FROM THE ROOT OF THE STRAWBERRY.\*

By Dr. T. L. PHIPSON, F.C.S., &c.

I HAVE found in the root of the strawberry (*Fragaria vesca*) certain substances closely allied to some which are contained in the Cinchona barks. I am still occupied with this investigation, which was only begun quite recently, but in the meantime, desire to make known the curious substance I have termed Fragarine, which can be obtained in considerable quantities by the process described below :—

There exists in the root of the strawberry a kind of tannin of a very pale yellow colour, which is soluble in water and in alcohol, and strikes a green colour with salts of iron. It is soluble in water slightly acidulated with hydrochloric acid. With more hydrochloric acid it combines to form an insoluble compound, and is also precipitated in purple flocks by alkalies. It can be obtained pure by evaporating its aqueous solution in an atmosphere of carbonic acid, and is then in the form of a pale yellow amorphous substance, with an astringent taste, devoid of bitterness; it takes a fine purple colour in contact with

potash, and colours per-salts of iron dark green. This substance, which may for the present be termed Fragarianine, is a kind of tannin, closely allied to quinotannic acid, but instead of yielding *Cinchona red* like the latter, it yields a somewhat similar substance, which I call Fragarine.

To obtain the latter about 50 grms. of the strawberry root in thin slices are left for forty-eight hours in a stoppered bottle with water acidulated with about 5 per cent of hydrochloric acid. The solution filtered off is of a pale golden-yellow colour; it is strongly acidified by addition of more hydrochloric acid and boiled for an hour or two. As the temperature rises towards boiling point the pale yellow liquid becomes darker and redder, and finally takes a splendid orange-red colour. On boiling it becomes cloudy, and after some time Fragarine is abundantly precipitated in flocks of a reddish brown colour. After allowing the liquid to become quite cold it is filtered, and the new substance collected is washed with cold water. The filtered liquid contains glucose.

Fragarine thus obtained has the following properties:— It is an amorphous reddish brown powder, highly electrical by friction, soluble to some extent in water, alcohol, and ether, dissolving in potash with a fine reddish purple colour. It dissolves in concentrated sulphuric acid, and forms a conjugated acid, the solution of which is brownish purple. Boiling hydrochloric acid does not affect it. Treated with nitric acid it forms a brilliant yellow nitro compound, different from picric acid, yielding no picramic acid when reduced by sulphide of ammonium. Chlorate of potash and hydrochloric acid mixture yields a bright yellow chlorine compound, insoluble in water, decomposed by ammonia.

Heated in a tube Fragarine yields water, is decomposed without fusion, depositing much carbon, and producing a white volatile substance, which condenses in the tube and is soluble in water; the solution produces a green colour with salts of iron; it is probably pyrocatechin. Melting hydrate of potash decomposes Fragarine with production of dark brown substances and a little protocatechuic acid, which can be isolated by ether from the acidulated solution of the products of this reaction, and also colours iron salts green.

Whilst Fragarine is being produced by boiling with hydrochloric acid as above there is diffused through the laboratory a very agreeable odour of essence of cedar. When the same experiment is made with an acid decoction of red and yellow cinchona barks (obtained in the cold) there is produced an odour of heated spermaceti. It is curious that both essence of cedar and cetene of spermaceti contain 32 equivalents of carbon. Instead of giving a dirty green colour with potash, as *Cinchona red* does, Fragarine dissolves with a reddish or brownish purple colour. This is the best way of distinguishing between these two substances. I cannot yet say anything with certainty about its composition ( $\text{C}_{26}\text{H}_{20}\text{O}_8$ ?).

Besides these two substances the strawberry root yields a compound very similar to quinovine; at least, a body similar in many respects to quinovic acid can be obtained by the usual method, but probably not identical with it. There is also a small amount of gallo-tannic acid, but no alkaloid. The tannin mentioned above as Fragarianine appears to be partly combined with ammonia, which causes it to produce the rose or flesh-coloured tint visible in the section of the older roots.

Researches on Glycolide.—T. H. Norton and J. Tcherniak.—Pure glycolide is a perfectly white powder, insipid to the taste and without sensible action on blue litmus. It melts at 220°. Ethyl-amin transforms it easily, even at 0° into glycol-ethyl-amin, identical with the compound obtained by Heintz, on acting upon glycolic ether with ethyl-amin. Anilin gives rise to a new body glycol-phenyl-amin.—*Bull. de la Soc. Chim. de Paris.*

\* Read before the Chemical Section of the British Association, Dublin, August, 1878.

## NOTES FROM THE PARIS EXHIBITION.

## THE CAPTIVE BALLOON.

In the middle of the "Place de Carrousal," behind the Tuilleries, may be seen an enormous globe, which, from a distance, resembles an immense metallic ball: this is the captive balloon, constructed by M. Giffard. Every afternoon it is ascending and descending, each journey taking up about 30 people.

The balloon takes on an average 15 minutes to go up to a height of about 550 metres and come down again; when down, it is held by eight strong cables, each cable under the management of two men, who have to attach and detach it. When anchored in this manner the balloon could bear a wind pressure of 400 lbs. on the square metre without being blown away. It is sufficiently powerful to take up 100 people, but 50 is the maximum which the car will comfortably contain. The diameter of the balloon is 135 feet; therefore it is a little more than 405 feet in circumference. The envelope is formed of seven layers of different materials, all fastened firmly together in such a manner that there is no fear of a rupture. The first layer inside is strong muslin, then a layer of india-rubber, then very strong linen, after which comes a second layer of india-rubber, then another layer of linen, followed by a layer of vulcanised india-rubber, and outside a layer of muslin, over which the varnish is laid, to prevent any escape of gas; and lastly the whole is painted all over with a white zinc paint, which gives it its fine metallic appearance.

The bands of stuff are sewn together in a zigzag manner, to stop the possibility of the seams ripping, and each seam is covered with india-rubber. If all the bands used were laid one after another in a straight line they would extend to a distance of 150 miles.

The envelope, which is of a perfectly spherical form, is enclosed in a net-work of 60,000 meshes; the ropes are not knotted together, as the knots might wear holes in the case, but they are passed through each other.

The cordage altogether weighs 16,000 lbs., not including the cable by which the balloon is held down. This cable is a little more than 600 metres long, and is made somewhat thinner at the lower end than at the upper, so that in case it were to break, the fracture would be at the lower end, and the descent of the balloon would be made much easier, because of the immense guide-rope the aëronauts would have in their aid. The diameter of the cable at the upper end is  $8\frac{1}{2}$  centimetres, and at the lower end  $6\frac{1}{2}$  centimetres.

The cable passing from the balloon to the bottom of the basin, which has been dug to facilitate the entry into the car, turns round a large pulley and goes along a tunnel 60 metres long to the machine which draws the balloon down.

The large drum on which the cable is wound is 14 metres long, and about  $1\frac{3}{4}$  metres in diameter; it makes about 30 turns a minute, but in case of necessity it can revolve much quicker. A groove is cut round and round the whole length for the cable to fit in; the drum is worked by two double-cylinder horizontal engines, one at each end, and the steam is generated in two boilers, but one alone is sufficient for the work in the case of either of them getting out of repair.

The direction of the balloon is under the control of one man, who, by simply turning a tap can make it ascend or descend at will. The first few ascensions were directed by M. Giffard himself, but subsequently the direction has been given into the charge of M. Carot.

The car weighs about 3600 lbs., and is made to carry 50 persons comfortably at a time. It is constructed with a round hole in the middle, through which passes the cable, fastened to the cordage above. In case anybody was taken with a desire to commit suicide, he could not carry out his intention, owing to there being a net all round the car. The car is furnished with all

kinds of instruments required for making scientific observations or to gratify the curiosity of passengers who wish to know to what height they have ascended; and, further, the car is supplied with ballast and the other necessary appliances for the manœuvring of the balloon in case it was to escape. There are two aëronauts who always ascend to look after the safety of the passengers in case of an accident.

From the height to which the balloon ascends one has a splendid view of Paris and the environs, which should tempt many people to make a journey upwards.

The first idea of making the balloon was brought forward about four years ago by the "International Meteorological Association," which includes most civilised Governments, when it was proposed that a balloon should be constructed for the purpose of studying the conditions of heat and moisture in the atmosphere from the height of one metre to 600 metres, but no Government wishing to undertake the expense of constructing the balloon, this has been done by M. Giffard, who is well known as an engineer. The French Government has contributed nothing to the enterprise, but even charges £4000 for the use of the court behind the ruins of the Tuilleries. The whole of the plans have been designed by the constructor, M. Giffard, from that of the immense machine to wind the cable, to the size and shape of each mesh in the net, and he may feel justly proud at having achieved so great a success.

H. C.

## ON SOME PRESUMABLY NEW EARTHS.

By Dr. B. W. GERLAND.

My friend, Mr. Ion. Down, formerly manager of the Alderley Edge Mining Company, and since of the Tharsis Company, called my attention some fifteen years ago to a mineral he had discovered in a vein of the Keuper sandstone. It covers the sides of crevices and cavities with small, shining, dark olive-green crystals, or impregnates the sandstone with pale apple-green colour, and consists principally of vanadate of copper and lead. As this deposit promised to offer vanadium compounds in workable quantity, the only one hitherto found, I took great interest in it, and examined the mineral carefully. Its composition is very complicated: I found nearly one-half of the known elements represented, and separated a group of oxides belonging to the rare earths, possessing properties which distinguish them from those already known. Their behaviour and characteristic reactions, as far as ascertained with the small quantity at my disposal, are as follows:—

The solution of the salts is precipitated by caustic soda and by ammonia: excess of the reagent does not re-dissolve the hydroxides, even in presence of ammonium salts. Sodium, potassium, and ammonium carbonates also cause a precipitate, which is easily dissolved by an excess. This solution is partially precipitated by carbonic acid. The separated substance consists of earth and alkali, fluxes at red heat, and does not give the reactions of alumina. The compound is re-dissolved by boiling with the mother-liquor. The earths are therefore more soluble in neutral alkaline carbonates than in acid carbonates.

Neither barium nor calcium carbonate act on solutions of the pure salts, but if these contain alumina or ferric oxide, the earths are completely separated from the solutions with these oxides.

The oxalates are insoluble in water, acetic acid, and dilute mineral acid, but soluble in strong acids and in sodium carbonate. They are crystalline, of white, or pink, or pinkish blue colour.

The earths form compounds with potassium sulphate, which are sparingly soluble in a concentrated solution of that salt. The more soluble part gives faintly coloured

salts and oxide, and shows the absorption-spectrum of didymium much brighter than the less soluble part, but neither gives the spectrum of erbium. These observations have been kindly verified by Professor Bunsen and Dr. M. H. Watts in June, 1876.

The oxides obtained from the less soluble part of the salts are leather-brown, and those of the more soluble part pale brown. They have no alkaline reaction, and dissolve readily in acids with evolution of heat, even after exposure to an intense heat. All attempts to produce a peroxide failed. The hydroxides and oxides dissolve slowly in ammonium chloride or nitrate solution, hot or cold, provided the ammonia can escape.

The salts formed with hydrochloric, chloric, perchloric, hydroiodic, periodic, and hydrofluoric acid are very soluble in water and alcohol, deliquescent, and not easily obtained in crystals. The chloride solution, evaporated with hydrofluoric-silicic acid, gives on the addition of alcohol only a very slight precipitate.

The sulphates are not very soluble; they crystallise with water in beautiful, hard, large, transparent crystals. The first crystallisation is bluish pink; the last, pale pink. They lose their water above 150°, and then become opaque, with lustre like mother-of-pearl. The analyses of the first and last crystallisation gave the following results:—

	I.	II.
K <sub>2</sub> O .. ..	21.30	17.54
SO <sub>3</sub> .. ..	37.10	33.55
Oxide .. ..	41.60	47.92
	100.00	99.01

If barium chloride is added to the solution of the salt containing even much free acid, a large portion of the earth separates with the barium sulphate.

The amount of these earths in the mineral is very small, and their extraction is made difficult by the quantity of foreign matter present, particularly alumina and oxide of iron. I have worked up different parcels of picked pieces, amounting to about three tons, and only collected a little above 1 grm. This is partly owing to my trusting too much to the insolubility of the oxalates, whilst, as I have ascertained since, they are perceptibly dissolved by solutions of aluminium and ferric oxalates. Before continuing the examination of these earths I wish to increase my stock, and this I am now enabled to do with greater facilities than before, since the eminent firm who have worked the deposit for some time have most kindly placed the material and the conveniences of their works at my disposal. But the progress of my investigation must necessarily be slow, owing to want of time, and this circumstance, together with the memorandum in a recent number of the CHEMICAL NEWS, on Mosandrium, by Dr. J. Lawrence Smith, induce me to publish my experiences in this imperfect state.

Macclesfield, August 3, 1878.

## CORRESPONDENCE.

### CYANOGEN COMPOUNDS IN ALKALI MAKING.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxxviii., p. 130, Mr. Maclear remarks:—"The formation of the cyanogen compounds takes place towards the end of the balling operation, when a high temperature of the mass prevails." In this and another passage of the same communication, taken together, Mr. Maclear implies that, in his opinion, cyanogen compounds are formed in the black-ash furnace more readily and in greater proportion at high temperatures than at lower ones. To that opinion I beg to oppose the following facts:

1. In many works it often happens that the same

revolver is sometimes worked with a "mixing," the carbonate of lime in which is all in the state of "lime-sludge," and at other times with a mixing, the carbonate of lime in which is all dry limestone. When working with a lime-sludge mixing the average temperature of the furnace is *lower*, owing to the 50 per cent of water which has to be evaporated from the "sludge," than when working with a limestone mixing: and the quantity of cyanogen compounds in the black-ash from the sludge mixing is always *greater* than the quantity of cyanogen compounds in the black-ash from the limestone mixing.

2. A certain revolver was at one time heated by gas. The black-ash made in it contained five times the ordinary proportion of cyanogen compounds. The mode of heating it was changed to the ordinary method of firing with coal, and the proportion of cyanogen compounds in the black-ash at once fell to the ordinary proportion. Nothing was changed except the method of heating; but it was observed that the temperature of the furnace, when fired with coal, was much *higher* than when the heating was done by gas.

3. Hand-furnace black-ash usually contains a smaller proportion of cyanogen compounds than revolver black-ash; and hand-furnaces are usually worked at a higher temperature than is obtained as a rule in revolvers.

4. French hand-furnace black-ash contains a smaller proportion of cyanogen compounds than English hand-furnace black-ash; and in France black-ash hand-furnaces are worked hotter than they are in England, and the charges remain in them a very much longer time.

5. Since I began to introduce the Pechiney process in England, more attention has been given by English alkali makers to the question of the cyanogen compounds in black-ash than they had previously given to it since the commencement of their industry. Nearly everybody have begun experimenting and observing, in the hope of arriving at something which will enable them to avoid having to pay the modest royalty on the Pechiney process. A part of my commission from M. Pechiney has been to insist upon the importance, in order to the production of the best possible black-ash, of the use of a minimum of mixing coal and a high furnace temperature. In several works, in each of which are several revolvers working at different temperatures, my insistence on the importance of these two conditions has led to very careful observation, not only of the effect of different proportions of mixing-coal, but also of the effect, with all manner of mixings, of different furnace-temperatures; and, whatever the mixing employed, it has invariably been found that black-ash made in revolvers working at high temperatures has contained smaller proportions of cyanogen compounds than black-ash made from precisely the same mixings, but in revolvers working at lower temperatures.

6. Those English manufacturers who are employing the Pechiney process are at present acting also upon a suggestion of mine. Together with Pechiney's "additional sulphate" they drop into the furnace a certain quantity of limestone dust, with the object of freeing the nearly finished black-ash from sulphide of sodium as well as from cyanogen compounds. The addition of these bodies of course *cools* the furnace, and it is found that, whereas when the quantity of limestone-dust added with Pechiney's sulphate does not exceed a certain amount the black-ash obtained is nearly free from sulphide of sodium and quite free from cyanogen compounds, the black-ash is *not* free from cyanogen compounds when the proportion of limestone-dust used is sufficient to carry the cooling effect of the after-charge beyond a certain degree.

These facts seem to me to indicate that, to the formation of cyanogen compounds in the black-ash furnace, *low* temperatures are more favourable than high ones. How, then, is it that cyanogen compounds are not found in the charge in the black-ash furnace until "towards the end of the operation," when "a high temperature of the mass prevails"? This is obviously because the quantity of undecomposed sulphate present is then lowest, not because

the temperature is then highest. That sulphate of soda, added to a nearly-finished charge of black-ash containing cyanides and intimately mixed therewith, completely destroys those cyanides, is now demonstrated as completely as any fact of industrial chemistry. This being so it is plain that there can be no cyanides in a black-ash furnace until "towards the end of the operation." Either they cannot form while there is yet much undecomposed sulphate present, or, if they do form, the undecomposed sulphate instantly destroys them.

While, then, Mr. Maçtear's idea that a low temperature in the black-ash furnace will help to enable him to "prevent the formation" of cyanogen compounds is contrary to all I have yet learnt on this subject, I am confident that "reducing to the lowest possible point the amount of mixing-coal" is what all alkali-makers must inevitably come to. But so far as the English alkali-makers are concerned, it is to M. Pechiney, my great master and teacher in this matter of soda-making, that they will be indebted for the great advantages resulting from the reduction of their mixing-coal to a minimum. For months past, at his instance, I have been urging this point upon them. I urged it upon Mr. Maçtear—who was then using immensely more than "under 29 per cent," although, he told me, he had once been "down to 32"—when I called upon him at St. Rollox, to introduce the Pechiney process to him, on the 23rd July. For months past I have been circulating among the English manufacturers copies of a letter addressed to me by M. Pechiney on the 14th March, in which he says:—"Pour avoir une belle qualité de sel de soude, il faut décomposer le sulfate avec la moindre quantité possible de charbon. . . . Le minimum de charbon mélange doit être employé. . . . Engagez, donc, ces Messieurs à faire des essais de cuites de soude en diminuant progressivement le mixing-coal." . . . Je crois qu'ils obtiendront des résultats qui les intéressent."

In France the proportion of mixing-coal used has long been reduced to about 30 per cent on the sulphate, and that is one reason why French black-ash has contained a smaller proportion of cyanides than English black-ash. But French black-ash, made with only 30 per cent of mixing-coal, still *does* contain cyanides. In adopting, however, the French proportion of mixing-coal, Mr. Maçtear uses less limestone than the French use, and also a lower temperature. I have given above what seem to me strong reasons for doubting that his lower temperature will assist his object of avoiding "the necessity for destroying the cyanogen compounds" by "preventing their formation," and the fact that black-ash made with Mr. Maçtear's proportion of limestone, but at the temperatures ordinarily employed, contains as much cyanides as black-ash made with larger proportions of limestone is certainly against the idea that his less limestone will be of much service towards the end now in question. But Mr. Maçtear says in his communication to you that "actual working" by the method described had shown that, with "careful attention," preventing the formation of cyanides "is a comparatively easy matter." Had he not jumped to that conclusion somewhat too rapidly? When he was so good as to call on me at my hotel in Glasgow on September 1st he told me he had been working in the manner described for about a fortnight. Had he, when he wrote to you two days later, arrived at the stage of *finished ash*? Above all, had he, by the method described in his communication to you, obtained a finished product, *made without removing any red liquors*, and yet as free from iron and as good in colour as ammonia ash? M. Pechiney does that regularly at Salindres; and therefore no method of conducting the balling operation can have really substantiated its claim to be considered as good as Pechiney's, or to be regarded as putting an end to "the necessity for destroying the cyanogen compounds" which are the bane of ordinary black-ash, unless it shall have done that too.

That by reducing the mixing-coal to a minimum, employing a suitable furnace temperature (and I could give

far more facts than I have given to show that a high one is the best), and bestowing upon the operation that "careful attention," the necessity for which it is so desirable to diminish rather than to increase, there is no doubt that black-ash can be got containing a very much smaller proportion of cyanogen compounds than ordinary English black-ash contains at present; but that it can be obtained by these or any other means except Pechiney's as free from cyanogen compounds as Pechiney's process yields it, is quite another question. And even if this question could be answered in the affirmative, I fail to see that anything would be gained. Pechiney's process does *not* require specially "careful attention," but offers a simple means by which any ordinary black-ash man can regularly produce black-ash free from cyanogen compounds, and this without one farthing of extra cost. At first, some of the English manufacturers who experimented with it failed to get by it as much work through their furnaces as they had been in the habit of getting, and found, or thought they found, that the process required more limestone than Mr. Maçtear's licensees use. Now, however, the process is worked in England at a cost for limestone certainly not exceeding the cost of Mr. Maçtear's limestone and lime, while neither the work got through the furnaces nor the lixiviation of the product leave anything to be desired. A cheaper means of dealing with the problem of the cyanogen compounds in black-ash is thus not conceivable; a more effective means is certainly impossible; and I have no doubt that, when the present excitement with respect to this subject shall have subsided a little, many who are now engaged in searching for some better process will begin to ask themselves what better, simpler, or cheaper process there could conceivably be than one which, when a charge of sulphate of soda has been converted into black-ash containing cyanide of sodium, converts both that cyanide and more sulphate into more carbonate of soda, at less expense than would be required for the conversion of the "after-charge" of sulphate into carbonate by any other method at present known?—I am, &c.,

WALTER WELDON.

Rede Hall, Burstow, Surrey,  
September 10, 1878.

## THE TELEPHONE RELAY.

To the Editor of the Chemical News.

SIR,—In your issue of July 26th, 1878, I notice the claim of Mr. Edison, of New Jersey, to the invention of the Telephone Relay, described by Prof. Thomson and myself in your issue of June 21st, 1878.

Mr. Edison, in his note to your paper, claims that "The telephonic repeater, described by Messrs. Houston and Thomson, in your issue of June 21st, was invented by me over a year ago." Now, since the invention of Prof. Thomson and myself consists in the application of the microphone of Prof. Hughes to the articulating telephone of Prof. Bell, it would appear singular, in view of the recent announcement of Prof. Hughes's discovery, that we should have been anticipated a *whole year* by Mr. Edison. It would seem, therefore, that before Mr. Edison can substantiate his claim to one particular form of Telephone Relay, that he must make good his claim to priority of invention of the microphone, and this he has certainly not as yet succeeded in doing.

As to Mr. Edison's further remarks, that "One of the many forms devised by me was published in the *Journal of the Telegraph*, &c.," I would remark that, as far as I am aware, this is the *only form* of which we have any published accounts, and therefore the only one in which Mr. Edison can base his claims for priority of invention. Now, it would appear from a description of this instrument in the *Telegraphic Journal* of July 1st, 1877, that Mr. Edison calls his invention a Pressure Relay, and states that it is intended to be used in connection with his

Speaking Telegraph. So far as I can learn, this speaking telegraph is not an articulating Telephone, but a species of harmonic telegraph, in which vibratory pulses of electricity are employed, in a manner somewhat similar to the system devised by Gray. Nowhere in this article, or indeed elsewhere that I can find, does Mr. Edison claim that his invention can be applied to the relaying of the rapidly varying currents of the articulating telephone. It would appear to be only after the announcement of our invention that anything is heard of the possibility of using the Pressure Relay for this purpose.

Not only, then, has Mr. Edison failed to have anticipated us in the invention of the particular form of telephone Relay devised by us, but, it would appear that he has also failed to established his claim to the invention of any form of telephone relay.—I am, &c.

EDWIN J. HOUSTON.

Central High School, Philadelphia,  
Aug. 22, 1878.

### COMMERCIAL SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—As a practical commentary on the deliverance of "J. H." allow me to say that my firm (which is one of the largest makers in the country) turns out all its sulphate, by a mode of working of its own, in good merchantable condition, with only 24 per cent of ammonia.

If we produced it with the 24½ per cent average, which "J. H." seems to think the consumer has a right to, we would be losing at the present moment about £20 to £30 per week. That there are any manufacturers doing this who have *nous* enough to regulate their process and make a decent use of their laboratories I am inclined to doubt. As long as only 24 per cent is guaranteed and paid for, it is probable the consumer will look in vain for a richer article. Immediately, however, the brokers consent to pay for another half or three-quarters per cent (as it is certainly to their clients' interest in mere carriage saving to do) a sulphate of 24.5 or 24.75 per cent will be forthcoming.

I know from former actual working that 24.75 can be made with ease without either the prolonged draining or artificial drying of "J. H." A previous correspondence in your columns struck a distinct blow at the other (I mean the colour) superstition. It is to be hoped that a second ventilation of the subject may suffice to give it the *coup de grâce*. It would be ludicrous if it were not melancholy that in this year of grace, 1878, manufacturers of sulphate should have to rack their brains, not to improve the quality of their product, but for a means of keeping down its proportion of valuable constituent; besides having to employ a comparatively costly acid to enable them to produce a "good grey" manure!

IN A FOG.

### "MILLER'S CHEMISTRY."—PART II.

To the Editor of the Chemical News.

SIR,—Would you allow me space to correct a slight error which occurs in your kindly review of the new edition of "Miller's Chemistry," Part II., and also to offer a word of explanation? You say, "Strangely enough nothing is said of the liquefaction of hydrogen, nitrogen, and oxygen, by MM. Cailletet and Pictet." On p. 143 of the work, however, there is a footnote:—"Quite recently oxygen, hydrogen, and nitrogen have all been reduced to the liquid state. Oxygen was first liquefied by Pictet at -140° (-220° F.), under a pressure of 320 atmospheres. Almost immediately afterwards Cailletet announced that he had succeeded in liquefying nitrogen and hydrogen." And references to this are given in the Index under "Hydrogen," "Oxygen," and "Nitrogen." The ex-

planation is simple enough: the first few sheets of the work had already been struck off when Pictet's discovery of the liquefaction of oxygen was announced, and the sheet containing an account of the properties of nitrogen was ready for press: fortunately, however, there was time to insert the short footnote above alluded to.—I am, &c.,

CHARLES E. GROVES.

### MAGNETIC FIGURES.

To the Editor of the Chemical News.

SIR,—Since writing the note on this subject (CHEMICAL NEWS, vol. xxxviii., p. 20) I have been informed by Prof. Thompson that I was labouring under a misapprehension, and that he lays no claim to originality in the method of preparing the plates. I am also informed that these figures (which I have not yet seen) are original. Under these circumstances the remarks made in my note cease to have any meaning, and I therefore hasten to withdraw them.—I am, &c.,

ERNEST H. COOK.

Bristol, September 2, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 5, July 29, 1878.

New Communication on the Subject of the Notes on Alcoholic Fermentation found among the Papers of C. Bernard.—L. Pasteur.—The author complains that portions of these notes have been suppressed or even modified in the *Revue Scientifique*. He announces his intention of repeating the experiments of the late Claude Bernard.

Variations in the Intensity of Currents Transmitted through Imperfect Contacts, according to the Pressure Exercised upon them.—Th. du Moncel.—One of the most interesting manners of demonstrating the variations in the intensity of currents transmitted through imperfect contacts is to roll upon a glass tube a coil of copper wire (No. 16) deprived of any isolating covering, and adapting to the two ends of the tube two systems of screws with their threads arranged in such a manner that on turning and approaching each other they may compress the spiral longitudinally, and consequently effect a greater or less pressure of the turns against each other. When the pressure is very feeble the resistance of the wire of the helix is little inferior to what it would be if covered with silk, but it diminishes successively as the screws are tightened and the coils pressed against each other.

The Part Played by Coal-dust in Producing Explosions in Mines.—L. Simonin.—The author demands permission to make known certain facts which prove that it is in the majority of cases the heating of the coal-dust diffused in the galleries of the mines to which explosions are due. Referring to the catastrophe in the Jabin Mine at Saint Etienne (February 4, 1876) he states, on the authority of the manager, that the mine in question contains very little fire-damp, and that the precautions hitherto taken with an exclusive reference to that gas are not sufficient. Others must be taken against the extremely fine coal-dust, which at the moment of the explosion of slight amounts of fire-damp, or even of blasting powder, liberates rapidly a part of the coal-gas which it contains, and propagates the explosion, reproducing the cause

of the evil with so much the greater energy as the current of air is more violent. Thick crusts of coke (2 or 3 centimetres) prove this fact and explain how it is that extensive tracts in which fire-damp has never been observed are burnt like the rest of the workings. Hence, it appears that the precautions to be taken in fiery mines are complex whenever the coal-dust is rich in gas and very finely divided. Explosions may then ensue even in mines where fire-damp is unknown. There is no need to suggest the existence of cavities full of carbonic oxide, or of gaseous hydrocarbons, and suddenly laid open by a blow from the miner's pick. (Is not the attempt, recently made in some mines, to screen the coal below ground, a dangerous mistake as calculated to increase the quantity of dust diffused in the air of the mine?—*Ed. C. N.*)

**Non-existence of the Elongation of a Conductor Traversed by an Electric Current Independently of Calorific Action.**—R. Blondlot.—The author finds that the passage of a current in a metallic conductor produces no mechanical effect, either of lengthening or shortening.

**New Observations on Commercial Sub-nitrates of Bismuth.**—A. Carnot.—An examination of a recent paper by M. Riche.

**Thermic Formation of Phosphuretted and Arseniuretted Hydrogen.**—J. Ogier.—The heat of the formation of phosphuretted hydrogen from its elements,  $P + H_3$ , is +36.6 calories; that of solid hydrogen phosphide,  $P_2H$ , is +66.7 cal.; that of hydrogen arsenide,  $AsH_3$ , = -11.7 cal.

**Researches on Amylic Alcohol: Dextrogyratory Alcohol.**—J. A. Le Bel.—The rotatory power of commercial samples of amylic alcohol varies between  $-1^\circ$  and  $-2^\circ$  for 10 centimetres. The author has nevertheless found that on the distillation of low residual liquids, containing butylic and propylic alcohols boiling at  $108^\circ$  and at  $98^\circ$ , there is obtained as residue an amylic alcohol whose rotatory power is  $-3^\circ$  and even above. As these alcohols have the same source as ordinary amylic alcohol there is reason to admit that in the distillations of propylic and butylic alcohols the active amylic alcohol has been carried over in a larger proportion than its inactive isomer, whence it results that at a low temperature it must have a temperature much greater than the latter, and that the separation can be effected by distillation in a vacuum. By means of the action of moulds (*Penicillium*) the author has decomposed inactive amylic alcohol, and has obtained a mixture very rich in dextrogyratory alcohol.

**Identity of Inulines from Different Sources.**—MM. Lescœur and Morelle.—Contrary to the opinion of MM. Ferrouillat and Savigny the authors find the inulines obtained from elecampane, from the dahlia, and from chicory identical.

No. 6, August 5, 1878.

**On Roasting Plasters, and on the Manufacture of Plasters which Set Slowly.**—E. Landrin.—Plasters which have served once cannot be usefully roasted again, as it has been repeatedly proved. Gypsum heated to a temperature more and more elevated loses more and more its affinity for water, but retains the property of resuming its water of crystallisation. Plasters heated to redness and mixed with water in the ordinary manner no longer sets, but if, instead of being drenched with water, it is mixed with the smallest possible quantity of that liquid, say 33 per cent, it sets in ten or twelve hours, and becomes extremely hard. This fact, which has never before been observed, explains the action of the elevated temperature necessary for the manufacture of English cement.

**Abnormal Solubility of Certain Bodies in Soaps and Alkaline Resinates.**—A. Livache.—For some time substances have been met with in trade under the name of petroleum soaps, obtained by adding to the materials commonly employed in soap-making petroleum oils mixed with a certain proportion of Carnuba wax. If these products are submitted to a moderate heat all the petro-

leum present distils over and the soap remains unaltered. But if they are brought in contact with water they dissolve entirely, without separation either of the petroleum or of the Carnuba wax, even as an emulsion. Yet if we attempt to dissolve petroleum, either in soap at the moment when it forms a paste, or in soap-lye, we cannot succeed; petroleum is, *per se*, absolutely insoluble in that medium. It is therefore to the presence of Carnuba wax, added at the moment of the manufacture of these so-called petroleum soaps, that their singular solubility must be ascribed. Carnuba wax is a complex product; in contact with alkalis it becomes saponified, and yields as characteristic product melissic alcohol, which must be considered as the true cause of the phenomenon mentioned above. Petroleum and melissic alcohol mix in all proportions, and if the mixture is brought in contact with soap-lyes it dissolves at once. In like manner very small quantities of wood-spirit, amylic alcohol, &c., enable ordinary soaps to dissolve as much as 50 per cent of alcohol, the product obtained being entirely soluble in water.

**Action of Zinc Chloride upon Methylic Alcohol: Hexamethyl-benzin.**—MM. Le Bel and Greene.—The substance obtained by this reaction is identical with the hexamethyl-benzin of MM. Friedel and Crafts.

**Influence of Atmospheric Electricity upon Vegetation.**—L. Grandeau.—It has been long ago remarked that in the neighbourhood of an isolated tree deprived of branches to a great height vegetation develops feebly. In vines the shoots which extend under a tree rarely produce ripe grapes, though air and light circulate freely around them. Lofty trees bordering arable lands produce the same effects on the neighbouring crops. In forests of high growth the underwood has disappeared and the turf where it exists is formed by plants, which never acquire the luxuriant growth they do in the open country. These results are generally ascribed to deficient light, influence of green light which has traversed the leaves, spreading roots, &c. To these causes the author's experiments enable him to add absence of static electricity in the air in such situations.

Mr. Edison, by the intervention of M. du Moncel, presented to the Academy an apparatus which he has named microtasimeter, and which serves to measure infinitesimal degrees of temperature or of moisture.

Another apparatus presented by the same inventor is the electromotograph, which renders it possible to obtain, under the influence of an excessively small electric force and over circuits of very great length, mechanical effects without the intervention of any electro-magnetic organ.

MM. Chardin and Berjot presented to the Academy a new model of the microphone explorer applied to the detection of calculi in the bladder.

Moniteur Scientifique Quesneville.  
August, 1878.

**Means of Extracting and Recognising Morphia in cases of Poison.**—Prof. Selmi.—In the detection of morphia in the viscera, ether dissolves a little of this alkaloid if the alkaline liquid is left for twenty-four hours in contact with ether. If the viscera are recent, morphia may be detected with certainty. Chloroform in the cold does not dissolve the morphia contained in the viscera. This solvent may be employed to separate a part of the cadaveric alkaloids and some other impurities. A portion of the morphia present in the viscera is decomposed during the operation. Purification with basic lead acetate and sulphuretted hydrogen is useful for decolorising the aqueous extract, but the precipitate of lead sulphide may retain a portion of the dissolved alkaloids. An amylic solution of tartaric acid may serve to remove certain cadaveric alkaloids accompanying the morphia. In the putrid viscera the morphia is decomposed, and seems to be replaced by a derivative which possesses certain of its

reactions, but which is deprived of the most characteristic. The detection of a derivative of morphia ought not to be considered satisfactory proof that the viscera contain this base. Half a m.grm. of morphia, dissolved in 4 or 5 drops of sulphuric acid, yields, on the application of heat, a violet liquid. When cold this solution gives the following reactions:—If saturated with bicarbonate of soda, nothing; but on adding a drop of tincture of iodine, a green colour. With a drop of chlorine water the violet passes to a cherry-red, which becomes green on neutralising with bicarbonate of soda. With a drop of the solution of lead tetrachloride, a cherry-red colouration, more intense than that produced with chlorine water, and also turning green with bicarbonate of soda. With bromine water the violet becomes almost blood-red, which turns to an intense green on saturation with bicarbonate of soda. With iodic acid the violet is intensified. With nitric acid the cherry-red first produced becomes yellow, and on saturation with ammonia turns to a brown. Red prussiate gives a fine cherry-red colouration, as does also sulphate of binoxide of manganese if the solution is diluted.

**Chemical Industry at the Universal Exhibition of 1878 (continued).**—A. Kopp.—The author describes, at great length, the improvements effected in a variety of the heavier chemical manufactures. There is an account of the preparation of fuming sulphuric acid, which is made no longer at Nordhausen, but near Pilsen and Elbogen, in Bohemia, where M. Stark possesses twelve establishments, with 110 furnaces, which employ yearly 72,400 retorts, and furnish about 34,000 quintals of acid. The residue obtained from the distillation of copperas is now utilised as colcothar. M. Winckler prepares fuming sulphuric acid on another principle. Concentrated sulphuric acid is resolved by heat into sulphurous acid, oxygen, and water. The latter is condensed, and the two gases being brought in contact with a porous body, such as platinised asbestos, re-combine, forming sulphuric anhydride. The platinised asbestos only requires to be heated to redness at the outset, and the heat evolved by combination maintains it afterwards at the necessary temperature. Bisulphate of soda, ferric or zinc sulphates may also be heated in place of sulphuric acid. There is then no occasion to dry the gases evolved. A furnace with five retorts treats 1800 kilos. of oil of vitriol daily, giving 1000 kilos. of sulphuric anhydride, which, if dissolved in 1500 kilos. of acid, at 66° B., produces 2500 kilos. of a fuming acid containing 85 per cent of SO<sub>3</sub>. The section on chlorine and chloride of lime contains a discussion of the processes of Weldon and of Deacon, the latter of which is still characterised as practically unavailable, notwithstanding the ingenious attempts made by the author to overcome its besetting difficulties.

**Danger in the Use of Tempered Glass.**—M. J. Laurent.—A capsule of a medium size was in use in the laboratory of M. F. Fournier, at Marseilles, and was employed, along with porcelain capsules, in determining the moisture of fatty substances. After being in use for a month, it was one day heated to 110° over a gas-stove, and kept at that temperature till its contents ceased to bubble. When cool enough to be handled it was transferred to the pan of a balance; but on touching the metal it burst with explosive violence, and its contents were projected to a distance. The operator was fortunately on his guard, and escaped with some slight burns. The author asks what would have been the result if the capsule had contained an acid or a concentrated alkaline solution?

action of sodium-propionate upon a mixture of phthalic acid and propionic anhydride; of sodium acetate upon a mixture of phthalic anhydride and phenyl-acetic acid.

**The Solution-Heats of the Dithionates, the Nitrates, and the Sulphates.**—Julius Thomsen.—A series of tables.

**On Thialdehyds,**—H. Klinger. (See *Ber.*, x., p. 1877, and xi., p. 1893).—The determinations of the vapour-density of  $\beta$ -acethialdehyd have given the peculiar and unexpected result that it possesses the same molecular formula as the thialdehyd discovered by Weidenbusch, the density of which was determined by Hofmann as 6.27 (as compared with air).

**On Atmospheric Hydrogen Peroxide.**—Em. Schöne (Fifth Communication).—In the strata of the atmosphere accessible to investigation there appears a larger quantity of vaporous hydrogen peroxide the higher the sun rises above the horizon, both during the day and during the year, and the smaller obstructions the sun's rays encounter in their passage through the atmosphere. The author considers it very probable that the proportion of hydrogen peroxide in the atmosphere will generally increase as we approach the Equator.

**On a New Constituent of Coto Barks.**—Jul. Jobst and O. Hesse.—The compound in question is an acid, C<sub>8</sub>H<sub>6</sub>O<sub>4</sub>, and is identical with piperonylic acid.

**On Certain Derivatives of Dimethyl-hydroquinon.**—J. Habermann.—An examination of the chlorine-substitution products, of the bromine, and nitro-derivatives.

**On Certain Derivatives of Dimethyl-resorcin.**—M. Honig.—Also a notice of chlorine, bromine, and nitro-derivatives.

**On Substituted Benzaldehyds.**—C. Loring Jackson and J. Heming White.—An examination of parachlorbenzaldehyd, parabrombenzaldehyd, and paraiodbenzaldehyd. All these compounds, on treatment with sulphuretted hydrogen, form reddish white, varnish-like, thio-compounds.

**Reaction of Potassium Cyanide upon Dichloroacetic Ether.**—A. Claus.—The writer points out an error of Schiff's in the last issue of the *Berichte* (x., p. 810).

**On Azoxy-, Azo-, and Hydroazo-Compounds.**—H. Limpricht.—An examination of meta-azoxy-sulphobenzolic acid, of hydro-azo-sulphobenzolic acid,—a compound formed of treating the foregoing with stannous chloride,—of meta-azo-sulphobenzolic acid, and hydro-azo-sulphobenzolic acid.

**On Hexoylen from Mannite.**—Otto Hecht.—Hexoylen is a colourless, mobile liquid, of penetrating, unpleasant odour. It is optically inactive; has at 0° the sp. gr. 0.7494; does not congeal in a mixture of salt and snow, and boils between 80° and 83°. Its composition is expressed by the formula C<sub>6</sub>H<sub>10</sub>.

**Contributions to the Synthesis of Phenylated Fatty Acids.**—Max Conrad.—An account of the preparation and properties of benzyl-acetic-ester, methylbenzyl-acetic-ester, methylbenzyl-acetic acid, methylbenzyl-acetic-benzyl-ester, ethylbenzyl-acetic-ester, and benzyl-acetsuccinic-ester.

**On Isoxycuminic Acid from Carvacrol.**—Oscar Jacobsen.—An examination of sulphocuminic acid, isoxycuminic acid, and their salts.

**On a Bromated  $\alpha$ -Metaxylo-sulphonic Acid.**—E. Weinberg.—A dilute solution of  $\alpha$ -metaxylo-sulphonate of baryta was gradually mixed in the cold, with the corresponding quantity of bromine. The precipitate deposited was trifling, and the filtrate on evaporation yielded a bromated barium-salt—monobrom- $\alpha$ -meta-xylo-sulphonate of barium.

**On Bibrom-naphthoquinon and Bromonaphthalic Acid.**—Th. Diehl and V. Merz.—Chloronaphthalic acid has been employed as a colouring-matter, and was pre-

pared on the large scale according to a method derived from Laurent's process. The author has prepared the analogous compound, bromonaphthalic acid, and describes its reactions and certain of its salts.

On a Compound of Cobaltous Chloride with Aniline.—E. Lippmann and M. Vortmann.—A red salt which at 100° turns blue, and has then the composition—



Characteristics of the Two Nearer Derivatives of Milk-Sugar.—H. Fudakowski.—This memoir is not adapted for abstraction.

On Measures and Weights of Rock Crystal.—H. Buff.—The author contends that the charges brought against platinum are of no importance.

On Rosanilin.—E. and O. Fischer.—The authors infer that rosanilin is simply triamido-triphenyl-carbinol.

Ammoniacal Derivatives of Isatin.—E. von Sommaruga.—The substances obtained from isatin by the action of ammonia under pressure are a diamid of isatin distinct from Laurent's imesatin, and two bodies which he names oxydiimido-diamido-isatin and desoxyimido-isatin.

Action of Bromine on Pyromucic Acid.—P. Tönies.—The author has obtained and described pyromucic ether tetrabromide, pyromucic acid tetrabromide, and dibrom-pyromucic acid.

Remarks on M. Barth's Paper on Invertin.—E. Donath.—The author regrets that Barth has represented his results on this subject as differing so essentially from his own.

Chlorodinitro-cymol, Bromdinitro-cymol, and the so-called Solid Nitro-cymol.—E. v. Gerichten.—The author's dinitro-chlor-cymol is isomeric with Ladenburg's dinitro-chlor-cymol from dinitro-thymol.

On Aniline-Black.—R. Nietzki.—The author finds that if the acid is left out of regard, the formulæ for aniline-black—as proposed by Goppelsröder, Keyser, and himself—all correspond to the simplest expression  $C_6H_5N$ , thus confirming his view that aniline black is formed from aniline by the elimination of a molecule of hydrogen. The salts of aniline black lose a part of their acid either on washing with water or on drying strongly. The author dried the hydrochlorate at 100°, and obtained 11.6 to 11.8 per cent Cl. Goppelsröder dried at 110°, and obtained only 8.9. He had, on a former occasion, described a substance found present in aniline black, and characterised by dissolving in chloroform with a blue colour. This compound is readily formed by the oxidation of the salts of orthotoluydin. Its salts are green, but the free base is of a violet-blue, sparingly soluble in alcohol, but readily in chloroform and aniline. Its composition is  $C_7H_7N$ . Aniline black is formed by the action of almost all oxidising agents upon salts of aniline in an acid solution, the presence of metallic salts being by no means necessary. It is the representative of a whole series of similar bodies. The author then speaks of a product of the action of chromic acid upon aniline black, technically known as black that does not turn green. If the base of aniline black or one of its salts is treated with solution of potassic bichromate, a violet-black product is formed, which is no longer turned green by diluted acids. It shows much resemblance with the original base, but on friction assumes a yellowish metallic lustre. Goppelsröder ascribes to this compound an additional atom of oxygen. The author finds that it contains a considerable quantity of chromic acid, 8.17 per cent, whence he concludes that it is the chromate of the base aniline black.

Remark on Violacein and Eupitton.—C. Liebermann. The author, in reply to a passage from Grätzel, in Wagner's *Annals of Chemical Technology*, 1878, p. 940.\* dec ares that he has never pronounced violacein identical

with eupitton. The technical value of violacein he considers doubtful.

Certain New Compounds of Boron.—C. Counciler.—The author describes ethylen-mono-borate, iso-propyl-borate, the action of anhydrous boric acid upon secondary caprylic alcohol and boroxo-trichloride.

The Steric Law.—H. Schröder.—In a memoir laid before the Academy of Sciences at Munich, December 1, 1877, the author has established the "steric law" to this effect:—In every solid compound there predominates the volume-measure, *i.e.*, the stere of one of its elements, which, by means of the forces effective in crystallisation, determines all the other components and elements to adopt the same volume-measure, the same stere. With this law the way is opened for the determination of the volume-molecules of solid bodies. For this so many atoms of an element or of a compound must be taken, but not more than are necessary, in order that the volume of each element alone, or in combination, may be expressed as a whole multiple of the predominant stere. In other words, the solid molecule of each element contains only whole volumes or steres. Thus, *e.g.*, the solid molecule of zinc and zinc oxide =  $Zn_3$  and  $Zn_3O_3$ , because three atoms of zinc alone, and in the oxide, take up the space of five volume unities or steres, and the three atoms of oxygen 3 steres. The author indicates the number of atoms of each element in a compound, as customary with a whole number on the right hand and below, along with the symbol of the element, and the number of its steres with a whole number to the right hand above. He gives prominence to the stere by a line above the figures, and to the volume observed and calculated by a line below the figures. In a compound he indicates that element which determines the stere by a line above it. If the atomic weights are expressed in grammes, the steres and the volumes will be cubic centimetres. Thus metallic silver is  $\overline{Ag}_3^2 = 2 \times 5.14 = 10.28$ , observed vol. =  $\underline{10.28}$ , *i.e.*, an atom of silver, or 108 grms. occupy the space of 10.28 c.c., *i.e.*, twice 5.14 c.c. or two silver steres. Silver chloride, bromide, and iodide are—

$$\overline{Ag}_3^2 Cl_3^3 = 5 \times 5.14 = 25.70 \text{ observed } \underline{25.7}$$

$$\overline{Ag}_3^2 Br_4^4 = 6 \times 5.14 = 30.84$$

$$\overline{Ag}_3^2 I_6^6 = 8 \times 5.14 = 41.12$$

In all three compounds the silver stere predominates; they contain silver with 2 steres, its metallic volume; chlorine with 3, bromine with 4, and iodine with 6 silver steres.

Contributions to the Steric Laws.—H. Schröder.—The author applies his law to a number of compounds belonging to different groups.

## MISCELLANEOUS.

American Association for the Advancement of Science.—Dr. H. Carrington Bolton, the Permanent Secretary, kindly sent us from St. Louis the daily programme of the twenty-seventh meeting of the above Association, which commenced on August 21st last. The names of the President and Officers we gave in our issue of June 21st. The following is a list of the papers brought before the Chemical Section:—

*Ellen S. Richards and Alice M. Palmer*—Notes on Antimony Tannate.

*Prof. F. W. Clarke*—The Electrolytic Estimation of Mercury.

*Prof. F. W. Clarke*—Some New Seleno-cyanates.

*Prof. F. W. Clarke*—Some Specific Gravity Determinations and Conclusions from them.

*Prof. J. Lawrence Smith*—A Short Account of the Nature of Oxide of the New Element Mosandrum.

\* *Jahresbericht der Chemischen Technologie.*

**Prof. J. Lawrence Smith**—The New Meteoric Mineral Danbrulite, and its Frequent Occurrence in Nature in Meteoric Iron.

**B. S. Hedrick**—On the Development of Ozone in the Air by means of Sudden Changes of Temperature.

**A. P. S. Stuart**—Electricity an Agent in Vegetable Growth.

Among the papers read before the Physical Science Section we notice the following:—

**Prof. G. F. Barker**—On the Results of the Spectroscopic Observations of the Solar Eclipse of July 29, 1878.

**Prof. G. F. Barker**—A New Method of Determining the Pitch of the Tuning Fork.

**T. A. Edison**—A New Voltmeter.

**T. A. Edison**—On the Principle Involved in the Microphone and the Carbon Telephone.

**Ormond Stone**—On the Possibility of Observing the Solar Corona without the Aid of an Eclipse.

**B. S. Hedrick**—On the Development of Ozone in the Air by Means of Sudden Changes of Temperature.

**P. H. Van der Weyde**—On a Modified Form of Telephone Intended for a Sensitive Electroscop for the Detection of Feeble Currents.

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August, 1878.

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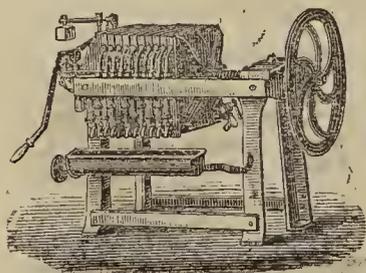
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Vol. XXXVIII. No. 982.

## ESTIMATION OF LEAD AS IODATE.\*

By CHARLES A. CAMERON, M.D.

THE author found that plumbic iodate was practically absolutely insoluble. Iodic acid and alkaline iodates precipitate lead far more perfectly than sulphuric acid, even when alcohol is added to the latter. The plumbic iodate formed is weighed, or, if a volumetrical inertia be desired, the following is the process:—Precipitate with standard solution of soluble iodate, and filter off the plumbic iodate. The filtrate and washings are to be mixed, and the excess of iodic acid contained in them estimated volumetrically by the hydrochloric acid and hyposulphate method. As it is almost impossible to procure pure iodic acid or potassium iodate, the solution of iodate must be standardised by means of a solution of pure nitrate of lead. Owing to the slight solubility of plumbic iodate in alkaline chlorides, iodides, and bromides none of these salts must be present. HCl rapidly dissolves iodate of lead.

## ON SULPHUR AND PHOSPHORUS IN IRON.

By SERGIUS KERN, M.E., St. Petersburg.

It is a well-known fact that sulphur and phosphorus are diffused very unequally in iron and also in steel. The author had an opportunity of analysing a piece of square iron (1" x 1") for sulphur and phosphorus, taking shearings from this bar in different places, which for this purpose was divided through its length into seven equal parts. The length of the bar was 44 inches. The following results of the analyses of these shearings may be of some interest:—

	Sulphur. Per cent.	Phosphorus. Per cent.
1. .. ..	0.041	0.031
2. .. ..	0.042	0.025
3. .. ..	0.060	0.045
4. .. ..	0.055	0.026
5. .. ..	0.059	0.034
6. .. ..	0.042	0.037
7. .. ..	0.036	0.025

The sulphur was estimated as barium sulphate, and the phosphorus by the method of Eggertz.

## GLUCOSE REACTION.

By DAVID LINDO.

IF the yellow crystalline compound obtained by the action of nitric acid on brucine (CHEMICAL NEWS, vol. xxxvii., p. 98) is dissolved in a solution of potash or soda, a fluid is obtained which glucose, owing to its action as a reducing agent, changes from yellow to intense blue.

To show this reaction, dissolve half a grain of the substance in one fluid ounce of liquor potassa, B.P. Place about 60 minims of the amber-coloured solution thus obtained in a moderate sized test-tube, heat to boiling, then add two or three drops of a dilute solution of grape-sugar.

\* Abstract of a paper read before the Society of Public Analysts' Dublin, September 19, 1878.

The colour of the fluid will change almost immediately to intense blue. Cane-sugar has little or no action on the test. This is a very beautiful reaction, and the method of obtaining it one of easy application. I had hoped to render it available as a means of testing for sugar in urine, but it appears of little value for this purpose, as the normal constituents in urine are not without action on the reagent. Every sample of urine tried was found to produce a change of colour more or less intense when heated with an equal volume of the test fluid prepared as above. The following method was then tried:—40 to 50 minims of the solution (half grain to the fluid ounce or liquor potassa) was placed in a test-tube  $4\frac{1}{2} \times \frac{1}{2}$  inch, heated to boiling, and two or three drops of the urine added. The tube was then slightly shaken, and held between the light and eye.

120 specimens of human urine, free from sugar and apparently otherwise healthy, examined in this way gave the following results:—

98	No notable change.
12	Decided darkening of the test fluid.
8	Decided change to green.
2	Decided change to blue.

120

But the urinometer showed the test to be of little practical value, even as regards negative results thus obtained with it, though the above figures might seem at first to indicate the contrary. The sp. gr. of those urines which produced no notable change was rarely as high as 1020, and ranged chiefly between 1012 to 1016. In urines of this moderate density it is known sugar is rarely found, and it is therefore seldom looked for. The sp. gr. of the urines which caused decided darkening or change of colour with the test, ranged between 1020 to 1030. Some of these were diluted with an equal volume of water, and two or three drops tested again as above, when in most cases no appreciable change of colour was observed. A few specimens that of themselves produced no change, were mixed with grape-sugar in various proportions, and two or three drops tested with the following results:—

$\frac{1}{2}$ gr. sugar to 1 fluid ounce of urine.—	Change to green, not intense.
1 gr. sugar to 1 fluid ounce of urine.—	Change to intense green.
* $2\frac{1}{2}$ grs. sugar to 1 fluid ounce of urine.—	Change to intense blue.

Ordinary diabetic urines containing from 5 to 10 per cent of sugar would therefore, even if diluted with 10 to 20 parts of water, give a very decided reaction with the test. As the method is one of easy and rapid application it may sometimes prove useful as a preliminary step in the examination of such urines. Reaction obtained with it, however decided, would require confirmation by other means.

No appreciable change of tint would indicate that sugar is absent, or, if present, that the quantity is less than a grain to the ounce of urine; but this result, as the above experiments have shown, will rarely be obtained with urines of high density, though sugar may be altogether absent. The results obtained in the following experiments may prove of some interest:—

1. Fresh healthy urine was mixed with 2 per cent of grape sugar; 2 drachms of the mixture placed in a small filter made of parchment paper, and dialysed into about 7 drs. of distilled water contained in a rather narrow 1 ounce beaker. The filter rested in the mouth of the beaker, and the external water was quite up to the rim. (Temp. 85° F.). At the end of an hour 30 minims of the external water heated with the same volume of test fluid changed it to intense green.

\* Two grains of sugar to an ounce of urine will generally be found sufficient to produce intense blue reaction.

2. Urine mixed with 4 per cent of sugar afforded a very decided blue reaction in an hour under the same treatment.
3. Urine entirely free from sugar, but which reacted rather strongly on the test when applied direct, was dialysed in the same way for twenty hours, but the external water at the end of that time failed to produce the slightest change of tint when heated with an equal volume of the test fluid. It had been tested at intervals during the process with the same result.

I believe no urine free from sugar would afford reaction under this treatment, but of course further experiments are required to confirm this. On the other hand, only such urines as contain notable quantities of sugar would furnish proof of its presence in one or two hours by the process, which for obvious reasons could not be greatly prolonged.

Falmouth, Jamaica, August 20, 1878.

NOTE.—The deep blue colour produced by the reagent is not very permanent at any temperature, and disappears rather quickly at or near the boiling-point of the fluid. It remains visible, however, quite long enough for all necessary purposes of observation. The test fluid is to be brought to the boil, but not kept boiling for any length of time before adding the fluid to be tested, nor is the mixture to be boiled again after the fluid that is being tested has been added.

#### ANALYSIS OF BEHAR OPIUM-ASH.

By C. J. H. WARDEN, Surgeon H.M.S. Bengal Staff,  
Off. Principal Assist. Opium Agent, Behar.

THE following is the result of an analysis of opium-ash, obtained by preserving the ashes of all samples of Behar opium analysed at the Government Opium Factory, Patna, for some years past.

Fe <sub>2</sub> O <sub>3</sub> .. .. .	1'9839
Al <sub>2</sub> O <sub>3</sub> .. .. .	traces
Mn <sub>3</sub> O <sub>4</sub> .. .. .	traces
CaO .. .. .	7'1344
MgO .. .. .	2'3104
K <sub>2</sub> O .. .. .	37'2405
Na <sub>2</sub> O .. .. .	1'7006
SO <sub>3</sub> .. .. .	23'1419
P <sub>2</sub> O <sub>5</sub> .. .. .	10'9021
CO <sub>2</sub> .. .. .	traces
Cl .. .. .	traces
SiO <sub>2</sub> and sand .. .. .	15'2740
	99'6878

The ash was of a very light grey colour, and contained 0'8575 per cent of charcoal, which was deducted before calculating its percentage composition. It yielded to boiling-water 58'4961 per cent of soluble salts. The aqueous solution gave marked indications of the presence of SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O.

The large amount of SO<sub>3</sub> present in the ash is noteworthy. The acid is usually considered to be in combination with potash and lime. According to Christison, sulphuric and meconic acids are the solvents of the active principles of opium. Bilty, in *Buchner's Repertorium*, xxxix., quoted by Christison in his "Dispensatory," gives 2 per cent as the amount of sulphate of potash contained in Turkey opium. Sulphuric acid is also a constituent of the poppy plant ash. Mr. John Scott, in his "Manual of Opium Husbandry," gives analyses of poppy plant ash, in which the SO<sub>3</sub> varies from 5'93 to 10'08 per cent. And Mr. Scott points out that the larger the amount of sul-

phuric acid in the plant, the smaller is the yield of morphia, thus—

SO <sub>3</sub> in Plant-ash.	Morphia in Opium.
5'93 per cent	8'66 per cent
7'64 " "	6'47 " "
10'08 " "	4'65 " "

It would be interesting to ascertain whether or not there is a similar correlation between the SO<sub>3</sub> in opium-ash and the amount of morphia contained in the drug. Possibly the SO<sub>3</sub> in opium may be directly proportional to its richness in morphia.

The iron present in opium-ash is doubtless introduced by the abrasion of the iron instruments used for scarifying the poppy capsules, and for collecting the exuded juice.

Patna, September 20, 1878.

#### ON THE EXTRACTION OF IODINE AND BROMINE FROM KELP.\*

By ROBERT GALLOWAY, F.C.S.,

Professor of Chemistry in the Royal College of Science for Ireland.

HAVING had, some time ago, facilities for becoming completely acquainted with the manufacturing processes followed for the extraction of iodine, bromine, and the potash salts from kelp, I devoted a considerable portion of time to the study of this branch of manufacturing industry. It is one of the manufactures which ought to flourish in Ireland, owing to the large quantity of the raw material (sea-weed) which can be obtained in this country. I am sorry to have to state that there is now no kelp factory in Ireland; the only buyers of Irish kelp at the present time are the Scotch manufacturers.

The description in works on Chemistry of the processes followed for the extraction of the kelp products are very meagre in a manufacturing point of view, especially as regards the extraction of the two most valuable substances, iodine and bromine, and these two substances are the most difficult to extract with manufacturing success. The descriptions state that such and such processes are followed; but important details are altogether omitted, as, for instance, the conditions most suitable for carrying out the processes successfully, and the different precautions which ought to be observed.

Iodine was at one time a monopoly. The iodine manufacturers combined together not to sell this substance under a certain price; which, like all other monopolies, had the effect of impeding rather than of promoting improvement in this branch of manufacture. The monopoly exists, I believe, no longer: new sources of supply of the substances I have termed kelp products—iodine from the mother-liquors obtained in refining the nitrate of soda in Peru, bromine and potassic chloride from the salt beds in Prussia—have not only extinguished it, but have also rendered necessary the adoption of superior and more economical methods in the extraction of these substances from kelp, for the continuance of kelp being employed as a raw material.

Many methods have been proposed for the extraction of the two metalloids, iodine and bromine, from the ash of sea-weed; but the only one, as far as I am aware, which has been followed in the United Kingdom, at least up to a very recent period, is the one ascribed to Wollaston. By this method they are set free from the metals with which they are combined by the addition of sulphuric acid and manganese peroxide to the mother-liquor which remains after the extraction (of course as far as it is practicable) of potassic sulphate and chloride, and what are termed the kelp salts, which are a mixture of sodic sulphate, carbonate, and chloride.

\* A Paper read before the Royal Irish Academy, April 8, 1878.

The sulphuric acid is added for a twofold purpose: a portion is required for the decomposition of the alkaline sulphides, sulphites, and hyposulphites, present in the mother-liquor; the other portion, along with the manganese oxide, liberates the iodine and bromine from their combinations. When the sulphur which is set free from the decomposition of the hyposulphites has completely deposited, the clear liquid is drawn off into the iodine still, and the manganese peroxide is then added to it.

When this process first came into operation, bromine had not been discovered in the ash of sea-weed; even the late Dr. Anderson, in his well-known and often quoted analyses of the ash of sea-weed, does not give it as a constituent. New analytical investigations of the ash of the various sea plants are wanted; the plants ought to be carefully freed, before incineration, from all adhering salt water, so that the quantities of chlorine, bromine, and iodine they naturally contain might be correctly ascertained. The investigation would lead, most probably, to the discovery that there are, properly speaking, *bromine* as well as iodine producing plants.

The three metalloids are each liberated from their metallic combinations by the manganese peroxide and sulphuric acid, but owing to their different degrees of affinity for metals—chlorine having the strongest, and iodine the weakest affinity—the latter is the first set free; but it requires the greatest care and attention to prevent some portion of the other two from being set free at the same time. If this occurs, they enter into union with one another, forming volatile compounds which affect the eyes, and have a very pungent odour. The liberation of the bromine or chlorine, or both, during the extraction of the iodine may occur, for instance, from the manganese oxide becoming unequally diffused in the liquid; they will also be liberated if the temperature of the liquid becomes too high; and it appears to me highly probable that the influence of *mass* will also cause their liberation, especially when the quantity of iodine becomes, by volatilisation, much decreased in quantity. That they are liberated to some extent during the distillation of the iodine is at once perceived by those who visit the still during the distillation, and who are acquainted with the properties of these compounds. I may here observe that the stillman judges whether at least an undue proportion of the other two are volatilising by the colour of the vapour; if it is of a brownish or whitish colour he is aware he is losing iodine. When the distillation is finished, and the still head removed, the vapour which escapes from the still has always a violet colour, and some iodine always remains in the liquid; for if the distillation were continued until all the iodine had volatilised, there would be evolved along with it in the last stages one or both of the other metalloids in somewhat large proportions; and consequently there would be a loss instead of a gain in iodine. These are some of the imperfections and difficulties of Wollaston's process.

The extraction of bromine follows the extraction of iodine, the same process being adopted, and similar precautions have to be observed.

It is evident such a process is unsuitable for the extraction of valuable substances like iodine and bromine, and it may also be observed that the liquid from which they have been volatilised has to be thrown away, on account of the difficulty of utilising it, although it contains a large quantity of potash salts and all the sulphuric acid employed in the extraction; the money value of which is estimated to be nearly one-half of the whole cost for extracting all the products from the kelp.

Chlorine is the agent, out of the many proposed as substitutes for the manganese oxide and sulphuric acid, which I would recommend, but under conditions somewhat different from those I have seen described; this difference in the conditions would render the process more exact, and better results in every respect would be obtained. The kelp solution I would render neutral by the addition of sulphuric acid before adding an aqueous

solution of chlorine; and as I have found by investigation that the kelp solution contains clay, and as this substance tends to render the solution viscid and unfavourable for crystallisation, I would, before evaporating to obtain the last crop of potassic chloride, nearly neutralise the liquid so as to get rid of it. Although a little more acid would be consumed than if it were all added in the ulterior stage, the disadvantage would be more than compensated by the larger crop of crystals of potassic chloride which would be obtained and the greater concentration of the liquid. After the extraction of the last crop of potassic chloride, I would neutralise the liquid exactly, and then place it in a graduated vessel; I would then add to a small measured portion of it some bisulphide of carbon, and finally some chlorine water from a graduated vessel, until the violet colour just disappeared. This is a process frequently employed for the estimation of iodine, and occupies only a minute or two. Having ascertained the exact quantity of chlorine water which decolourises the iodine—that is, converts it into pentachloride of iodine—it would only remain to add to the larger measured quantity of the liquid containing the iodine one-sixth of the relative quantity of the chlorine water which was required on the smaller scale. The small portion of iodine which would remain dissolved in the liquid, owing to its slight solubility in water, I would remove either by bisulphide of carbon or benzol. After the removal of the iodine, I would treat the liquid with chlorine water, with similar precautions for the removal of the bromine; but as the compound of chlorine and bromine is a monochloride, one-half, and not one-sixth, as in the case of the iodine, of the relative quantity of chlorine water would have to be added to the larger measured portion of the liquid.

If, in any case, it should be found desirable not to precipitate the entire portion of the iodine and bromine with chlorine water, on account of rendering the liquid too dilute, a portion might first be precipitated by chlorine gas, and the remainder by means of chlorine water in the way I have described.

This method would not only be speedy, but exact, for it would be the conversion of a quantitative analytical operation into a manufacturing process. After the removal of the bromine, the alkaline salts which remained in solution could be easily recovered.

It would be necessary to sublime the precipitated iodine.

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#### ON THE DETERMINATION OF SULPHUR IN COKE.

By W. A. BRADBURY.

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THE sulphur in coke is usually determined, either by boiling with nitric acid and potassic nitrate or by fusing with potassic nitrate, sodic carbonate, and salt.

I was induced to go into the following experiments by the fact that boiling nitric acid and aqua regia and potassic chlorate gave results considerably below those obtained by fusion.

Percy (*Fuel*, p. 274) says, "Sulphur is always present in coal. It may exist in the state of sulphuric acid in combination with a base; in combination with iron as iron pyrites or bisulphide of iron; and doubtless also in combination with the organic elements of coal, as it exists, for example in hair. It chiefly occurs in the state of iron pyrites, from which no coal is entirely free. In the sequel (p. 344) analytical evidence will be given in support of the above statement, that sulphur is present in some varieties of coal in what may be designated a state of organic combination, but what the definite compound may be which contains it is unknown." Turning to page 344 we find the following:—

## Coal from New Zealand.

Carbon .. .. .	79.00
Hydrogen .. .. .	5.35
Oxygen .. .. .	7.71
Nitrogen .. .. .	0.89
Sulphur .. .. .	2.50
Ash .. .. .	3.50
Water .. .. .	1.05
100.00	

From the west coast of Middle Island. This coal is black, firm, and uneven in fracture. Colour of the ash, remarkably white. Coke contains 2.35 per cent of sulphur. No sulphuric acid was detected in the hydrochloric acid, in which the powder of the coke had been boiled. It would appear that the sulphur was present in the same state of combination in the coal as that in which it exists in albumen, fibrin, &c.; for it could not have been combined with iron, as in that case the ash would have had a decided red colour." On p. 326 he also gives a table of South Staffordshire coals, as below:—

Carbon.	Hydrogen.	Oxygen and Nitrogen.	Sulphur.	Sulphur to form Pyrites with Iron.	Total Sulphur in Coal.
76.12	4.83	16.10	0.63	0.37	1.00
77.01	4.71	16.35	0.60	0.14	0.74
76.40	4.62	17.23	0.52	0.34	0.55
72.13	4.32	16.88	—	1.08	0.54

From this it will be seen that there may be considerably more sulphur existing in organic combination (?) than in the form of pyrites. The same thing is shown in the following analyses of Dowlais coals and ashes, taken from pages 325 and 352 Percy's "Fuel." The C, H, O, N are omitted.

## Coals.

Sulphur .. .. .	0.55	1.01	1.07	1.22
Ash .. .. .	1.20	2.00	3.32	7.18

## Ashes.

Silica .. .. .	35.73	24.18	37.61	39.64
Alumina .. .. .	41.11	20.82	38.48	39.20
Ferric oxide .. .. .	11.15	26.00	14.78	11.84
Lime .. .. .	2.75	9.38	2.53	1.81
Magnesia .. .. .	2.65	9.74	2.71	2.58
Sulphuric acid .. .. .	4.45	8.37	0.29	—
Phosphoric acid .. .. .	0.99	0.21	2.00	trace
Ferrous sulphide .. .. .	—	0.38	—	—

Calculating the ash into its constituents the coals then become—

	I.	II.	III.	IV.
Sulphur .. .. .	0.550	1.010	1.070	1.220
Silica .. .. .	0.434	0.484	1.269	2.902
Alumina .. .. .	0.499	0.421	1.298	2.889
Ferric oxide .. .. .	0.135	0.417	0.498	0.858
Lime .. .. .	0.033	0.188	0.085	0.132
Magnesia .. .. .	0.032	0.196	0.091	0.179
Sulphuric acid .. .. .	0.052	0.169	0.009	trace
Phosphoric acid .. .. .	0.012	0.004	0.006	0.220

Calculating the iron to pyrites and the lime to sulphate we have—

No.	As Pyrites.	As Sulphate.	Calculated Total Sulphur.	Sulphur in Coal.
I. .. .	0.104	0.020	0.124	0.55
II. .. .	0.334	0.114	0.448	1.01
III. .. .	0.389	0.049	0.438	1.07
IV. .. .	0.686	0.075	0.761	1.22

The following is an extract from a paper read before the Chemical Society, June 7, 1877, by J. W. Thomas, "On the Gases enclosed in Lignite Coal and Mineral Resin of Bovey Neathfield." "Four samples were examined, two of which contained much hydrated oxide of iron in the cleavages. The gases consisted of carbonic

TABLE I.

No.	Weight taken. Grms.	Sulphur. Per cent.	Remarks.
1.	3.0000	0.204	Boiled with aqua regia and potassic chlorate.
2.	1.0000	0.212	Ditto Ditto
3.	1.3734	0.210	Ditto Ditto
4.	1.0000	0.233	Boiled with nitric acid and potassic chlorate.
5.	1.3734	0.205	Ditto Ditto
6.	2.7468	0.340	Boiled with aqua regia and potassic chlorate.
7.	2.7468	0.334	Boiled twice with aqua regia and chlorate.
8.	2.0000	0.395	Boiled with potassic nitrate and nitric acid.
9.	1.5000	1.162	Fusion.

Method.—The finely divided coke was boiled with the acid, evaporated to complete dryness, taken up with hydrochloric acid, filtered, and the sulphate precipitated with barium chloride. The numbers connected by a bracket are the same coke.

TABLE II.

Name of Coke.	Marley Hill.	Throckley.	Consett.	Hamsterley.	Coanwood.
	P. c.	P. c.	P. c.	P. c.	P. c.
Sulph. evolved as H <sub>2</sub> S	0.114	0.063	trace	0.084	0.013
Do. as sulphate ..	0.018	nil	trace	trace	trace
Do. dissolved by aqua regia and KClO <sub>3</sub> ..	0.263	0.261	0.119	0.290	0.186
Total sulphur by acid	0.395	0.324	0.119	0.374	0.199
Sulphur by fusion ..	1.163	0.976	0.577	0.814	0.887
Difference between fusion and acid ..	0.768	0.652	0.458	0.440	0.688
Ash .. .. .	7.930	7.220	6.910	7.280	9.000
Iron in ash .. .. .	1.162	1.956	1.071	0.994	1.127
Iron dissolved by dilute HCl .. .. .	1.306	1.880	1.283	1.166	1.703

Method.—The finely powdered coke was boiled with dilute hydrochloric acid and the H<sub>2</sub>S absorbed by means of ammoniacal solution of silver. The contents of the flasks were filtered, and filtrate tested for sulphate with barium chloride. The residual coke was then boiled with aqua regia and potassic chlorate. The total sulphur by acid is the sum of the three products.

acid, carbonic oxide, nitrogen, sulphuretted hydrogen. In one case sulphur was sublimed off in yellow crystals; organo-sulphur compounds, mercaptan, sulphide of allyl, &c., were also found in the gases. It seems probable that the iron pyrites of true coal have derived their sulphur from that existing in organic combination in the plants from which coal is produced."

From these examples I think that it will be allowed that a large amount of sulphur in coal may exist in organic combination.

The sulphur in coke is generally supposed to exist as sulphide of iron; but I think that from Table II. it will be seen that the sulphur can exist in another state of combination. It will be noticed that only small quantities of sulphuretted hydrogen is evolved on treating with dilute hydrochloric acid; also that all the iron in the coke is dissolved out by dilute acid, thus proving the absence of both protosulphide and bisulphide of iron. Only a trace of sulphur as sulphate exists in them. It would therefore appear to be in organic combination.

It will also be noticed that the amount dissolved out by acids is considerably lower than that obtained by fusion. That the same result is not always obtained when using the acid process is shown by Crossley (Crookes's

"Select Methods in Analysis"), who draws attention to the fact that boiling nitric acid gives results considerably below those obtained by fusion. He came to the conclusion that it was not that some of the sulphur was not oxidised, but that it was lost by volatilisation on evaporating to dryness. By adding a little nitre to the solution before evaporating to dryness to fix the sulphuric acid formed, he obtained results as accurate as those obtained by fusion. Table I. shows that Crossley's conclusion does not hold for all cokes, as by using different weights of coke and different amounts of acid, the same result can be obtained for the same coke, although that result is far below its real value. On fusing the residual coke after treating with acid, an amount of sulphur equal to that required to make up the amount equal to that obtained by fusion is obtained, thus showing that the acid has not oxidised all the sulphur existing in the coke.

## NOTICES OF BOOKS.

*Original Research.* The Governing Principles of the Elements; explaining and supplementing Dr. Dalton's Doctrine of Definite, Reciprocal, and Multiple Proportions, and the Substitution, Hydrogen-replacement, and Compound Radical Theories of Modern Chemistry. By HERBERT MASSON. Part I. London: H. Masson, 11, Bedford Street, W.C.

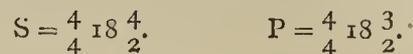
THE somewhat mysterious announcements which lately appeared in our advertising columns were intended to herald to the scientific world the *magnum opus* the first part of which is now before us. The key to the Universe, the grand *arcanum* which shall for ever disperse the clouds of ignorance from the fields of Science, is here offered us in imposing form and in language which rises in magniloquence until it even bursts into exceedingly blank verse.

The preface is much in the style of the advertisement, and must have given the author considerable pleasure. It points out that "Dr. Dalton, in enunciating his theories, could not explain the secret and hidden governing principles which *compel* atomic matter, when placed under the necessary conditions, to combine in definite proportions by weight, or in a certain ratio of multiple proportions." This task has been reserved, it appears, for Mr. Masson, and his preface concludes with the satisfactory announcement that "the chemist will instantly recognise the true explanation of the phenomena so familiar to him, and at once perceive that the problem of chemical combination is solved.

Fired with the hopes thus excited we turned to the body of the work, and read it again and again, each time with a more profound sense of bewilderment, until it seemed as a kind of scientific nightmare. For in spite of type of all sizes, and repeated assurances that everything was being explained, the style proved to be so obscure, the grammar so terrible, and the author's notions—when by chance we grasped them—so crude and foggy, that anything like real comprehension appeared impossible. If, therefore, we attempt to give some kind of sketch of the contents of the work, it is with the frank admission that we do not fully understand it.

The starting-point is the assumption—rather a cool one—that "all the separate atoms of the simple elements are condensations of hydrogen units which, in their aggregation, have left out of equilibrium with the rest of the atom either one, two, three, four, five, six, or seven constituent units, each of which are [*sic*] of the value of one free hydrogen unit." Of these constituent units some, which form the *nucleus*, stand in equilibrium in the centre; the others are placed unsymmetrically to the right and left. The number of units on the right is less than on the left, the deficiency indicating the quantiva

lence of the atom. Thus with sulphur and phosphorus the atoms are represented as follows:



It is, of course, easy to manipulate the atomic weights in this way, and thereby to indicate the quantivalence of the elements. All depends on the quantity you leave as nucleus. Molecules are formed, first, by the addition of other atoms (called *subordinates*) or radicals to the right, or by their addition to the left of the atom, in which latter case the combining value of the right is assumed to be diminished in like proportion. When the number of units on the right is raised to equality with those on the left, the *ruling number*, which cannot be exceeded, is reached.

Armed with atomic formulæ such as these, so easily—and it appears to us so gratuitously—constructed, the author proceeds to employ them in the representation of inorganic and organic compounds. Elaborate tables of compounds are given in which many refinements of the general system are introduced, but into the details of these we cannot enter. We fail to see that the author really explains anything. We do not know what he means by equilibrium among the constituent units, or what is the "fundamental principle" of which he writes, and are consequently quite unable to endorse the remarkable passage with which his first section ends. We give it in Mr. Masson's own words—and grammar:—

"The reader, after going through the sulphur compounds, will know the *reason*, the *why*, these combinations are formed; will have seen the cause, and the sufficiency of that cause to produce the effects; and the single letter S will represent to his mind not only the atomic weight and the equivalence of the element, but also the governing principles which subjects its own subordinates, and rules its relations with other compounds."—P. 13.

The finest thing in the book, because the most amusing, is the poem entitled "Carbon in its Organic Relations." Carbon speaks first, exhorting the chemist to search, and boasting in language which is possibly pure carbonese of his triumphs in Nature:—

"Neath summer skies  
My nest lies hid amongst the flowers, where a  
Thousand beauteous forms and tints of colour  
Grace and adorn my floral fairy-home."

But the Chemist is promptly down upon him, and "shuts him up" with the following pithy stanzas, which almost make one sorry for the unfortunate element:—

"Not thus shall be my search proud element;  
But I will take one of thy wondrous forms,  
One of thy grandest structures, and by the  
Potent agency of Heat I will command  
Thy subordinates to fly from thee.

"What art thou now? Poor Element! Black as  
The shades of Night; the slightest touch will crush  
Thee into powder, a mass devoid of  
Colour, form, or beauty.—Disclose thyself."

After which terrible allusion to destructive distillation the poet returns quietly to symbols.

*The Retrospect of Medicine, &c.* Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. Vol. lxxvii., January and June, 1878. London: Simpkin, Marshall, and Co.

THERE is but little to interest the chemist in the latest issue of Braithwaite's "Retrospect of Medicine," showing that even in this enlightened age the number of medical men that look upon chemistry as one of the most valuable handmaidens to the art of healing is still very small, although it must be acknowledged that they are slowly increasing. The extended use of amyl nitrite and iodoform, the introduction of thymol as a substitute for carbolic acid as an antiseptic in the Listerian system of treating wounds, and as a topical remedy in certain skin

diseases, and of chrysophanic acid in psoriasis are about the only items relating to chemical science occurring in the volume. This strange neglect of chemistry on the part of medical men will undoubtedly continue while the present cramming system remains in fashion.

*The Transactions of the American Medical Association.*  
Vol. xxviii. Philadelphia. 1877.

WE should not have noticed this work at all if it did not fully confirm what we have already so repeatedly said touching the singular apathy with which the medical men of the present day seem to regard chemico-physiological studies. We had thought that in practical America at least—which has already endowed the world with so many valuable vegetable remedies—some one of her thousands of heavily diplomaed sons would have tried at least to have added one more chemical remedy to our very meagre list. Throughout the whole of the 700 pages of this report there is not the vaguest allusion to any such research, past, present, or future. *Materia Medica*, too, seems almost entirely neglected, the only notice of this branch of medical science being a few lines devoted to salicylic and salicylic acid as remedies for rheumatism, and strychnia, woorara, and zanthium (*sic*) spinosum in rabies, and gelsemium in neuralgia.

It may interest some of our readers to know that the Association is using every possible effort to procure the passing of the Morrison Bill now before Congress, which will have the effect of abolishing the heavy prohibition duty on foreign quinine, thus entitling them to the thanks of their fever-stricken fellow-countrymen of the West, and to the gratitude of the manufacturers of that precious alkaloid in Europe.

*Domestic Medicine and Hygiene.* Being a Short Account of the More Common Diseases, their Causes and Treatment. Written in plain language, by WILLIAM J. RUSSELL, M.B. London: W. H. Everitt, 34, Bouverie Street. 1878.

MANUALS of domestic medicine may be divided into two classes—those written by medical men, which are in most cases rendered unintelligible to the ordinary reader by the constant occurrence of scientific terms whose meaning is known only to the initiated; and those written by ordinary compilers, which are always more or less erroneous and very often dangerous. Dr. Russell's little manual steers clear of both these evils, and gives a clear and concise account of most of the diseases that affect the human subject, and the remedies to be applied, in plain straightforward language, which even the poorly educated will not fail to understand.

This little book, which literally teems with information in spite of its size, was primarily intended as a companion to the medicine-chest containing Thevenot's globules (of which a notice has already appeared in the CHEMICAL NEWS), but it may be used with equal advantage by those who have not the good fortune to be acquainted with these convenient medicaments.

The information conveyed is excellently arranged. The Introduction gives a short account of the nature and properties of different foods and drinks; the hygienic effects of exercise, bathing, sleep, clothing, &c.; and some very salutary warnings on the use of purgatives, so-called soothing medicines, and popular nostrums, as well as some useful hints about the evils of prescribing for one's friends.

The first part treats of general diseases, such as fevers, small-pox, measles, diphtheria, constitutional ailments, such as rheumatism, cancer, scurvy, dropsy, &c. The author then passes on to local diseases, such as water on the brain, sunstroke, paralysis, affections of the eye, ear, skin, heart, lungs, stomach, and so on. The third part, which begins at Chapter IX., gives an account of the

diseases and management of children in a very sensible manner, while the next chapter is devoted to the last scene of all—second childhood. Chapter XI., treating of local injuries and emergencies, is much too short for a popular manual of the kind; for instance, nothing is said about the treatment of cuts and wounds which have become inflamed from neglect. The chapter on poisons and their effects is copious and precise; and the last chapter, on *Materia Medica*, deserves similar praise.

We are sorry to say that the Index is particularly meagre, barely four pages being given to the contents of over four hundred. This is a defect, however, which is to some extent compensated for by the admirable arrangement of the subject-matter.

Emigrants, travellers, and wanderers generally, Lady Bountifuls, and country clergymen will find Dr. Russell's little book an invaluable guide, more especially if they supply themselves with a small stock of Thevenot's globules.

*Design and Work: a Mechanic's Journal for Workmen of all Trades.* Vol. IV., Vol. I. New Series. London: G. Purkess. 1878.

IN many respects this is an excellent journal, and is a very gratifying proof that the English workman is making steady progress in science. Primarily it is a technological journal, and treats of almost every known handicraft, from organ building to electro-plating and paper-collar making. The articles on technological subjects are numerous, and seem for the most part to be written by practical men, but some of them want editing most woefully. It is a singular fact that whenever a thoroughly practical man gets a pen into his hand he at once becomes the most unpractical of human beings, and instead of using the common everyday phraseology that he would use in instructing his apprentice, he bursts out into a torrent of what he imagines to be fine writing, and talks about the "functions of the carpenter," "the manipulation of timber," and other similar expressions. To such writers we would recommend an attentive study of the valuable articles called "The Mechanic in the Workshop," by "Practical Mechanic," who seems to be as much at home with his pen as he certainly is with his file and chipping chisel.

In addition to the articles on technological subjects we have a large amount of excellent information on the scientific discoveries of the day, the telephone, microphone, and phonograph of course receiving the lion's share of attention. There are also serial articles on chemistry and physics, but the less said about them the better. The intentions of the authors are no doubt excellent, and as a rule are fairly carried out, but the workman wants to know why iron rusts red in water and black in the fire; why one oil will dry and another will not; why he "kills" his spirits of salt with zinc before using it as a solder, and a hundred other simple items of information, without having his brain addled with mathematical formulæ, thick and thin symbols, bonds, and graphic formulæ.

The Notes and Queries department, with their corresponding answers, form a valuable feature; but would not its usefulness be greatly increased if some kind of supervision were exercised over certain long-winded writers? The journal is copiously illustrated with woodcuts, but many of them are far from being worthy of the text they illustrate.

These critical remarks are made in the most friendly spirit, and we heartily congratulate our fellow editor in having reached his fourth volume.

*Seaside Water: an Examination into the Character of the Water-Supply at the Watering Places of England and Wales.* By G. W. WIGNER, F.C.S. London: Kent and Co.

MRS. GRUNDY has decreed that all who are able to go out of town in the summer shall make their way to some

seaside locality. Inland places, such as Keswick, Ambleside, Dolgelly, Castleton, Lyndhurst, or Edwinstowe—however teeming with objects of interest and beauty—are neglected, while such dreariness as Blackpool and Southport, Harwich and Clacton—where there is not the remotest approximation to pleasant scenery, count their visitors by thousands. Such being the case, Mr. Wigner has not done ill to investigate whether those who leave their homes in the real or pretended pursuit of health may not run the risk of imbibing the germs of disease. We might think that as soon as a town or village sets up for a watering place its local authorities would make it one of their first duties to secure proper sanitary arrangements. The water-supply of a health resort ought to be, like Cæsar's wife, above suspicion. But the result of Mr. Wigner's investigations shows that such expectations are not as yet fulfilled. It is sad to think of invalids having to drink water of "a dirty yellow-green" colour, in which "the microscope shows not only living organisms of various kinds in abundance, but pieces of skin and muscular fibre, and an excessive proportion of organic remains of all kinds." We read of other samples "full of bacteria," having "an unquestionable smell and taste of sulphuretted hydrogen and excreta," giving off when warmed "a distinct smell of urine," &c. It is, indeed, perfectly true that in many rural districts of England—we might instance central Suffolk—waters fully as bad as any that figure in Mr. Wigner's report form the sole available supply of a population who are far from showing any excessive mortality. But there is an important distinction to which Mr. Wigner refers, but which deserves to be brought into more decided prominence. The population of such villages has been habituated for generations to the use of waters which have gradually become more and more polluted. Those persons easily affected by such influences have been killed off, and thus by a process of natural selection a race has been formed who can drink diluted sewage with impunity. But in a watering place the conditions are totally different. We have here a population consisting largely of strangers perhaps, accustomed to drink the comparatively pure waters supplied to London, Manchester, Leeds, or Glasgow. Such persons, suddenly compelled to drink polluted waters, can scarcely fail to be injuriously affected.

We trust that in all such places the local authorities will take to heart the lessons conveyed in Mr. Wigner's pamphlet, and bestir themselves at once to procure a satisfactory supply of the "first necessary of life."

*Holmes's Botanical Note-Book: a Practical Guide to a Knowledge of Botany.* By E. M. HOLMES, F.L.S., Curator of the Museum of the Pharmaceutical Society of Great Britain; late lecturer on Botany at Westminster Hospital. London: Christey and Co. 1878.

THIS is a handy volume for the use of medical and pharmaceutical students who wish to gain something more than a mere book knowledge of botany. The bulk of the volume consists of sixty schedules containing the principal characters of each plant to be filled up by the student from actual observation, thus ensuring an intimate knowledge of each specimen. It also contains a variety of information with respect to the collection and examination of plants, and two charts, one showing the natural orders of flowering plants in general, the characters of all the orders indigenous to Britain. There is also a list of the plants most easily obtainable during each month of the year, so that the student may keep himself busy from January to December. As an efficient antidote to the cramming system as applied to botany we cordially recommend Mr. Holmes's little work. The student who has filled up the sixty schedules of this book from actual observation will know ten times as much botany as if he had studied the whole of the numerous manuals on that subject and had learned their definitions and descriptions by heart.

*Zeitschrift für das Chemische Grossgewerbe. Kurzer Bericht über die Fortschritte der Chemischen Grossindustrie.* In Vierteljahresheften.\* II. Jahrgang. By JUL. POST. Berlin: R. Oppenheim.

WE have here a most useful compendium of discoveries, inventions, and improvements connected with chemical manufactures, compiled with that patience and thoroughness which are so characteristic of German science. The subjects treated of are trade politics, trade hygiene, factory legislation, &c.; literature, plant, and machinery relating to the chemical arts; purification of water; fuel, and the production of heat; utilisation of wood-tar; paraffin and petroleum; coal-gas, utilisation of gas-liquor; sulphur, acids, alkalies, salts of alumina, chromates, and borates; chlorine and chloride of lime; oils and fats; starch and sugar; fermentation and alcohol; wine, beer, and vinegar; colours and dyeing; tanning and glue; manure manufacture; explosives; glass, earthenware; lime, cement, and gypsum; metallurgy; bread, and the preservation of articles of food; the minor chemical arts; and, lastly, chemical patents. In all these various departments the editor enjoys the assistance of men practically acquainted with their respective subjects. It may throw some light upon the intelligent zeal with which the chemical arts are now cultivated in Germany if we mention that one of these sub-editors is described as representing the "Experimental Station of the United Spirit Trade of Germany." Another holds a similar position in the "Scientific Experimental Station for Brewery." The leather trade and the manure manufacturers have also organised similar "stations."

The journal before us must be of the highest value to chemical technologists, and we wish it ample success.

## CORRESPONDENCE.

### COLOURED COMPOUNDS OBTAINED FROM BRUCINE.

*To the Editor of the Chemical News.*

SIR,—In the CHEMICAL NEWS, vol. xxxviii., p. 35, I observe an extract from an article by R. Röhré, entitled "Behaviour of the Products Obtained by Treating Brucine with Nitric Acid and Reducing Agents."

In the CHEMICAL NEWS, vol. xxxvii., p. 98, I described some of the properties and a simple method of preparing the violet crystalline compound referred to in the above article. I believe the substance had not been obtained in a separate form by any one else before.—I am, &c.,

DAVID LINDO.

### STATEMENT OF THE RESULTS OF ANALYSIS OF COMMERCIAL PHOSPHATES.

*To the Editor of the Chemical News.*

SIR,—May I be allowed to say a few words on Mr. Jamieson's letter in the CHEMICAL NEWS, vol. xxxviii., p. 130, in which he finds exception to an assertion I made to the effect that the acetate of ammonia precipitate in phosphatic materials is not a definite chemical compound?

Mr. Jamieson's letter, instead of refuting my statement, confirms it in a very satisfactory manner. He says that he finds the "phosphoric anhydride" in the acetate of ammonia precipitates "to be almost identical with the quantity found by reckoning as phosphate of iron." Now, as many of the substances in which phosphoric acid has to be determined contain 3 or 4 per cent of alumina, we are forced to the rather unpleasant conclusion that these precipitates do not consist wholly of the ortho-phosphates

\* Journal for the Heavy Chemical Trades. Brief Report on the Progress of the Chemical Arts. In quarterly issues.

of iron and alumina, or that Mr. Jamieson's determinations are wrong; unless, indeed, phosphate of iron and phosphate of alumina have the same equivalents.

Neither can I believe that it is the intention of the Committee that the phosphoric acid should be directly determined in these precipitates, for surely no process requiring more than double the amount of necessary work would commend itself to chemists.—I am, &c.,

ALFRED SMETHAM.

1, Park Lane, Stoke Newington, N.,  
September 7, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 8, August 19, 1878.

On a New Mineral named Thaumassite.—M. Nordenskiöld.—The composition of this mineral is given as  $\text{CaO}, \text{SiO}_2 + \text{CaO}, \text{SO}_3 + \text{CaO}, \text{CO}_2 + 14\text{HO}$ .

Spectrometric Study of Certain Sources of Light.—A. Crova.—The spectra compared are the solar, that of the electric light, of the Drummond light, and of a moderator lamp. The intensity of the red being the same in the four, the fading off towards the violet varies with each source, according to a certain function of temperature.

A Wandering Electric Spark.—G. Planté.—The condensers of mica which enter into the construction of the rheostatic machine are sometimes perforated when too slender under the action of a current of 800 secondary couples, just as is the glass of an overcharged Leyden jar. This accident enabled the author to observe a very curious fact, which consists in a slow and progressive movement of the spark, which the author shows in an illustration.

On a Telephone Transmitting Sounds to a Distance.—M. Righi.—The receiver of this arrangement is a Bell's telephone, only that the plate of iron is fixed on a membrane of parchment paper, stretched at the bottom of a funnel, and the magnet is thicker than usual. The transmitter is composed of a plate of wood, or of metal, or of an extended membrane, in the midst of which is fixed a piece of metal whose lower surface is plane. This piece rests upon a conducting powder placed in a metallic cube, supported by an elastic blade pressed by a screw. The powder may be formed of silver, copper, iron, charcoal, graphite, or, preferably, of a mixture of one of these latter substances with silver.

Improvement in the Peroxide of Manganese and Sal-ammoniac Battery.—M. Leclanché.—The author uses masses agglomerated by the hydraulic press in the form of plates adhering to a surface of gas-coke of about half a square decimetre.

Dissociation of Metallic Sulphides.—MM. de Clermont and Frommel.—The experiments of the authors relate to the sulphides of arsenic. They consider that the pentasulphide either does not exist or that it is so unstable as not to resist even the feeblest agents.

Value of Magnesia as an Antidote to Arsenious Acid.—MM. de Clermont and Frommel.—The authors show that if arsenious acid passes into the state of trisulphide, either in the stomach or in the intestines, the administration of magnesia renders this sulphide soluble and assimilable. This transformation of arsenious acid is not a mere hypothesis, but has actually been observed.

Two Deposits of Phosphate of Lime in the Vosges.—P. Guyot.—Specimens from Damblain contain 76.99

tribasic phosphate; those from Blevaincourt 77.74 per cent.

New Meteoric Mineral, Daubreelite.—Lawrence Smith.—The composition of this mineral is:—

Sulphur .. .. .	42.69
Chrome .. .. .	35.91
Iron .. .. .	20.10
	98.70

It occurs very frequently in meteorites.

No. 9, August 26, 1878.

Vibratory Forms of Solids and Liquids.—M. C. Decharme.—The author concludes the following law. Upon circular plates the breadths of the striæ are inversely proportional to the square roots of the numbers of vibrations of the corresponding sounds.

On Pelletierin, an Alkaloid from the Bark of the Pomegranate.—C. Tanret.—This compound is colourless, but becomes coloured on exposure to the air. Its sp. gr. at 21° = 0.985. It is very soluble, and dissolves in water with contraction. It is dextrorotatory. Its aqueous solution has a rotatory power of  $[a]_D^{20} = +8^\circ$ . With sulphuric acid and potassium bichromate it gives a green as intense as does alcohol under the like conditions. Its composition is expressed by the formula  $\text{C}_{16}\text{H}_{13}\text{NO}_2$ . It is the taenicide principle of pomegranate bark.

Researches on Strychnin.—MM. H. Gal and A. Etard.—By the action of hydrated baryta upon strychnin the authors have obtained two new bases, which they name dihydrostrychnin,  $\text{C}_{42}\text{H}_{26}\text{N}_2\text{O}_8$ , and trihydrostrychnin,  $\text{C}_{48}\text{H}_{28}\text{N}_2\text{O}_{10}$ .

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.* No. 9, 1878.

Preparation of Quinon.—R. Nietzki.—If a solution of hydroquinon is mixed with excess of potassium bichromate and sulphuric acid in the cold, on agitating the mixture with ether and allowing it to evaporate quinon is obtained almost in the theoretical proportion.

Rosolic Acid and Rosanilin.—H. Caro and C. Graebe.—The author retains the name rosolic acid exclusively for the acid  $\text{C}_{20}\text{H}_{16}\text{O}_3$ , which is obtained from rosanilin,  $\text{C}_{20}\text{H}_{19}\text{N}_3$ . Aurin is the compound of phenol and para-roosanilin. Aurin and para-roosanilin agree in this property, that they are precipitated by hydrochloric acid from a hot alkaline solution in very characteristic needles, fine as hairs, which dissolve without melting in the dilute boiling liquid, and on cooling appear as a heap of felted needles of a reddish yellow colour, and a lustre resembling chromic acid. Under the same circumstances rosolic acid forms confused resinous drops of a metallic green, which congeal slowly and never form needles. The authors are of opinion that rosolic acid, rosanilin, and their accompanying leuco-compounds are derivatives of one and the same hydrocarbon. Rosanilin and rosolic acid are derivatives from a tolyl-diphenyl-methan; aurin and para-roosanilin from triphenyl-methan.

Determination of Hydrogen in Gas Analysis.—H. Bunte.—This paper cannot be intelligibly abstracted without the accompanying figure.

Aromatic Hydantoins.—P. Schwebel.—(Second communication.) An examination of the behaviour of urea with tolyl-glycocoll.

Action of Bromine Water and Nitrous Acid upon Phenyl-glycocoll.—P. Schwebel.—The author has obtained and examined tribromo-phenyl-glycocoll and nitroso-phenyl-glycocoll.

*Bulletin de la Societe Chimique de Paris,*  
Tome 30, No. 3, Aug. 5, 1878.

New Method of Preparing Allyl Bromide.—M. H. Grossheintz.—The author adds to potassium bromide

sulphuric acid, diluted with an equal volume of water, and heats the mixture in a simple distillatory apparatus. When hydrobromic acid begins to escape, allylic alcohol is allowed to fall in drop by drop, and the bromide distils along with watery vapour.

On Diehic Acid.—M. Maumené.—Already noticed.

Cenocyanin.—M. E. Maumené.—The author denies that the name cenocyanin has been given by Mulder to a "blue matter not yet analysed." M. Gautier appears to commit a second error in ascribing to the blue matter which the author has named cenocyanin the composition given in the *Comptes Rendus*. It contains no iron when obtained under the conditions indicated.

On Ethylen Cyanide.—Nilan Nevolé and J. Tcherniak.—The authors have greatly facilitated the preparation of this salt, and obtain it perfectly pure by a process which they describe. They have not found it possible to obtain appreciable quantities of normal butylen-diamin by Fairley's method, the reduction of ethylen cyanide by tin and hydrochloric acid.

Mono-chloro-ethyl-acetamid.—T. H. Norton and J. Tcherniak.—This compound, when recently prepared, forms a very mobile liquid, neutral to paper, and possessing an irritating and slightly camphory odour. It is soluble in all proportions in water, alcohol, and ether. Carbonate of potassa separates it from its aqueous solution. It is not distillable without decomposition.

Ethoxy-aceto-nitrile.—T. H. Norton and J. Tcherniak.—Ethoxy-aceto-nitrile, the first fatty oxythylated nitrile is formed by the dehydrating action of phosphoric anhydride upon ethyl-glycolamide.

A New Manner of Forming Ethylic Glycolate.—T. H. Norton and J. Tcherniak.—Glycolide is enclosed in sealed tubes with its equivalent quantity of absolute alcohol.

Certain Compounds Analogous to Chrome Iron.—M. J. Risler.—The author has formed and examined the manganites of calcium, barium, strontium, zinc, and lead.

Production of the Ultramarines of Different Metals.—MM. Forcrand and Ballin.—The authors have studied the formation of the yellow ultramarine of silver, the regeneration of blue ultramarine from this yellow form, and the transformation of yellow ultramarine into the ultramarines of potassium, barium, zinc, and magnesium. Their yellow ultramarine is not a mixture, but a homogeneous compound, showing under the microscope no grey or black particles of metallic silver. This yellow ultramarine, if heated with pure potassium chloride, yields a bluish-green potash ultramarine; with barium chloride, a yellowish brown potassic ultramarine; with zinc chloride, a violet zinc ultramarine.

Presence of Arsenic in Sulphuric Acid made from Pyrites, and in Certain Salts of Soda Prepared with such Acid.—M. E. Hjelt.—In Spanish pyrites the author, using A. Smith's method, finds 0.91 per cent of arsenic; in Westphalian 0.30, and in Norwegian mere traces. In chamber acid he finds 0.202 of arsenic; in the acid from Glover's tower 0.331, and in that from Gay-Lussac's condenser 0.334. The bulk of this arsenic is present as arsenious acid. In the last chamber the acid contains merely 0.019 per cent of arsenic. The mud deposited in Glover's towers consists chiefly of arsenious acid.

—————  
*Biedermann's Central-blatt,*  
Heft 5.

Proportion of Ozone in the Air in the Libyan Desert.—P. Ascherson.—The author has made above 100 observations in the Nile valley, in the Oasis of Bauiti, and in the intervening desert. The proportion of ozone was found uniformly larger by night than by day. The lowest results were obtained in calms, and the highest in

time of northerly winds, and especially in dewy nights. The author concludes that the condensation of watery vapour is as decidedly a source of ozone as is evaporation.

Influence of the Soil and of Forests upon Climate.—L. Fautrat.—From the *Comptes Rendus*.

Carbonic Acid in Sea-water.—J. Buchanan.—The quantity of carbonic acid in sea-water is much larger than that which an equal volume of distilled water is able to retain under similar circumstances.

On Changes of the Soil in Volume.—Prof. F. Haberlandt.—The extreme changes of volume which soils undergo according to their dry and moist condition, range from 0 to 30 per cent. They are measurable only in soils of a solid texture. Humus has the greatest influence upon the shrinking of a soils during its drying.

Experiments on Nitrogenous Manures.—Prof. R. Heinrich.—Of all the nitrogenised manures nitre applied in spring gave the best results both in corn and straw. Nitrogen in blood-dust, horn-dust, and fish-guano are about equal in value for winter corn and on a sandy soil. Sulphate of ammonia, under these circumstances, has no higher value. Meat-dust, rich in fat, had no action. Hence other animal manures, e.g., fish-guano, should be freed from oil before use.

Influence of Atmospheric Moisture on the Development of Plants.—Dr. P. Sorauer.—Moist air produces a greater length of stems and roots.

Chemical Studies on Wine.—T. Peneau.—According to the author's analytical results, the acidity of wines is not exclusively due to tartar, but depends in great part on volatile acids, especially acetic acid. The glycerine bears no fixed proportion to the alcohol, but, like the succinic acid, varies according to the manner in which the fermentation is conducted.

Preservation of Fruit.—A. dal Piaz recommends to lay the fruit in a solution of sugar, mixed with salicylic acid. The proportions are 100–500 grms. sugar, 2½ to 3 grms. salicylic acid to 1 litre water. Cherries, raspberries, pears, grapes, &c., have been preserved in this manner for a year without losing their natural aroma.

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*Chemiker Zeitung.*

No. 33, August 15, 1878.

The Medical Faculty of the University of Tubingen publish a letter which they have received from a diploma-broker in London. He substantially asks the faculty on what terms they will pass his candidates as M.D., offering to remit the customary fee, "and something more." We regret to find that the writer of the letter appears to be an Englishman.

No. 34, August 22, 1878.

At Brunswick several children have become ill in consequence of eating ginger-bread.

A serious explosion took place on the 15th inst., at the Badische Aniline and Soda Works, at Mannheim. Four men were seriously injured.

The first premium for a model of the proposed monument to Liebig has been awarded to the sculptor, Wagnüller.

Behaviour of Magnesian Salts with Lime Salts at various Temperatures.—Bohlig calls attention to the fact that at temperatures up to 100° carbonate of magnesium and gypsum are transformed into carbonate of lime and sulphate of magnesia. On the other hand, at temperatures above 120°—as steam boilers—carbonate of lime and sulphate of magnesia yield carbonate of magnesia and sulphate of lime. If the pressure in the boiler exceeds 3 atmospheres, the magnesia is found in the sediment not as carbonate, but as oxide. It follows from Bohlig's experiments that the old statement of the textbooks, that carbonate of magnesia is deposited on boiling

natural water, is incorrect. If gypsum is present in sufficient quantity, and the temperature has not risen above 100°, the precipitate must be free from carbonate of magnesia. The method hitherto followed of inferring the quantity of bicarbonate of lime present in the water from the lime found by prolonged ebullition of the precipitate, must lead to exaggerated results.—*Zeits. Anal. Chemie*, xvii., 301.)

**Detection of Small Quantities of Iodine in Sea-Water, &c.**—The liquid to be tested is placed in a test-tube along with carbon disulphide, and a few drops of dilute sulphuric acid. Hereupon the vapour of red fuming nitric acid is allowed to fall for a moment into the tube. After strong agitation, the sulphide of carbon is coloured rose colour if the slightest trace of iodine is present.—(*Zeitsch. Anal. Chemie*, xvii., 305.)

**Detection of Free Tartaric Acid in Wine.**—Claus evaporates the wine to the consistence of a group, shakes up with ether (in which, contrary to the statement of the text-books, tartaric acid is freely soluble), and dissolves the crystalline residue left on the evaporation of the ether. If an alcoholic solution of acetate of potassa is added to the liquid, crystals of tartar will be formed, if free tartaric acid must have been present in the wine, which, if in any important quantity is a suspicious feature.—(*Zeitsch. Anal. Chemie*, xvii., 314.)

**New Determination of Glucose and of Mercury.**—Hager mixes the aqueous solution of glucose, neutral or acid, with a mercuric acetate dissolved in a solution of sodic chloride in excess, and heats for an hour or upwards on the water-bath. A precipitate of mercurous chloride is formed, which is washed successively with very dilute hydrochloric acid, water, and alcohol, dried in the water-bath and weighed. The weight of the precipitate divided by 5.88 gives the quantity of the glucose, and divided by 6.19 the quantity of the saccharose which has been converted by acids into glucose. The reagent is prepared by grinding up 30 grms. red mercuric oxide with 30 grms. sodic acetate, and covering with 25 grms. concentrated acetic acid in a flask. Hereupon 50 grms. sodic chloride are added, and the whole made up to 1 litre. To 1 gm. glucose 200 c.c. of the liquid are required.—(*Zeitsch. Anal. Chem.* xvii., 380.)

**Oxalic Acid in Toxicology.**—Van Melckebebe shows that in the processes used for the destruction of organic matter in toxicological investigations, oxalic acid is always formed by the oxidation of the hydrates of carbon, which are always present. Hence it may be erroneously concluded that the acid was administered as a poison during the life of the subject.—(*Pharm. Centralhalle*, xix., 273.)

No. 35, August 29, 1878.

An article on chemical theories concludes with the following passage:—"Thus the fabric of the structural theory, scarcely raised to its top stone, begins to totter on its foundation, confirming the saying of Mephistopheles—"Grey, worthy friend, is every theory." Many chemists of the present day give simply empirical formulæ and reject every theoretical conception. Whether a new system will be developed, whether such will incline to the unitary or the dualistic view, or whether it will be found practicable to shore up the structure of the structural theory and supply it anew with firm foundations, the future must decide."

*Reimann's Färber Zeitung*,  
No. 31, 1878.

**Alizarin Carmine, a New Tinctorial Substance.**—This compound, recently introduced into the market as a dye for woollens, is the sodium salt of a sulpho-acid of alizarin. With the ordinary mordants it gives a variety of brown, chocolate, orange, red, and scarlet shades. The latter, though inferior in brightness to cochineal and

eosin scarlets, are absolutely fast as against air and light, and are injured neither by soap-lyes nor by perspiration. The new colour will therefore be well adapted for carpets, hangings, military uniforms, &c.

No. 32, 1878.

**The Valuation of Insoluble Colours.**—The method recommended is the well-known process of ascertaining how much of a white powder—zinc-white is the one here selected—to let down a pure normal colour to the shade of the sample under examination.

Malachite green has exactly half the solubility of crystallised methyl green. It is dissolved in boiling-water.

The condition of the Alsatian calico-printing establishments is represented as deplorable, several of the leading houses being shut up. An import duty on English printed goods is recommended as a remedy.

No. 33, 1878.

This issue contains nothing of general interest.

*Revue Universelle des Mines, de la Metallurgie, &c.*,  
Tome 3, No. 2, March and April, 1878.

This issue contains no chemical matter beyond certain extracts from the *Comptes Rendus*.

Tome 3, No. 3, May and June, 1878.

**Note on the Relation between the Origin and the Geometrical (?) Characters of the Guano Deposits.**—E. Detienne.—The author, whilst admitting the animal origin of the Peruvian guano beds, remarks that uncertainty prevails with regard to the elevated position which some of them occupy. Thus at Pabellon de Pica guano is found at the altitude of 160 metres, a height incompatible with what is known concerning the habits of sea-fowl, and especially of seals. The author accounts for these phenomena by a progressive elevation of the coasts, so that the oldest deposits are the most elevated. Other facts corroborate this view.

**On the Graduation of Burettes.**—M. L. L. de Koninck.—The author shows that there exists a notable discrepancy in the graduation of burettes, even if procured from the most eminent makers. He mentions two burettes which, if used for the determination of ferric oxide by the permanganate process, would show a discrepancy of 1.70 per cent.

*Archives Neerlandaises*.  
Tome xiii., 1me Livraison.

**Considerations on the Theory of Capillary Phenomena.**—P. M. Heringa.—An extensive mathematical paper, not adapted for abstraction.

**Fourth Memoir on the Piscifauna of New Guinea.**—M. P. Bleeker.—The author has identified and described 269 species of fishes from New Guinea.

**Certain Cases of Movement in a Non-Compressible Fluid.**—G. J. Michaelis.—Incapable of abstraction.

**The Numerical Determination of the Power of Distinguishing Colours.**—F. C. Donders.—The author proposes to obtain a numerical determination by indicating the limit at which a colour or shade of colour can still be recognised with certainty. This limit may be sought, *a* in the luminous intensity, *b* in the saturation, and *c* in the visual angle.

*Les Mondes, Revue Hebdomadaire des Sciences*,  
No. 17, August 22, 1878.

**Liquid Rings.**—M. Esriche.—If from a small height we let fall slowly into a dilute solution a few drops of another solution capable of forming a precipitate with the

former, we see rings formed which descend to the bottom of the vessel, rolling over upon themselves just as do the rings produced by the liberation of phosphorus trihydride.

No. 18, August 20, 1878.

**Darkness of Caverns.**—The fact that the light of torches does not diffuse itself in a cavern is ascribed to the presence of a mouldiness which covers their roofs and sides, and absorbs all those floating particles of dust which would otherwise act as reflectors.

## MISCELLANEOUS.

**Messrs. Johnson and Matthey's Exhibit at the Paris Exhibition.**—In our issue of July 26 we referred to the excellence of the exhibit of this eminent firm at the Paris Exhibition. We have now the pleasure of stating that two grand prizes have been awarded to them, one in Class 43 and another in Class 53. The *Grand Prix* is the highest class of recompense; the *Grand Diplôme d'Honneur* is only given to a public body or Government for a collected exhibition, where a *Grand Prix* cannot be given.

**South London School of Pharmacy.**—This institution was opened for the tenth session on Tuesday, the 17th September, when a full attendance of new and old students took place. The annual report was read by Mr. Baxter (the Secretary), and an address to the students was delivered by Mr. Joseph Ince. The chair was occupied by the Rev. S. Bache Harris, Vicar of the Parish, who was supported by a number of local magnates and gentlemen interested in the school.

## TO CORRESPONDENTS.

*H. G. R.*—It has not been done except by freezing.

*R. Baybutt.*—Consult Crookes's "Dyeing and Calico Printing."

*N. M.*—We are not aware that a second paper on Fremy's researches on Hydraulic Cements has yet been published.

*Hugh Justeince.*—Reimann's "Aniline and its Derivatives," or Crookes's "Dyeing and Calico Printing." Both works are published by Longmans and Co.

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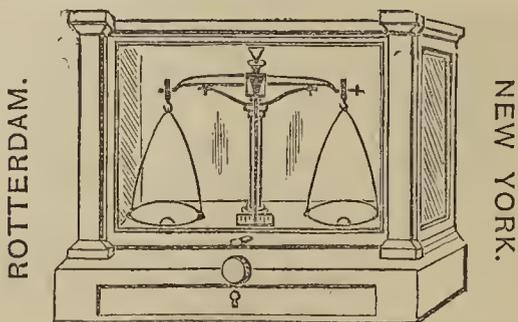
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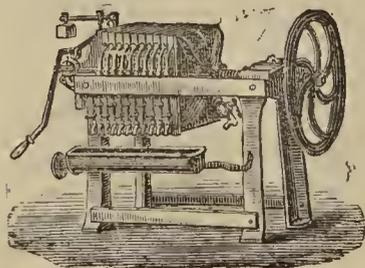
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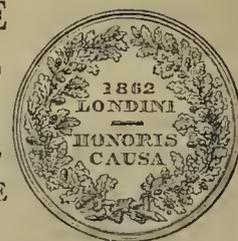
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# THE CHEMICAL NEWS.

VOL. XXXVIII. No. 983.

## ON THE ESTIMATION OF IRON AS FERRIC OXIDE.

By SERGIUS KERN, M.E., St. Petersburg.

THE author thinks it possible that several chemists use nearly the same method as is here described for the collection of the hydrated ferric oxide, and only gives notice of the method used by himself, as it has been remarked that in certain laboratories this flocky precipitate is collected on paper filters—a very tiresome operation.

In order to collect this precipitate a thin platinum funnel is used. The tube of the funnel is closed by asbestos-wool, previously ignited and weighed. The solution is next filtered, the precipitate washed. The funnel is then placed on a sand-bath, and when the precipitate is dry the bottom part of the funnel-tube is closed by means of a platinum stopper, and the whole is next ignited and weighed.

Knowing the weight of the asbestos and of the funnel, the weight of the ferric oxide may be calculated.

In this way the weight of many flocky precipitates in a dry state may be estimated in a quick and convenient manner.

## ANALYSIS OF COMMERCIAL NITRATE OF IRON.

By W. E. BLYTHE.

No drug supplied to dyers seems to be of a more variable nature than the nitrate of iron. A sample recently purchased proved to be of the following composition;—

Fe <sub>2</sub> O <sub>3</sub>	.. .. .	18.12
SO <sub>3</sub>	.. .. .	18.61
H <sub>2</sub> O	.. .. .	63.26
FeO	.. .. .	trace
		99.99

Sp. gr. 1.41 = 82° Tw.

This sample, on dilution, deposited a basic oxide of iron, and contained (as shown above) not a trace of nitric acid.

It is hardly necessary to point out the difficulties that the use of this salt of iron might occasion a dyer who imagines he is using the nitrate. I have on several occasions seen persulphate of iron bought and paid for as nitrate.

## VERIFICATION OF GRADUATED GLASS VESSELS AND AREOMETERS FROM 4° TO 45° C.\*

By P. CASAMAJOR.

THE graduated glass vessels used in laboratories are generally divided into cubic centimetres, and the volumes designated are supposed to be correct at a certain temperature, taken as a normal, which is generally 15° C.

I propose now to give a table (No. 2) for the verification of these graduations at all degrees of temperature, from 4° to 45° C., in which will be found, for every degree, the weight of distilled water which will occupy a space which at 15° C. is equal to 100 c.c.

\* Read before the American Chemical Society, July 11, 1878.

Afterwards I will consider the verifications of the graduations of areometers.

It is needless to add that the methods used for the verification can be easily applied to the graduation of measuring vessels and of areometers.

Let us suppose that we have a graduated flask, capable of holding 100 c.c. of water at 15° C., when filled up to a line etched on its neck, and that we wish to know if this graduation is correct. To ascertain this, we may fill up the flask with distilled water, at the temperature of 15° C., up to the line on its neck, and find whether the weight of the water is the proper weight. This leads us to inquire: What is the weight of distilled water which, at 15° C., will occupy exactly 100 cubic centimetres?

For the solution of this question, we have to make use of Table No. 1, which has already been published twice in our *Proceedings*,\* but which must be given again in this place, as it is to be the base of all our calculations. In this table, as here given, the temperatures range from 4° to 45° C., while, as previously published, the lowest temperature was 5°.

In the first column of this table are the temperatures for every degree from 4° to 45° C. Opposite to these, in the second column, are to be found for every degree numbers representing the absolute expansion of 1 c.c. of water, starting from 15° C. as a normal. For the degrees below 15° the numbers in this column represent absolute contractions, and are to be subtracted. We may see, in the second column, that if we take 1 c.c. of water and heat it to 16°, it will become 1.000173 c.c.; if heated to 25° it will become 1.002179 c.c., &c. If, instead of heating, the temperature is lowered from 15° to 14°, 1 c.c. of water will become 1 - 0.000150 = 0.999850 c.c.; if cooled to 7° it will become 1 - 0.000820 = 0.999180 c.c., &c.

For the methods used in obtaining these numbers I must refer you to the *Proceedings* of this Society, vol. i., First Part, p. 193.†

TABLE No. 1.  
Total Expansions from 15° C.

Degs. C.	Absolute Expansion.	Relative Expansion.	Degs. C.	Absolute Expansion.	Relative Expansion.
4	0.000887	0.000600	25	0.002179	0.001919
5	0.000878	0.000612	26	0.002445	0.002159
6	0.000856	0.000622	27	0.002717	0.002405
7	0.000820	0.000612	28	0.002995	0.002657
8	0.000772	0.000590	29	0.003279	0.002913
9	0.000706	0.000550	30	0.003569	0.003179
10	0.000622	0.000492	31	0.003869	0.003453
11	0.000524	0.000420	32	0.004181	0.003739
12	0.000412	0.000334	33	0.004503	0.004035
13	0.000288	0.000236	34	0.004836	0.004342
14	0.000150	0.000124	35	0.005180	0.004660
15	normal	normal	36	0.005533	0.004987
16	0.000173	0.000147	37	0.005895	0.005323
17	0.000357	0.000305	38	0.006265	0.005667
18	0.000551	0.000473	39	0.006644	0.006040
19	0.000756	0.000652	40	0.007032	0.006382
20	0.000971	0.000841	41	0.007428	0.006752
21	0.001119	0.001039	42	0.007832	0.007130
22	0.001428	0.001246	43	0.008244	0.007516
23	0.001670	0.001462	44	0.008664	0.007910
24	0.001920	0.001686	45	0.009092	0.008312

The numbers of the third column represent the total relative expansions of 1 c.c. of water, starting from 15° C. as a normal. They were obtained by subtracting the number 0.000026, the coefficient of expansion of glass for 1° C. as many times, from the quantities in the second column, as there are units between the corresponding number of degrees and 15° C. The numbers in this third

\* *Proceedings of the American Chemical Society*, vol. i., First Part, p. 193; Part Second, p. 20. Also see *American Chemist* for January, 1877, p. 251; *CHEMICAL NEWS*, vol. xxxv., p. 161; and *Moniteur Scientifique*, vol. vii., 3rd series, August, 1877, p. 862.

† Also *American Chemist*, loc. cit.; *CHEMICAL NEWS*, vol. xxxv., p. 161; and *Moniteur Scientifique* for March, 1877, p. 237.

column represent the apparent expansion of water in glass vessels.

If we wish to know the weight, in grammes, of 100 c.c. of distilled water at 15° C. we must refer to the definition of the gramme, which is: *the weight of 1 c.c. of distilled water at 4° C., taken in vacuo.*

By referring to the second column of Table No. 1, we may see that if we take 1 c.c. of water at 15° C., and lower the temperature to 4°, the cubic centimetre of water becomes  $1 - 0.000887 = 0.999113$  c.c., which will weigh in vacuo 0.999113 grammes; therefore, the weight of 100 c.c. of distilled water at 15° C. and *in vacuo* is 99.9113 grms. To make this result of practical value, we must proceed to eliminate the two conditions of weighing *in vacuo* and at the temperature of 15°.

It is no easy matter to keep liquids for any length of time at a temperature different from that of the room in which we operate, and, when the temperature of the liquid is much lower than that of the room, condensation of moisture takes place on the surface of the vessel which holds the liquid, which circumstance interferes with accurate weighing.

As the most favourable condition is that the temperature of the liquid be the same as that of the room, I give, in the second column of Table No. 2, the quantity of distilled water to be weighed *in vacuo* at every degree from 4° to 45° C., so that the volume shall be that which in a glass vessel at 15° is equal to 100 c.c. We will afterwards eliminate the condition of weighing *in vacuo*.

If we had a flask made of a material which would not expand by the action of heat, and this flask had a volume of 100 c.c., we could calculate, from the second column of Table No. 1, for every degree of temperature above and below 15°, the weight of water which is equivalent to 99.9113 grms. at 15°, or, in other words, the weight of water which occupy 100 c.c. For instance, the weight at 16° would be—

$$99.9113 \times \frac{1}{1.000173},$$

and so on for every temperature above 15°. For 14° we would find—

$$\frac{99.9113}{1 - 0.000150},$$

and so on for every temperature below 15°.

TABLE No. II.

Weight, in Grammes, of Distilled Water, occupying a Volume, in a Glass Vessel, equal to 100 c.c. at 15° C.

Degrees Centigrade.	Weight of Distilled Water in vacuo.	Weight of Distilled Water at Pressure = 760 m.m. of Mercury.	Degrees Centigrade.	Weight of Distilled Water in vacuo.	Weight of Distilled Water at Pressure = 760 m.m. of Mercury.
4	99.9712	99.8595	25	99.7200	99.6163
5	99.9723	99.8610	26	99.6960	99.5927
6	99.9735	99.8626	27	99.6716	99.5686
7	99.9723	99.8618	28	99.6465	99.5439
8	99.9702	99.8601	29	99.6211	99.5189
9	99.9662	99.8565	30	99.5945	99.4926
10	99.9604	99.8512	31	99.5674	99.4658
11	99.9532	99.8444	32	99.5390	99.4377
12	99.9446	99.8362	33	99.5097	99.4087
13	99.9348	99.8268	34	99.4793	99.3787
14	99.9237	99.8161	35	99.4479	99.3476
15	99.9113	99.8041	36	99.4155	99.3155
16	99.8965	99.7896	37	99.3723	99.2726
17	99.8818	99.7753	38	99.3282	99.2288
18	99.8640	99.7578	39	99.2814	99.1824
19	99.8462	99.7404	40	99.2277	99.1290
20	99.8273	99.7218	41	99.2412	99.1428
21	99.8075	99.7024	42	99.2040	99.1060
22	99.7869	99.6821	43	99.1660	99.0682
23	99.7654	99.6610	44	99.1272	99.0298
24	99.7431	99.6390	45	99.0877	98.9906

As, however, we have to deal with a glass flask whose volume varies with the temperature we must use the third column of Table No. 1, the numbers of which were obtained, as we have already said, by subtracting from the corresponding numbers in the second column the number 0.000026, the coefficient of expansion of glass as many times as there are units in the difference between the number expressing the degree of temperature and 15° C.

If we have a glass vessel holding 1 cubic centimetre of water at 15°, and if we mark the place on its neck which corresponds to the surface of the liquid, when we come to raise the temperature of the vessel and its contents to 16°, the liquid will expand, as we have said, to 1.000173 c.c.; but the volume, marked on the glass vessel, will itself expand to 1.000026 c.c., and the expansion of the liquid beyond the line on the glass would be the difference = 0.000147 c.c., and the weight of liquid below the line would be—

$$\frac{0.999113}{1.000147} \text{ grms.}$$

If the flask is capable of holding 100 c.c. at 15° up to a line on its neck, the weight up to that line at 16° would be—

$$\frac{99.9113}{1.000147} = 99.8965.$$

By proceeding in the same manner for all temperatures up to 45°, we obtain a series of numbers expressing the weight in grammes, taken *in vacuo*, which will occupy a volume in a glass vessel, which at 15° is equal to 100 c.c. These we place in the second column of Table No. 2.

For temperatures below 15°, we may notice that if we cool down 1 c.c. from 15° to 14° the volume is reduced to  $1 - 0.000124 = 0.999876$  c.c., and, consequently, to fill up the flask up to the mark representing 100 c.c. at 15°, we must weigh—

$$\frac{99.9113}{0.999876} = 99.9237 \text{ grms.}$$

In the same manner we obtain the weights for temperatures down to 4° C., and we also place the numbers thus obtained in the second column of Table No. 2.

(To be continued.)

## THE HISTORY AND WORKING OF THE ALKALI ACTS OF 1863 AND 1874.

In the Report appended to the evidence collected by the Noxious Vapours Commission 1876, just published, an interesting and valuable account of the beneficial working of the Alkali Acts of 1863 and 1874 is given at some length.

The history of the passing of these Acts is instructive. In the year 1862 a Select Committee of the House of Lords was appointed to enquire into the truth of a mass of complaints which had been made for several years previously as to the injurious results of the escape of noxious vapours given off in certain manufactures, as well as with respect to the state of the law upon the subject. The Committee reported that great injury had been done in different parts of the country to vegetation generally, including trees, hedges, corn, grass, and garden-stuff, the chief mischief being from alkali and copper works. As for the effect of the vapours on the life and health of men and animals they declined to express any opinion, as the majority of witnesses seemed to agree that animals were only indirectly affected by feeding on herbage tainted with the noxious fumes.

With regard to copper works they did not recommend that they should form the subject of special legislation, seeing that up to that time no efficient means had been devised for neutralising the vapours evolved in the smelting of copper consistently with carrying on this important

branch of industry; in other words, the members of this very unscientific Committee were effectually hoodwinked by certain clever copper smelters of the period. They consequently confined their attention to alkali works, their great bugbear being hydrochloric acid gas, and reported not only on the evidence of scientific men, but upon that of the manufacturers themselves, that it was perfectly easy to carry on the manufacture without perceptible injury to the vegetation in the neighbourhood. Acting on this evidence, therefore, they recommended that a Bill should be introduced into Parliament which, without specifying the particular process by which every alkali works should consume its own hydrochloric acid gas, should nevertheless enact that a substantial penalty should be attached to the escape of the gas during the process of manufacture. They also recommended the appointment of inspectors with large powers and wholly independent of local control and local influence.

In virtue of these recommendations, a Bill embodying them in substance was introduced by the Government in the year 1863, and was shortly afterwards made law under the title of an "Act for the More Effectual Condensation of Muriatic Acid in Alkali Works," 26 and 27 Vict., cap. 124. Considerable modifications were made in the Bill during its passage through Parliament. The main provisions of the Act were that alkali works should consume not less than 95 per cent of the hydrochloric acid given off during the process of manufacture, the penalties being £50 for the first offence and £100 for the second. The registration of all alkali works was provided for, and inspectors and sub-inspectors were to be appointed by the Board of Trade. The owners of alkali works were also empowered to make special rules for the guidance of their workmen, and punish them by fine in case of contravention. Contrary to the recommendations of the Select Committee it was enacted that the penalties should be recoverable by civil action to be brought in the County Court by the Inspector instead of at Quarter Sessions, the power of removing cases and appealing to higher courts being given to both parties.

The Act was at first looked on as an impracticable experiment, and was intended to continue in force from January, 1864, to July, 1868, but before it expired it was made perpetual.

The first Inspector appointed was Dr. R. Angus Smith, F.R.S., who we may say once for all has been the life and soul of the movement, whether engaged in fighting recalcitrant manufacturers, making reports to the Government, or in giving evidence and making recommendations before the Committees and Commissions. Dr. Smith, in addition to his extensive knowledge as a chemist, has brought with him from the other side of the Tweed a stock of the well known plant called Scotch hard-headedness, which has thriven and borne abundant fruit in spite of all the noxious vapours of Widnes, Runcorn, and St. Helens put together. Four sub-inspectors were also appointed, whose head-quarters were Liverpool, Manchester, Newcastle-on-Tyne, and Glasgow.

The general opinion among chemists and manufacturers has been that the effects of the Act have been beneficial both to the public and the manufacturers, but owing to the Franco-Prussian war and other circumstances the increase in the size and number of alkali works has been so great that it is difficult to estimate the exact amount of good effected. One thing, however, seems certain; that in those districts where no such increase has taken place the improvement has been most satisfactory. Another factor in rendering the results of the Act uncertain has been the great increase in the number of other manufactories evolving acid fumes. Under all circumstances it may be safely decided that the Act of 1863, although very imperfect in its action, nevertheless effected much good in a negative way by the prevention of much injury that would otherwise have arisen. As far as the manufacturers go they have found that the large sums they have expended have not only been not wholly unremunerative, but have

indirectly led to an increase in their profits. Dr. Angus Smith maintains—and his opinion is corroborated by several manufacturers—that, taking the whole trade together, the enforcement of the Act has been a gain to the manufacturer. The conversion of the hydrochloric acid into chlorine, which in its turn is converted into bleaching-powder, is undoubtedly a source of profit, and the pressure of the Act has resulted in many instances in improvements in various manufacturing processes, and in the greater economy of raw material and fuel. So far, the good, negative and positive, which was effected by the Act of 1863; but Dr. Angus Smith was far from being satisfied with what he very justly considered such meagre results. He found that the clause of the Act fixing the amount of hydrochloric acid gas to be condensed at 95 per cent was uncertain and unequal in its operation. He therefore set to work to devise a new and more definite standard with which manufacturers, after a certain time spent in experiments, could be expected to agree to. On the other hand, the experience of eight years had taught him that the big bogey of the Select Committee of 1862, hydrochloric acid gas, was not the only culprit concerned in the destruction of vegetation and interference with the comfort of the inhabitants. In his Report to the Board of Trade for 1871 he asserts that the greater part of the injury done to vegetation and the air is not merely due to the action of hydrochloric acid gas, but to the sulphur acids, and goes on to specify the class of works which are specially guilty in this respect. Dr. Smith also declared that there was a great difference in the quantity of sulphur compounds which were allowed to escape from different works. These investigations were pursued for some time, and it was not until 1874 that on the recommendation of Dr. Smith an Act was passed called the "Alkali Act of 1874," 37 and 38 Victoria, cap. 43, which enacted that the standard for the escape of hydrochloric acid gas should be fixed at one fifth of a grain for each cubic foot of air, smoke, or chimney-gases escaping from the works into the air. The most important portion of the measure was that which by a new definition of "alkali works" brought "wet" copper works within the scope of both Acts, while the definition of "noxious gas" was so extended as to include sulphuric acid, sulphurous acid except that arising from the combustion of coal, nitric acid, and other noxious oxides of nitrogen, sulphuretted hydrogen, and chlorine, with respect to which every manufacturer was bound to use the best practicable means for preventing their discharge into the air, or for rendering them harmless before such discharge.

This Act came into force in March, 1875, but so many complaints were made on the one side of its inefficiency, and on the other of its too great stringency, that a Royal Commission was appointed in July, 1876, to enquire into the working of both Acts, as well as into the working and management of works and manufactories from which noxious vapours were given off, to ascertain their effects on animal and vegetable life, and to report on the best means to be adopted to prevent their evil effects. The Commission consisted of Lord Aberdeen, Earl Percy, the Hon. Wilbraham Egerton, Messrs. J. C. Stevenson and F. A. Abel, Drs. A. W. Williamson and H. E. Roscoe, and Admiral Hornby.

Within the two years they have been sitting, the members of the Commission seem to have got through a good deal of work. They have visited Widnes, Runcorn, St. Helens, Northwich, Swansea, Tyneside, and the banks of the Thames, and have inspected alkali, cement, and chemical manure works, coke ovens, copper works of all descriptions; glass, lead, nickel, and salt works, and potteries. They have also taken evidence in London, Liverpool, Tynemouth, Newcastle-on-Tyne, and Swansea, and have examined manufacturers, land-owners, farmers, clergymen, and occupiers of houses, lands, and gardens, land agents, scientific witnesses, medical men, and local officers, as well as the Inspector (Dr. Angus Smith) and the Sub-Inspectors under the Acts. Tin-plate works, gal-

vanising works, cobalt and spelter works, they do not seem to have touched, there being no peculiarities about them that should separate them from the other works which emitted noxious fumes, and enumerated above. Gas works they considered beyond their province, inasmuch as so much special legislation had been bestowed upon them.

With a large portion of the evidence brought before the Commission we have little or nothing to do on the present occasion, our intention being to examine the past action of the two acts so frequently mentioned rather than to look into the future.

The complaints against the existing law are numerous, and in certain cases appear well founded.

Mr. Maclear, of St. Rollox, objects to the clause of the Act of 1874 which fixes the standard of escape at one-fifth of a grain of hydrochloric acid. This section, in his opinion, weighs very unequally on manufacturers, rendering it necessary for some of them to dilute their gases with air before allowing them to escape. Mr. Maclear seems, however, to be alone in this opinion, and it seems to be pretty generally agreed amongst other manufacturers that the new mode of testing is superior to that in the original Act.

Dr. B. W. Richardson objects to the provisions of the new Act on logical grounds. He says in his evidence:—"There is only one logical solution to the question of the exact quantity of noxious gas that should be allowed by law to escape, and that is that there should be none." He also considers the expression, "The best practicable means," in section 9 of the new Act to be too indefinite.

Some of the witnesses seemed to be under the impression that the owners of alkali works are absolved from responsibility for the acts of their workmen by the Act of 1874, but this is an erroneous idea, of which they were soon disabused by the Committee.

Dr. Angus Smith considers that the time has come for the fixing of the standards of escape for nitric and sulphuric acid, an opinion in which he is borne out by Mr. Fletcher, the Lancashire Sub-Inspector, and by one or two Tyneside manufacturers, including Mr. Glover, the inventor of the condensing-tower which bears his name.

The clauses of the Acts giving either party the power to move the action into a superior court is greatly objected to by persons of the class of farmers and market gardeners, to whom it is often equivalent to a denial of justice. Mr. Pardey, a landowner at Liverpool, stated that forty actions were commenced in the County Court at the same time, but the manufacturers moved them into a superior court, putting the plaintiffs to such heavy expense that the whole thing was given up, although five or six recovered in some cases that went to arbitration.

Another difficulty seems to exist with respect to mere nuisance. The owners of some houses at Widnes and St. Helens, which were rendered uninhabitable from the sulphuretted hydrogen which escaped from the waste heaps, could not recover damages because there was no physical injury done to their property.

It will be seen from the above extracts from the Report that although the two Acts are objectionable in some respects, that they have certainly effected an immense amount of good, and that by a few additions and amendments they may be transformed into good working laws that will need but little tinkering from our future legislators.

## NOTICES OF BOOKS.

*Memoir of the late Alfred Smee, F.R.S.* By his Daughter. With a Selection from his Miscellaneous Writings. London: G. Bell and Sons.

We have here the life-history of one too early removed from our midst, but who has left behind him abundant proofs of an intense and varied activity. At once a che-

mist, a physicist, a biologist, a geologist, a photographer, an electro-metallurgist, a medical practitioner, a horticulturist, a sanitary reformer in the best sense of the term, he took a lively interest in public affairs, local and national. The inventor of Smee's battery was also the author of "A Practical Remedy for Extortion and Intimidation practised by the aid of the Superior Law Courts;" of pamphlets on "The Puppet Parliament," on the "Final Reform Bill," on "Locked-up Money," on the "Unseaworthiness of Ships sent to Sea"—a subject into which he entered with a heartiness scarcely inferior to that of Mr. Plimsoll himself—and on "Chancery Reform." Nor was he, as is too commonly the case with men of versatile dispositions, a mere dilettante—a superficial trifler. To all these varied subjects he brought the power of close observation and original thought, and even those who more or less dissent from his views are compelled to own that "nihil tetigit quod non ornavit." It is true that had he even confined himself to some one of the many matters upon which he touched he might have attained in that department greater eminence, and have left to the world more profound researches. But, on the other hand, it is very doubtful whether his varied knowledge was not an essential element in his most important legacy to posterity—his contributions to sanitary science. The sewage question has been complicated no little by the dogmatism of chemists who are neither medical men, nor agriculturists, nor, above all, common sense men of the world.

Those who take an interest in the influence of heredity upon character and ability will be pleased to learn that Mr. Smee's forefathers were distinguished, if not for scientific attainments, yet for uncommon talents and great force of character. Young Smee from his earliest days evinced those peculiarities which followed him through life. Though active, and fond, *e.g.*, of climbing, he never when at school engaged at cricket or the other ordinary amusements of boys. "In after life he never entered into such recreations as billiards, backgammon, whist, or any other game." Though exceedingly humane and kindly, both to his own species and to the lower animals, he was not a humanitarian. "He considered that there are times when animals must suffer for the weal of man, and that morbid sentimentality ought not to be permitted to step in and stop experiments." In his student days he was more of an observer and worker than of a "reader," and in our days of learning in order to "pass" he would have made no brilliant figure. At King's College he carried off, however, the medals for chemistry, anatomy, and physiology, and lost the theological prize by one mark only. It appears, indeed, that from an early age his mind was deeply imbued with religious thought. Nevertheless, in consequence of some of his electro-physiological researches he was in after life most unjustly accused of materialism. His work on "Electro-metallurgy" not merely popularised the *art*, but in great part created it. His election as a Fellow of the Royal Society took place in 1841, before he was twenty-three years old. Did space allow it we ought here to give an account of Mr. Smee's activity in connection with the potato disease, which he ascribed to the ravages of an insect, *Aphis vastator*. In so unscientific a manner was this controversy waged that Mr. Smee received minatory letters by almost every post, and, as we are informed, even his life was threatened.

But we must pass on to a consideration of his treatment of the sewage question, a subject upon which he took a decided stand, and in connection with which he has been grossly misrepresented. It is commonly supposed that to the bigotry of irrigationism he opposed a bigotry similar but antagonistic. He was not an enemy of sewage irrigation, but he contended that it ought to be fairly and properly conducted, as it otherwise became a source of grave danger. He complained, and justly that—"The effect of sewage-grounds, as hitherto conducted, has been as bad morally on the minds of th

people as it has been physically on their bodies. Largely exaggerated statements have been made by their supporters. Facts are suppressed or not fairly given. General denials are made to all complaints. The most insolent observations are made to those who point out their dangers." Among these dangers Mr. Smee points to the very plain fact that, admitting the disinfecting power of soils, still a given quantity of soil cannot go on oxidising and destroying an unlimited quantity of sewage matter. Were this not the case there would be no necessity to close over-crowded graveyards, nor could wells be polluted by the infiltration of sewage through the surrounding soil. If the limit is once passed the earth of a farm becomes water-logged and saturated with filth; the oxidation process is at an end, and the waters must pass off unpurified. He adds the very important caution that "in the choice of a situation, underground channels, capable of directly conveying the sewage to distant parts, should be avoided: for example, chalk strata have cracks probably of miles in length. These cracks or fissures vary from a hair's breadth to a width of nine or ten inches, and if sewage were turned into one of these fissures it might reappear miles off,"—and of course contaminate wells and water-courses where no suspicion of danger exists. He considers that "unless the sewage is defæcated before irrigation a layer of fæcal matter is deposited on the surface of that part of the ground which has no crops upon it, and if there are crops the fæcal matter is deposited upon the plants." From these self-evident facts he infers that "sewage irrigation cannot be practised without creating a nuisance, unless by the previous removal of the solids and the precipitation of the greater part of the dissolved portions of animal matter." Of the possibility of this last operation Mr. Smee was far too sound a chemist to doubt.

As to the effects of feeding cattle upon grass which has whilst growing served as a strainer for excrementitious matter, and whose every stem is coated with filth, there is no room to doubt. If putrescent animal matters are supplied to plants in moderate quantity, these matters are no doubt ultimately assimilated. But such assimilation is a work of time, and until this process has been completed the plants themselves and their juices are offensive to the smell, and enter into putrefaction more rapidly than plants or the juices of plants which have not been watered with sewage. On this subject some interesting experiments have been performed by Mr. A. H. Smee, the son of the subject of the memoir. That organic matters are absorbed by plants without being previously resolved into their inorganic constituents is shown by the phenomena of "carnivorous plants," at which indeed Mr. Smee, who was no Darwinian, seems to sneer. But he follows up the scent, literally speaking, from the polluted vegetation to the polluted milk, butter, or meat. The following extract from a letter to Dr. John Simon, F.R.S., &c., speaks for itself:—"During the spring, my son directed without my knowledge that my cows should be fed with a small proportion of sewage-grass, when without knowing the reason the butter was so offensive that we could not bear it on the table; the other members of the family were loud in their complaints, and the neighbours for a long time came for no more butter. Upon enquiry I heard of the feed of sewage-grass, which was immediately discontinued, when the milk, cream, and butter resumed their former excellence."

The experiment was subsequently repeated without any warning, when the same results again occurred. It was further observed that the milk of cows fed upon sewage-grass underwent decomposition earlier than the milk derived from natural grass, and gave off a much more offensive odour. No one has as yet to our knowledge even attempted to refute the conclusions drawn from these facts. The only argument urged in opposition is substantially that of the thief who offered to bring a hundred witnesses who had not seen him steal anything. Mr. This and Dr. That say that no harm has to their knowledge

arisen from drinking sewage-milk. This argument, if it proves anything at all, proves too much. A family may drink the drainage of a cesspool for years without taking any tangible harm, and may consider the water "excellent." But some day the *dejecta* of a patient suffering from cholera or from typhoid fever pass from the cesspool into the well—and then?

Mr. Smee's recommendations are in short that sewage farms should only be laid out in places where the soil is not restricted, and where it is free from fissures, that the sewage should be defæcated before application, that its quantity should not be greater than the soil can dispose of, that no vegetables be taken for the food of man or beast unless a month or six weeks have elapsed since the last dose, and that care should be taken that cattle do not drink the sewage. Were these precautions observed he considers that irrigation might be conducted without peril.

It is not possible for us to pursue further an examination of Mr. Smee's views, but we feel convinced that few disinterested and unprejudiced persons can peruse this work attentively without feeling their belief in irrigation rudely shaken. For this reason, but by no means for this alone, we strongly recommend the "Memoirs of Alfred Smee" to all municipal and local officials and to all educated rate-payers. They will find its study both pleasant and profitable.

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*Report of the Air of Glasgow for the Six Months, November to April, 1878.* By E. M. DIXON, B.Sc. (Presented to the Committee of Health of the Magistrates and Council of Glasgow, July 29, 1878.)

THE author—or rather his successor, Mr. Dunnachie—has adopted an automatic method of air-washing. The air is forced through the absorbing medium by water-pressure, and its volume is measured by a gas-meter. The carbonic acid, sulphur, and chlorine are each collected in a separate series of absorbers, but ammonia and albuminoid ammonia in the same series. The absorbing agents used are—for carbonic acid, a strong solution of caustic potash; for the ammonias, dilute sulphuric acid; for sulphur, dilute permanganate; and for chlorine, dilute ammonia.

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*Results of a Series of Tests of Cold-Punched and Hot-Pressed Nuts at the Mechanical Laboratory of the Stevens' Institute of Technology, Hoboken, New Jersey.*

THIS pamphlet, which is descriptive of certain of the specialities of the firm of Hoopes and Townsend, of Philadelphia, is deficient in one important item. It has no title, and in default we are obliged to take the heading of its most important chapter. The work comprises a history of the firm of Hoopes and Townsend, and an account of the chief articles of their manufacture, especially the "cold-punched nuts." There is also some correspondence with the *Polytechnic Review*, and an account of the comparative trial of "hot-pressed" and "cold-punched" nuts conducted at the Stevens' Institute under the supervision of Prof. R. H. Thurston. The results of the trial are described as showing that the cold-punched nuts possessed a greater average strength, combined with greater rigidity and slightly greater uniformity, than were exhibited by the hot-pressed nuts.

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Ultramarines at the Universal Exhibition for 1878.—J. F. Plicque.—The industrial production of green and violet ultramarine is still quite recent, but the qualities of these new products are already highly appreciated. The total annual production of ultramarine in Europe exceeds ten million kilos., its mean price being 2 francs per kilo. In 1820 natural ultramarine cost 4000 francs per kilo.—*Moniteur Scientifique.*

## CORRESPONDENCE.

## CYANOGEN COMPOUNDS IN ALKALI MAKING.

To the Editor of the Chemical News.

SIR,—In your issue of the 13th inst. (CHEM. NEWS, vol. xxxviii., p. 137) there is a letter from Mr. Weldon criticising my communication regarding cyanogen compounds, which you were good enough to insert in the CHEMICAL NEWS of the 6th inst. I shall esteem it a favour if you will allow me to make a few remarks on the subject.

Mr. Weldon seems to misunderstand my statement, which is—That a higher temperature of the mass or charge prevails at the end of the reaction, and that it is then that the formation of the cyanogen compounds takes place. Nothing in his communication has in the least disproved this: on the contrary.

The cyanogen compounds are not produced from the nitrogen of the mixing coal, as is the generally accepted theory of the subject; but these compounds are produced by the action of the highly-heated nitrogen in the gases of combustion from the fuel upon the alkalis carbon in the mass in the furnace. If this carbon can be kept at a minimum, and the heat of the mass at the end of the reaction be kept down, little or no cyanogen is formed: this is established beyond any doubt.

In the ordinary "mixing," where much more limestone is used than with my system of making black-ash, the temperature of the mass at the end of the reaction is just so much higher according to the fusing-point of the charge. The temperature of the furnace and the temperature of the mass are two totally distinct things. I keep my furnaces just as hot as I can by burning the maximum of fuel in the grates; but I keep down the temperature of the charge by reducing the melting-point of the mass to the lowest point. I believe that the furnace temperatures I employ are higher than in any other case in the trade, from the great command of draft I have both at St. Rollox and Hebburn, and as furnace outputs of 300 and 330 tons sulphate per week would show; whilst that the melting-point of the charge is much reduced is shown by the fact that as much as 75 per cent additional work has been got through by furnaces working on my system compared with the old method. I am quite certain that in no case in practice does the heat of the charge ever attain to that of the furnace without the most disastrous results as to quality of black-ash produced.

The facts adduced do not oppose, but in my opinion strongly support, my statement, thus:—

1. *Lime-sludge Mixing.*—In all cases of lime-sludge mixing which I am acquainted with (and they are many) a considerable excess of both carbonate of lime and mixing-coal are employed: we have therefore a high fusing-point of the mass, and also large quantities of excess carbon, both of which are highly favourable to the formation of cyanogen compounds; the only effect of the 50 per cent of water is to lower the average temperature of the furnace, and thus cause the exposure of the mass at the end of the reaction for a longer time to the conditions most favourable to the formation of cyanides.

2. *The Revolver fired with Gas.*—In this case it is clear, from the well-known conditions of gas-firing, that much less excess air would be passing with the gases of combustion, and therefore gas relatively much richer in nitrogen would be acting on the heated mass. No doubt; also, the much lower heat which prevailed in the furnace when fired with gas had the effect of exposing the charges for a much longer time (under the most favourable conditions for the formation of cyanides) to the gases of combustion towards the end of the reaction, when the charge was melted, and alkalis carbon present. The time occupied in finishing a charge being much longer when heated by gas than when heated by fire, the mere change

to firing with coal would increase the number of charges made, by shortening the time per charge, and consequently the amount of exposure to the heated fuel gases, especially at the end of the reaction.

3. *Hand-furnace Black-Ash* is made under very different conditions: a great part of the decomposition takes place without contact of the fire-gases at all, and is much assisted by the bottom heat of the furnace; the amount of exposure to the heated gases is therefore less than in the revolver, where the charge is so thoroughly turned over, and less cyanides are to be expected.

4. *French Hand-Furnaces.*—This also is just what is to be looked for. In the French practice a very low amount of mixing-coal is employed and a higher furnace temperature (according to Mr. Weldon); but the charges, so far as I am aware, do not remain longer exposed to the heat while finishing. It is difficult to see how this could be, if the heat was higher, without the charges getting burned. I am certain Mr. Weldon is in error as to the temperature of these furnaces compared with, say, a Lancashire hand-furnace: a comparison of the amount of material melted per square foot in each case would be more convincing than an estimated temperature, which is usually very difficult to compare.

I hold, however, that the question of the temperature of the furnace has little comparatively to do with the matter; it is the higher temperatures of the mass and the presence of alkalis carbon which favours the formation of the cyanides.

5. I must protest against the inference to be drawn from this paragraph. It is unjust, not only to myself, but to many others. The destruction of the cyanides had been sought after and obtained by other methods before Mr. Weldon introduced Mr. Pechiney's process. Mr. Williamson, of the Jarrow Chemical Works, had been perfectly successful in destroying the compounds in the vat-liquor, and I had been successful in using a process in which hydrate of soda was added at the end with the view of getting rid of the cyanogen by the action of the hydrogen evolved. This was perfectly successful, and Mr. Weldon was told by me of this process many months ago. My experiments on the destruction of cyanogen compounds have been carried on since early in 1874.

6. I am satisfied from my experience of additions at the end of the balling process that the result obtained as described by Mr. Weldon under this head can be readily enough explained from my point of view, partly in the fact that the charge will be stiffened up and in a porous and favourable condition for the action of the nitrogen of the hot gases at the end of the operation.

In the paragraph at the foot of page 137 it appears to me that Mr. Weldon admits my position. He accounts for the cyanogen compounds not being found in the charge in the black-ash furnace till towards the end of the operation, when a high temperature of the mass prevails, by the hypothesis that the quantity of sulphate undecomposed is then lowest, not because the temperature is highest. He thus admits that the cyanogen compounds with which we have to contend are formed at the end of the operation, and it is then certainly that a high temperature of the mass prevails.

But, further, he does not prove in the least that the amounts of cyanides depends on the sulphate present, and having been able to obtain black-ash with considerably under 1 per cent of undecomposed sulphate which was free from cyanogen compounds by the simple method of working described in my last communication, I decline to accept his dictum without more proof than has yet appeared.

That sulphates of the alkalis added to cyanogen compounds destroy the cyanide is not a new fact in chemistry by any means, the reactions involved being described in "Watts's Dictionary," in the 1864 edition; but to M. Pechiney most clearly belongs the honour of applying these known reactions practically in the alkali making.

Mr. Weldon (I am sure unintentionally) totally mis-

represents my position when he says—"While, then, Mr. Macfear's idea that a low temperature in the black-ash furnace will help to enable him to prevent the formation of cyanogen compounds;" and I deny most emphatically that it is due to M. Pechiney that English manufacturers are indebted for the great advantages resulting from a reduction of their mixing-coal to a minimum. Mr. Weldon again does me wrong when he says that he urged the use of the minimum of coal upon me when he called on me of his own accord on July 23, as we were both at one on this point, and he should not, I think, quote a figure given off hand in conversation in support of his assertion. I told him that I had been down I believed to 32 per cent, but without consulting my figures, and simply to show that the principle is not new. I find, on looking at the figures in my note-books, that I had actually been down to 28 per cent so far back as September, 1874. I will not discuss the letter from M. Pechiney (a copy of which Mr. Weldon presented to me last time I saw him). It contains much that I agree with, but also much that requires explanation; but I would refer Mr. Weldon, before claiming either for himself or M. Pechiney the credit of introducing a knowledge of the effects of low amounts of mixing-coal, to the papers of Unger, Scheurer-Kestner, and others, but more especially to the masterly investigation of this subject by Kolb.

Mr. Weldon speaks of my adopting the French proportion of mixing-coal; he might have gone further and said the French process invented by Leblanc. He is quite wrong in saying that I use a lower temperature. I believe the temperature is considerably higher in my furnaces than in any French furnace.

He has thought it necessary in discussing a chemical question to make certain statements which he must pardon my noticing very briefly. When I called on him at his hotel in Glasgow, on September 1, it was at his urgent written request, brought by a messenger, he being too ill to call on me, although he had come to Glasgow for the purpose of seeing me. Our interview was long, and many points were discussed and many things said on both sides. I told him all I had done, a little unwisely it would appear, and he showed me certain figures and documents, and made the distinct statement that the opinion he then had was that our two processes must be worked conjointly, and that the "process of the future was a combination of Pechiney and Macfear." I told him that I could do perfectly well without Pechiney, and had no doubts whatever as to my results. I had arrived at the state of finished ash at this time. I had *not* "obtained a finished product made without removing any red liquors, and yet as free from iron and as good in colour as ammonia-ash," nor can I believe M. Pechiney does by his process, as I cannot see how he gets rid of all the double sulphide of iron and sodium (unless it be from the well-known property of NaCl in vat liquor of precipitating sulphide of iron, his liquors containing a very large amount of NaCl). It is the first time I have heard the claim advanced that ash made in this way was as free from iron as ammonia-ash although it may be as good in colour.

I must again say most distinctly that I do not advocate a low furnace temperature; on the contrary, the higher I can keep my furnaces the shorter time there is for the formation of cyanides at the higher temperatures prevailing at the end of the reaction. All experience in connection with the formation of cyanogen compounds from the air goes to prove that the temperature best suited for their formation is a very high one. I am of opinion that the formation of these compounds depends to a great extent on the reduction of the sodic compounds to the metallic state at the higher temperatures. Cyanides are readily enough formed if we pass heated air over a mixture of powdered coke and metallic sodium at a red heat (sodic oxide is given off in white fumes, which are most difficult to condense, even passing not only through water, but through dilute sulphuric acid). They are still more readily formed when nitrogen is employed instead of air.

That black-ash can be made as free from cyanogen compounds by other processes than that of M. Pechiney is a fact, and I do think something may be gained. The sulphate added at the end of the process it is claimed is decomposed into carbonate, but with the evidence I have had placed I prefer merely to state that I do not see how it can be so, and that the results do not show it to be the case.

The formation of cyanides may be prevented as I pointed out, or they may be destroyed after formation by the use of hydrates, such as sodic hydrate, or they may be destroyed by the addition of the earthy sulphates, or by metallic oxides, such for instance as oxide of iron;  $\frac{1}{2}$  per cent of "blue billy," or refuse oxide of iron from the copper works, having proved sufficient to destroy the cyanides in black-ash that I have made by my ordinary processes, without affecting prejudicially the vat liquors.

The claim advanced for M. Pechiney's process in the concluding part of the letter wants a great deal of confirmation.—I am, &c.,

JAMES MACTEAR.

September 21, 1878.

## THE PRINCIPLES OF COMMERCIAL CHEMISTRY.

*To the Editor of the Chemical News.*

SIR,—I have been an interested reader of the letters which have appeared lately in your valuable paper respecting "The Principles of Commercial Chemistry." As the manager of a works which consumes nearly 3000 tons per annum of sulphate of ammonia, and having had a number of years' experience in that article, I would like to give you the results of that experience in so far as the present question is concerned.

Good grey sulphate of ammonia invariably tests 24.50 per cent to 24.75 per cent. Darker coloured sulphate of ammonia tests 24.25 per cent; while that from the States, which is pure white and kiln-dried, tests 25 per cent. As regards the price: American ammonia invariably commands 10s. per ton more than good grey. Good grey commands 5s. per ton more than dark ammonia, and the price of the latter at present is £19 15s. to £19 17s. 6d., delivered at ———, and guaranteed 24 per cent. With respect to the altering of the present standard, there are a great many objections to it. How many manufacturers, may I ask, deliver their ammonia much over the 24 per cent? One half of the makers which supply us no sooner get their sulphate made than they ship it, in order to get their money, and it is shipped in such a condition as to prevent all possibility of its testing much over 24 per cent, and this merely on account of moisture, and if it had been dried through long storing would have shown 24.75 quite easily. Again, if the guarantee were made 24.75, the line being drawn so fine, the disputes with chemists would be endless, and the cost of a confirmatory analysis over little lots of 5 tons, &c., would soon sweep away the benefit. "In a Fog" has his remedy for the 0.75 per cent (which he would lose were he not such a good manufacturer) by guaranteeing 24.75 per cent, and people who know their business will pay him for it. At the present moment we get some lots of "good grey" made by those proverbially bad chemists, "Gas Works Managers," which are perfect samples of sulphate of ammonia, and for which we never hesitate to pay 10s. per ton more than we pay for dark lots, as they invariably test 24.75 per cent.—I am, &c.,

WORKS MANAGER.

## COMMERCIAL SULPHATE OF AMMONIA.

*To the Editor of the Chemical News.*

SIR,—I am sorry again to take up your valuable space in reply to your correspondent, "In a Fog." His so-styled "practical commentary"—and this, too, after his professed ignorance—lends a different aspect to the argument, and

explains also his jealousy (he a manufacturer himself) of Corporation Gas Companies and other makes superior to his own, the latter not having as yet solved the difficulty of making an *exact* 24 per cent in the ordinary way of working. And I have still my doubts whether your correspondent's sulphate, under these circumstances, is of proper quality, a large make, judging from the figures given, though it be. "In a Fog" need not remain long in doubt about what other makers produce if he will ask for samples and test them. I know from facts that most of the "good grey" is invariably over 24 per cent, and for this reason there will be great difficulty in getting consumers to pay immediately the equivalent of 1 per cent more, although not one in the trade would object to see a minimum guarantee of 25 per cent established and the market rates ultimately regulated, thereby doing away as it would with some of the disputes now sometimes arising. But as a 25 per cent is *not* made "with ease," in fact, as it could not be relied upon according to the present mode of manufacturing, I think manufacturers themselves would be the first to return gladly to the old standard. What "In a Fog" is aiming at is to sell on a basis of 24 per cent or per unit of ammonia; but of course in such a case every single parcel would have to be analysed, and this, taking into account how analytical chemists differ, would hardly be practicable, even leaving the great trouble and inconvenience occasioned thereby out of consideration. And does not your correspondent quite overlook the fact that the manufacturer guarantees 24 per cent *minimum*, and that if he cannot be compelled to deliver a product containing even 1-10,000th over the percentage, still his endeavouring in the final process to reduce the strength would barely be honest, and I am happy to say I know of no manufacturers who rack their brains for such a purpose, and "In a Fog" seems simply to have been stating his own case. If "In a Fog" had carefully read my letter it would have saved the repetition of some of my former remarks. I did not say it would require "prolonged draining or artificial drying" to reach 24.75; I referred to 25 per cent @ 25.25 per cent. And respecting the colour "superstition," I do not see what bearing it has upon the argument, but it is well known that very little prejudice exists now, white being not often asked for, although it is given the preference at same price.—I am, &c.,

J. H.

## AMMONIACAL LIQUOR.

*To the Editor of the Chemical News.*

SIR,—As it seems to be becoming more general among gas corporations and companies to sell their ammoniacal liquor, not at so much per degree of Twaddell's hydrometer as formerly, but on the basis of the actual strength of ammonia, and as one of these (Leeds, in a recently issued form of tender) is now stipulating that this shall be determined by the so-called "Wills's test," which consists in the old plan of boiling the ammonia into test acid with caustic soda, I think it desirable to draw the attention of those of your readers who may be interested to a paper published in the CHEMICAL NEWS, vol. xxxi., pp. 15 and 16, "On the Distillation of Ammonia in Presence of Sulphocyanides," in which it is experimentally proved that caustic soda tends to convert a portion of the sulphocyanide into ammonia; and that caustic lime, which has no such action and expels the ammonia quite as freely, should be substituted.

Should it not suffice in commercial contracts to specify that the actual percentage of valuable constituent shall be taken without stipulating that it shall be decided by a particular test which (as has been the case in this instance) may any day be demonstrated to be incorrect?—I am, &c.,

ALEXANDER ESILMAN.

Manchester, September 9, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 10, September 2, 1878.

Diffusion of Cerium, Lanthanum, and Didymium.—M. Cossa.—Certain specimens of scheelite, especially those from Traversella, and also the apatite of Jumilla, show the black absorption-band characteristic of the compounds of didymium. The presence of this metal gives reason to suspect cerium and lanthanum also. In fact, a few grammes of the scheelite of Traversella are sufficient to show the three metals by the ordinary methods of separation. Spectroscopic examination shows the presence of didymium more or less distinctly in the apatites of Capo di Sales, Cerno, Mercado, Miask, Sreiner, Snarium. Cerium can be detected in all these by chemical methods. The author has also found the three metals in the compact scheelite of Meymac, in the staffelite of Nassau, in phosphorites, osteolites, and coprolites from various sources. He detects them also in the saccharoid marble of Carrara, and in the shelly limestone of Avellino. In bone-ash, as used for the preparation of cupels, he has found 3 centigrms. of the oxalates of the three metals per kilo. He considers that these metals are very widely diffused in nature, and that they enter into the composition of organised beings.

No 11, September 9, 1878.

Novel Effects Produced in the Telephone.—M. du Moncel.—The author, after describing certain experiments which support the theoretical ideas which he put forward in March 1878, adds that they are further confirmed, at least as far as the molecular vibrations are concerned, by the receiving microphones, which are now improved so as to enable speech to be heard almost as well as with a Bell's telephone under the influence of a Leclanché battery of three elements. A simple morsel of charcoal adapted to the centre of a disc of copper, and upon which bears, under a pressure capable of being regulated, another fragment of charcoal on an elastic support—this is the whole apparatus, which may be used for transmitting as well as for receiving. With this system employed as a transmitter very interesting effects may be observed. If the regulating screw is slackened so that the vibrations of the plate may produce interruptions of the current, and if the current of the battery is passed through a small induction coil, the induced current of this coil passing through a telephone, in the current of which are interposed the two armatures of a small condenser, airs sung before the transmitter will be repeated at the condenser.

Variations of Intensity which a Current Undergoes on Modifying the Pressure of the Contacts which Establish the Circuit.—M. Trève.—If the current of the electro-magnet of Faraday or of Ducretet is closed between its two poles there is generally observed neither spark nor noise. On suddenly opening the circuit there is heard a detonation almost equal to a pistol-shot, as was first pointed out by De la Rive. This experiment renders it possible to demonstrate to a very numerous audience the influence of the pressure of contacts.

Application of the Telephone to the Determination of the Magnetic Meridian.—H. de Parville.—If in the ordinary telephone the short magnetic bar is replaced by a rod of soft iron of at least a metre in length the apparatus transmits sounds with an intensity which varies according to the direction of the rod. The maximum intensity of sound is received when the transmitter lies in the direction of the magnetic needle, and gives place to silence more or less complete when the telephone is

placed in a plane at right angles to the magnetic meridian. If a transmitting telephone with a long rod is fixed upon a Cardan's suspension it can be easily made to traverse the horizon. When the receiver communicating with the apparatus remains silent the transmitter is at right angles with the magnetic meridian. We may thus determine, not merely the direction of the magnetic needle, but, approximately at least, the variations of magnetic intensity.

**Constitution of the Inactive Glucose of Cane-sugars and Treacles.**—U. Gayon.—This inactive glucose is resolvable into a mixture of dextro-rotatory and lævoro-rotatory sugars.

*Moniteur Scientifique, Quesneville.*  
September, 1878.

**Certain Interesting Facts in Toxicology.**—Prof. F. Selmi.—When arsenic is deposited in the form of a ring or a spot one of the methods for its recognition consists in oxidising the deposit with nitric acid, evaporating gently to dryness, dissolving the residue in water, and testing with ammoniacal nitrate of silver; if during the oxidation arsenious acid is produced a yellow precipitate falls, but if arsenic acid the precipitate is a brick red. In practice, and especially when the quantity of arsenious acid is small, the complete oxidation of the arsenic is difficult, the evaporation having to be very carefully conducted for fear of volatilising a little arsenious acid not yet transformed. If the treatment with nitric acid is not several times repeated it may happen that the slight precipitate with nitrate of silver appears of an uncertain reddish yellow tint, which passes rapidly to a brown by the decomposition of the arseniate of silver. The author finds that the reactions of arsenious acid are more distinct than those of the arsenic, the light yellow precipitate of the former passing less readily into a brown than does the arseniate. In order to determine that arsenious acid shall always be produced he operates as follows:—The part of the tube containing the arsenic is cut off with the file so as to form a small glass ring containing the product. It is placed vertically in a capsule and a few drops of nitric acid are allowed to fall upon it from a pipette, in such a quantity only that it may remain enclosed by the capillarity of the tube. If the ring of arsenic is slight it is dissolved almost instantly; if it is somewhat thick time is required. In case it does not dissolve completely the liquid is removed with a pipette and the acid is renewed, touching with an iron wire slightly heated the *outside* of the tube opposite the place where the undissolved arsenic lies until it is completely taken up. The nitric acid used is prepared by mixing 1 vol. of pure nitric acid of sp. gr. 1.25, and 1 vol. of distilled water. The liquid is withdrawn and the tube rinsed with a few drops of distilled water. Ammonia is added till the reaction is alkaline, and if the volume is too considerable the whole is concentrated in the water-bath. After concentration a little more ammonia is added. A drop of a neutral and very dilute solution of silver nitrate is let fall into the liquid. If a yellow precipitate is formed, the author observes if a second, third, and fourth drop added successively augment the precipitate. The precipitate is allowed to settle, the liquid is removed as completely as possible with blotting paper without touching the precipitate, and it is treated with hydrosulphate of ammonia. The yellow precipitate dissolves, and silver sulphide remains. The precipitate is dissolved in weak nitric acid, and the silver is thrown down with a few drops of hydrochloric acid. The liquid is filtered and mixed with sulphuretted hydrogen and kept at a gentle heat for twenty-four hours, when the arsenic re-appears as sulphide. Another reaction of arsenic indicated by Fresenius and Pettenkofer is of great use for converting the arsenical ring directly into arsenic sulphide by means of a current of sulphuretted hydrogen. The regularity of this reaction has been called in question, but the author has repeated it several times and always with full success. If two or

three arsenical rings have been produced this reaction may be applied as a check-test. For this purpose the ring is inserted in the delivery tube of an apparatus producing pure sulphuretted hydrogen, and the part of the tube where the arsenic lies is gently heated, when the metallic aspect of the ring changes to a yellow, more or less inclining to orange, the ring not being displaced. The tube is allowed to cool, and there is poured into it a little sulphide of carbon, which dissolves the free sulphur deposited around the ring. On pouring away the liquid the arsenical deposit appears much more beautiful. The ring in a tube may be also treated as follows:—A few grammes of zinc sulphide obtained by precipitation, and mixed up with water so as to form a paste, are introduced into the end of the tube. The same end is then plunged into a few c.c. of dilute sulphuric acid, and the ring is heated, when the red sulphide is produced.

**Volatilisation of Arsenious Acid.**—In chemical treatises there appear contradictory statements concerning the temperature at which arsenious acid gives off vapours. According to Thenard volatilisation begins at a cherry-red heat; according to Berzelius, if heated in open vessels, it softens and begins to sublime at incipient redness. In the *Encyclopedie Chimique* it is said to soften and sublime under an ordinary pressure at 200°. Wurtz gives the same degree but without mentioning the softening. According to Watts ("Dictionary of Chemistry"), it begins to sublime at 218°, and according to Wormley at 190°. The author finds that it volatilises at much lower temperatures, especially when assisted by the evaporation of a liquid in which it is contained. Under these circumstances it is more or less volatile at temperatures ranging from 100° to 150°.

**On M. A. Gauthier's Process for the Detection of Arsenic.**—Prof. Selmi shows that in this process there may occur loss of arsenious acid. He modifies it as follows:—100 grms. of the suspected matter are heated with 20 grms. of pure nitric acid until reduced to a yellowish pulp. The heat is then withdrawn and 5 grms. of sulphuric acid are added. The mixture is heated again till white fumes begin to escape, when 10 to 12 grms. more of nitric acid are added, and heat is applied till a small portion gives with boiling water a dark yellow liquid. It is then filtered, washed repeatedly to ensure complete exhaustion, the liquid evaporated, and the residue taken up repeatedly with hot nitric acid until the solution becomes a light yellow. Sulphurous acid is then added in excess, the liquid is saturated with sulphuretted hydrogen, and left for a day at a luke-warm temperature, taking care that there shall be always an excess of sulphuretted hydrogen. On operating in this manner there is neither loss of arsenious acid during carbonisation nor is any arsenic retained in the organic matter.

**Detection of Blood upon Dyed and Dirty Tissues.**—If a spot of blood has dried upon a coloured tissue it is difficult to demonstrate the formation of crystals of hematin unless the spot is large enough to be removed mechanically. If the spots are small and the blood has been absorbed by the tissue it is necessary to steep the portion of cloth either in luke-warm water, ammonia, acetic acid, &c., and it often happens that the dye dissolves at the same time, and hinders the formation of the characteristic crystals. The author has observed that the tungstate of soda and acetic acid precipitate foreign matters along with the colouring-matter of the blood, and has examined if the colour-matter of the blood not dissolved would yield crystals of hemine. For this purpose the precipitate, filtered and drained, was put in a suitable vessel along with alcoholic ammonia, prepared with 8 vols. of absolute alcohol and 1 vol. of concentrated ammonia. After being left in contact for several hours the liquid became slightly coloured; on concentrating it gently to a small volume, and then further evaporating it upon a plate of glass and adding to the dry residue a drop of acetic acid and a drop of solution of chloride of sodium,

crystals of hematin were obtained by the ordinary process.

Theory of Alcoholic Fermentation according to the Latest Researches of Claude Bernard.—C. Blondeau.—The author seeks to establish the four following principles:—The ferment exists pre-formed in the interior of fermentescible bodies, and is not brought by the external air in which it does not exist. The ferment is secreted by organised cells which have arrived at a certain stage of their development; it is soluble and acts in the manner of diastases, changing the constitution of bodies with which it is found in relation, decomposing them, and determining the combination of their elements in forms generally more simple than those which originally existed. The presence of air is necessary to the life of the ferment, which finds in atmospheric oxygen the excitation necessary to its development and to the maintenance of its existence. Oxygen intervenes not merely to excite the vitality of the ferment, but further to burn the alcohol produced in the act of fermentation, and to furnish in consequence of such combustion the animal or vegetable heat necessary for the exercise of vital functions.

Chemical Industry at the Universal Exhibition of 1878.—A. Kopp.—*Bleaching*: The author gives an account of various improvements latterly introduced or suggested. Van Baerlé makes use in cotton bleaching of a sulphurous silicate, a clear solution of an alkaline silicate, and a sulphite. The raw material is steeped for twenty-four hours in this liquid at 2° B., passed immediately into hydrochloric acid at the same strength in a washing-machine, washed in cold water, and chlored slightly, and again washed in much water. According to Grothe the soluble glass is successfully applied in bleaching cotton. In class 47 of the chemical products is found the chlorozone of Dienheim-Brochoki, a so-called new bleaching-agent with an alkaline base. It is merely the solution of a caustic or carbonated alkali, saturated in the cold with a current of hypochlorous acid mixed with a current of air. The use of alkaline permanganates followed up by an acid, as proposed by MM. Tessié du Motay, Rousseau, and Maréchal is not now in use for any textile fibre. The solutions of certain sulphides, such as those of sodium, calcium, &c., have proved still less successful. M. Tessié du Motay's proposal to use barium peroxide for bleaching tussah silk has proved practically successful. M. C. Girard submits silks to the following processes:—A bath of weak hydrochloric acid removes all calcareous matter; the "ungumming" is then performed by means of carbonate of soda or caustic soda, marking 2° B., followed by rinsing; then follow baths of weak hypochlorite of ammonia varying in number according to the nature of the material, a passage in hydrochloric acid followed by rinsing, and a bath of slightly ammoniacal oxygenated water succeeded by a final washing. The hypochlorite of ammonia is prepared by decomposing sulphate or carbonate of ammonia with a solution of hypochlorite of lime. The bleaching is partly performed in the cold, and lasts for several days according to the nature of the fibre.

*Atti della R. Accademia dei Lincei.*  
1877-78. Serie Terza. Transunti, vol. ii.

On a Poisonous and Crystalline "Ptomain," extracted by means of Ether from the Viscera of Two Exhumed Corpses in which Arsenic had been found in Plenty.—Prof. Selmi.—The author gives a very full description of the reactions of this alkaloid, but he has not determined its composition.

The Physiological Spectral Phenomenon of Dr. G. Colasanti.—By this name the author signifies the phenomenon recently described by Boll: a luminous aureola, composed of lucid points, observed when the central aperture of an eye adjusted to a distant object is struck by a homocentric pencil of very intense light.

The dimensions of the aureola vary within the spectral colours. It begins small with the red ray (6°), rises to 15° in the orange, and in the yellow to 30° (on the line D.) It arrives at its maximum, 36°, between D and E in the yellowish green, and diminishing rapidly, reaches 6° on the line G in the violet.

Lining of the Eye in Mammiferous Animals.—Gaetano Mazzoni.—The so-called crystals of Réaumur consist of a mixture of guanin and xanthin, with a small quantity of hypoxanthin.

Occurrence of Tin at Campiglia.—M. Blanchard.—Ores of tin, to an extent capable of being worked, appear to be found at Monte Valerio, Cento Camerelle, &c.

## NOTES AND QUERIES.

Indelible Ink.—Requiring an indelible ink that would do without heating, and being unable to get any information here, I began some experiments myself and succeeded in some measure. I find that an ink can be made from hydrochlorate of aniline and red prussiate of potash in two solutions to be mixed when wanted. This ink requires no heating and will not wash out, but is acted on at once by *mango*.\* I added a little bichloride of copper, which is an improvement, but does not effectually resist the mango. I tried Blackwood's jetoline, and find it no better. The *English Mechanic* published a recipe for an ink said to be chemically indelible, but mango takes it out entirely. The principal ingredients of it are hydrochlorate of aniline in one solution, and bichloride of copper and ammonia in the other. I would be very thankful for a recipe for an ink that would require no heating and not be changed by chlorine, &c., and if possible be in one preparation.—T. W.

\* "Mango" is a trade name for solution of chloride of lime, and is largely used in public laundries for making the linen white.

## THE QUARTERLY JOURNAL OF SCIENCE.

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

Now ready, No. LX., October, 1878, price 5s.

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Notices of Scientific Works, Scientific Notes, &c.

London: 3, Horse-Shoe Court, Ludgate Hill, E.C.

## KING'S COLLEGE, LONDON. EVENING CLASS DEPARTMENT.

WINTER SESSION, 1878-9.

CHEMISTRY at 7 p.m., Monday, October 7th; Thursday, October 10th. Mr. W. N. HARTLEY.  
ANALYTICAL CHEMISTRY, from 7 till 9 p.m., Tuesday, October 8th. Mr. W. N. HARTLEY.

Fee for the Course of Lectures, £1 11s. 6d.; for the Laboratory, £2 2s. The Session terminates in March.

TO TAR DISTILLERS AND OTHERS.

The Directors of The Gas Light and Coke Company require the services of a duly qualified person as manager of their Tar Works at Beckton, under the supervision of the Resident Engineer of the Station.

He must possess a knowledge of Chemistry and be thoroughly acquainted with all the details of the distillation of Tar, and also be able, if required, to design and superintend any addition to the Works which may become necessary.

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Applications in writing accompanied by Testimonials, stating age and experience, should be addressed to me on or before Thursday, the 10th October.

(By order)

JOHN ORWELL PHILLIPS,  
Secretary.

Chief Office,  
Horseferry Road, Westminster,  
September 20, 1878.

THE CHEMICAL NEWS.

Vol. XXXVIII. No. 984.

ON THE  
ESTIMATION OF MINERAL OIL OR  
PARAFFIN WAX IN MIXTURES OF EITHER OF  
THESE SUBSTANCES WITH OTHER OILS  
OR FATS.\*

By WILLIAM THOMSON, F.R.S.E.

MIXTURES of mineral oil with other oils or fats for lubricating purposes have lately become of very general use, and as the problem to determine the percentage of mineral oil in such mixtures has many times been presented to me, I made a series of experiments with a view to devise a quick and accurate process for its estimation, and consider I have been successful in doing so, the process being equally applicable to the estimation of paraffin wax in mixtures of that substance with stearine or other fats or oils.

The principle adopted has been before suggested, but from the manipulative difficulties connected with the published process, I was unable to obtain any results by following it, whilst other published processes I found to be entirely erroneous.

The principle worked out was the saponification of the animal, vegetable, or fish oils or fats, with an alcoholic solution of soda, and the separation of the unsaponifiable oil or wax by means of light petroleum spirit, and the following gives the minutiae of the process, which was arrived at after many trials with known mixtures:—

200 grs. of the sample to be analysed are placed in a 10 ounce deep porcelain basin, and 350 grs. of an alcoholic solution of caustic soda (containing 9 grs.  $\text{Na}_2\text{O}$  in every 100 grs. measure of solution) added; the mixture is stirred, and heated to ebullition, and allowed to boil until the whole mixture begins to froth up: about 200 grs. measure of distilled methylated spirit are then added, and heat again applied till the resulting soap, &c., is dissolved. 90 grs. of bicarbonate of soda are now added and stirred into the mixture in small quantities at a time, to convert the uncombined caustic soda into carbonate, and, lastly, 500 grs. of previously washed and ignited mortar sand is added to the contents of the basin, and the whole intimately mixed together by stirring, the heating or boiling being continued for a few minutes longer over the Argand burner. The basin, with its contents, is now placed on a steam-bath until the last trace of alcohol or water is expelled, and the whole allowed to cool, and the contents of the basin carefully transferred to a clean, dry, wide-mouthed, stoppered bottle, of about 30 ounces capacity. The bottle is then filled about a quarter full and shaken with petroleum spirit which has previously been distilled at a temperature not exceeding  $190^\circ \text{F}$ . The stopper is then cautiously removed, and the bottle filled nearly full with petroleum spirit, and again shaken. The soap and sand separate very readily, the sand having a very remarkable power of bringing down the soap with it, leaving a clear liquid containing the mineral oil or wax, which is syphoned off through a filter of asbestos in the bottom of a  $4\frac{1}{2}$ -inch funnel (paper filters are apt to become clogged with the soap). The bottle is again filled and shaken with petroleum spirit, and the clear liquid again syphoned off from the soap and sand; a third treatment with petroleum spirit suffices to remove all the mineral oil or wax, and the residual sand and soap may be thrown on a cloth

and pressed to remove all the liquid from the plastic mass. The liquors containing the mineral oil are put, or filtered through paper if necessary, into a 40-ounce glass flask fitted with cork and condenser, the flask placed in a vessel of boiling water, and the spirit distilled off, which it does very rapidly.

When the whole of the petroleum spirit solution has thus been concentrated it is transferred to a 15-ounce flask provided with a hole blown in its side, into which fits a cork bearing a thermometer and small glass tube, all of which together have been previously tared. This flask is then placed on a sand-bath on its side, and the spirit further distilled off, being allowed at first to condense in a Liebig's refrigerator; afterwards this is detached when the thermometer, which must dip into the liquid, registers about  $220^\circ \text{F}$ . A current of dry air is now blown through the tube in the cork which expels the last trace of spirit, and the flask is then wiped with a clean cloth, and the whole arrangement with the oil or wax is allowed to cool and weighed, and the oil thus found calculated on the quantity originally taken.

There are, however, small corrections which should be made, because so-called saponifiable oils or fats contain small percentages of oils or fats which cannot be saponified and are dissolved by the petroleum spirit. As an example of this I give a few results:—

1. 25 grs. of Russian tallow were taken, saponified, and the resulting soap treated with petroleum spirit as above described, and 0.16 gr. of soluble matter was left, equal to 0.64 per cent.

2. A mixture was made of paraffin wax and tallow in the following proportions:—

Paraffin wax .. .. .	150 grs.
Tallow .. .. .	50 ,,
	200 ,,

This mixture was saponified, and the paraffin separated as above described and weighed. The amount found was 150.45 grs.; if tallow contains 0.64 per cent of unsaponifiable fat, then 50 grs. will give 0.32 gr.; total 150.13 grs. Taking this correction into consideration the mixture was found to contain 75.06 per cent instead of 75.00 per cent, giving an amount of 0.06 per cent in excess of that which the mixture contained.

3. A mixture was taken composed of:—

Mineral oil .. .. .	50.05 grs.
Olive oil .. .. .	150.05 ,,
	200.10 ,,

This was submitted to the above process, and the unsaponifiable oil found was 51.64 grs.; I know from previous experiments that olive oil leaves some unsaponifiable matter soluble in petroleum spirit, but have not estimated accurately its amount, assuming, however, that it contains the same amount as tallow, viz., 0.64 per cent, the 150.05 parts would give, say, 0.96 gr.; leaving for mineral oil 50.68. Calculating these results to per cent, the mixture contained of mineral oil, 25.01 per cent; found by analysis, 25.32 per cent.

Other analyses were made in duplicate of mixed oils, the compositions of which were unknown, and the results obtained agreed very closely with each other. In conclusion I have pleasure in acknowledging the aid I have obtained through the care and perseverance with which my assistant, Mr. Peter Henry Walsh, has carried out the experiments connected with this investigation.

Royal Institution, Manchester.

**Adulteration of Potassium Bitartrate.**—According to a paper by Dr. Squibb in the *Druggists' Circular*, the amount of true cream of tartar in this drug ranges from 92 per cent down to 10 per cent, the remainder consisting of tartrate of lime and *terra alba* (ground alabaster).

\* Read before the Chemical Section of the British Association, Dublin, 1878.

## A NOTE ON CHLOROPHYLL.

By A. H. CHURCH.

DURING some inquiries, which have now extended over three years, into the nature of the red pigment of beet-leaves, I obtained as a by-product a considerable quantity of crude chlorophyll. It had been extracted by means of ether from some hundreds of the dried leaves of a red-leaved variety of the garden beet. After removal of the ether the residue was exhausted with cold alcohol of 85 per cent, in order to effect at least a partial purification of the chlorophyll. The chlorophyll from the alcoholic solution was dried *in vacuo* over oil of vitriol, light being excluded. The product was not of a very satisfactory colour, and was left for a time without further attention. After the lapse of a few months the mass had become of so unpleasant an olive-brown hue that any idea of further work upon it was abandoned. But after some consideration it seemed a pity to throw away a substance which had been obtained with so much labour. And it struck me that some clue to the constitution or relationships of chlorophyll might possibly be secured by submitting my product, altered though it seemed to be, to the process of destructive distillation in contact with zinc dust. Accordingly the dark mass of chlorophyll was mixed with four times its weight of zinc powder, and placed in the water-oven for an hour or two. To my surprise its green colour was not merely restored—it became far more intense and characteristic in hue than the best sample of leaf-green I had ever before seen. The red fluorescence and spectral bands of its alcoholic solution were, moreover, those of the unchanged pigment. It would therefore seem that the gentle reducing action to which the pigment had been submitted when warmed with the metal in the presence of moisture had brought it back to the state in which it existed prior to its removal from the plant and exposure to the oxygen of the air. I trust to be able to pursue this promising line of research. After all, my original intention was carried out, and a considerable portion of the brilliant green mass still containing zinc (together with some sand to prevent frothing) was distilled in a current of dry hydrogen. It yielded about 30 per cent of its weight of an oily distillate, the less volatile portions of which solidified into a crystalline mass on cooling. Ether dissolves this distillate with a blue fluorescence; caustic soda solution does not appear to dissolve or affect it. It seems to be a mixture of not less than three substances, possibly hydrocarbons, but as yet not identified.

Cirencester, September 9, 1878.

## THE BEHAVIOUR OF NATURAL SULPHIDES WITH IODINE AND OTHER REAGENTS.\*

By H. CARRINGTON BOLTON. Ph.D.

IN a paper on the "Application of Organic Acids to the Examination of Minerals," presented to the Academy about a year ago,† we endeavoured to show that citric (or tartaric) acid and potassium nitrite can be advantageously added to the usual list of dry reagents employed in the determination of minerals. Owing to the facility with which the latter reagent is decomposed by the former, nitric acid can be carried practically in the solid form; hydro-potassium sulphate, already in use,‡ furnishes sulphuric acid in a solid state; and remains therefore to provide for hydrochloric acid, or chlorine. The alkaline chlorides, however, resist the action of organic acids; and a few experiments with easily decomposing sulphides

yielded only negative results. Iodine, on the other hand, while less powerful than chlorine, possesses similar properties, and in aqueous solution it attacks many minerals, giving rise to characteristic phenomena.

The employment of bromine in analytical operations\* has already demonstrated its power in decomposing natural sulphides; and it is precisely with these minerals that the most satisfactory results are obtained by the action of iodine.

The specimens named below are the same as those whose source and condition have been described in the paper referred to. The method of examination is exceedingly simple; the minerals in fine powder are placed in test-tubes, a small quantity of pulverised iodine is added, and then water poured on; after standing in the cold for some hours (usually over night), the results are noted; the contents of each tube are then heated to boiling, and the results again recorded. The solutions were tested by suitable reagents after expelling by heat the excess of iodine.

*Stibnite*, treated in the manner described, is strongly attacked; and with excess of iodine the solution turns deep brown-red. On boiling the red solution, it loses colour as the iodine volatilises, and after the latter is completely expelled, suitable reagents demonstrate the presence of sulphuric acid and of antimony. The decomposition of this mineral is complete.

*Molybdenite* is not attacked either in the cold or on boiling.

*Argentite* is attacked in the cold, yielding a red solution and a yellowish white precipitate. If an excess of iodine be present, the mineral is completely decomposed in the cold.

*Galenite* is decomposed in the cold, the liquid being completely decolourised. Lustrous, yellow crystals of plumbic iodide form on the surface of the mineral. On heating; the action is increased; and the solution deposits, on cooling, large and abundant crystals.

*Bornite* is strongly attacked in the cold, the solution being brown-red and the residue yellowish-white. On heating, the decomposition is hastened, and a heavy precipitate of cuprous iodide forms.

*Sphalerite* is strongly attacked in the cold, the solution turning dark red and crystalline precipitate forming. On heating, the decomposition is complete.

*Chalcocite* is strongly attacked in the cold, the solution with excess of iodine being brown-red. On the application of heat, the action is increased, but little (if any) cuprous iodide forms.

*Cinnabar* is strongly attacked in the cold. On heating, it is readily decomposed, with formation of small scarlet crystals of mercuric iodide.

*Pyrrhotite* is strongly attacked in the cold; the solution is not completely decolourised, and becomes darker on heating.

*Pyrite* is decidedly attacked in the cold; on boiling, the action is increased, but the decomposition appears to be incomplete.

*Niccolite* is strongly attacked in the cold, yielding a green solution, which turns brown on heating with excess of iodine.

*Smaltite* is strongly attacked in the cold, forming a brown-red solution; heat increases the action.

*Chalcopyrite*† yields a deep red solution in the cold; the action is increased by boiling, but no precipitate forms.

*Tetrahedrite*, *ullmannite*, and *arsenopyrite* behave like chalcopyrite.

*Bournonite* yields a deep-red solution in the cold; and on heating, a heavy precipitate falls, which is evidently a mixture of plumbic iodide with yellowish-white cuprous iodide.

\* Read before the New York Academy of Sciences, March 18, 1877.  
† *Annals N. Y. Acad. Sci.*, vol. i., p. 1.

‡ Distinction of Natural Sulphides by Bisulphate of Potassa; E. Jannettaz (Transl. from *Comptes Rendus*). *Am. Chem.*, iv., 450.

\* P. Waage; *Zeitschr. anal. Chem.*, 1871.

† Meusel has studied the behaviour of chalcopyrite with hydriodic acid; *Ber. Chem. Ges.* iii., 123, 1870.

From the preceding notes, it appears that molybdenite is the only one of the seventeen sulphides examined, which resists the action of an aqueous solution of iodine. The reactions of galenite and cinnabar are characteristic and beautiful; that of bournonite discloses its composition very satisfactorily. The difference of behaviour between bornite and chalcocite is marked.

The results obtained with pyrite and pyrrhotite require some explanations. Professor Henry Wurtz,\* in 1858, employed iodine-water to separate pyrrhotite from pyrite; he states that pulverised pyrite digested for 48 hours in the dark with a brown solution of iodine (pulverised and washed repeatedly to remove all free acid), "did not remove the brown colour of the liquid, and the latter had dissolved but a trace of iron." We repeated this process, observing all the precautions mentioned, and found that pyrites (from Colorado and from Saxony), was decidedly attacked. Possibly the discrepancy is only one of judgment as to the amount of decomposition which ensues, but under ordinary circumstances we are confident that iodine (in excess) with water decomposes pyrite.

Besides the natural sulphides, we examined the action of an aqueous solution of iodine on a few minerals belonging to various classes. Limonite, hematite, magnetite, and the manganese oxides, as well as pyromorphite and calamine, are not attacked even on boiling the solution. Cuprite is completely decomposed in the cold, with formation of a bright green crystalline precipitate (CuIO<sub>3</sub>?). Brucite, calcite, and natrolite are decidedly attacked on boiling. Anglesite is feebly attacked in the cold, and strongly on heating; cerussite and vivianite appear to be slightly decomposed under the same circumstances. None of these reactions have special interest, except perhaps that of cuprite, which is quite characteristic.

Having continually in mind the possible application of methods to the examination of minerals in the field, and recognising the impracticability of carrying iodine save in glass bottles, we were led to make another series of experiments with a view to providing iodine in a portable state. To this end, we took advantage of the ready decomposition of potassium iodide by organic acids. That even the weakest acids are able to set hydriodic acid free, in acting on the iodides of the alkaline metals, has been frequently noticed,† and we add the following observations:—

When solid potassium iodide is added to strong acetic acid, in the cold, hydriodic acid is set free; and after standing for some time (24—48 hours), this acid decomposes, and the free iodine communicates to the solution a brownish-red colour of varying intensity. With free access of air, the liberation of iodine begins at once, as shown by testing the mixture with carbon disulphide. This action is more marked in strong solutions than in weak.

Tartaric and nitric acids decompose potassium iodide in a similar manner.

A mixture of any of these organic acids with potassium iodide proves to be a powerful solvent of the natural sulphides. An examination of the seventeen sulphides already mentioned gave the following results:—

#### Behaviour with Potassium Iodide and Citric Acid.

*Stibnite, argentite, sphalerite, chalcocite, bornite, and ullmannite* are attacked in the cold, with liberation of sulphuretted hydrogen; heat increases the action,—the gas coming off freely.

*Galenite* acts in the same manner, with formation of

yellow crystalline flakes of plumbic iodide. On applying heat, the mineral is completely decomposed.

*Cinnabar* is also decomposed in the cold, with liberation of sulphuretted hydrogen. On boiling, the decomposition is complete, and crystals of mercuric iodide deposit on cooling, provided no great excess of potassium iodide is present.

*Arsenopyrite* is decomposed in the cold, but no sulphuretted hydrogen appears to be set free. On boiling, the decomposition proceeds rapidly.

*Pyrrhotite, chalcopyrite, and bournonite* yield no sulphuretted hydrogen in the cold, but freely on heating. The latter is but feebly attacked.

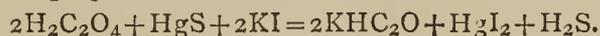
*Pyrite, niccolite, and smaltite* give no sulphuretted hydrogen, either cold or hot, though they are strongly attacked on boiling the liquid.

*Tetrahedrite* is attacked feebly in the cold; on heating, the action is increased.

*Molybdenite* resists the action of this mixture of reagents.

Similar results were observed with tartaric and oxalic acids, their decomposing power varying. *Cinnabar*, treated with a mixture of potassium iodide and oxalic acid, is decomposed with remarkable facility; the reaction sets in immediately and in the cold; on boiling, the decomposition continues with violence; and on cooling, the solution deposits white crystals of hydro-potassium oxalate, mixed with scarlet crystals of mercuric iodide.

The probable nature of this reaction is shown in the following equation:—



We examined the behaviour of a few additional minerals with a mixture of potassium iodide and citric acid, with the results recorded below; but no special interest seems to be attached to this method of attack.

*Magnetite* is decidedly, and *franklinite* feebly, attacked in the cold, and strongly on heating. *Hematite* is feebly attacked, and *chromite* not at all.

*Hausmannite, pyrolusite, and the other oxides of manganese*, being attacked by citric acid alone, yield, as may be anticipated, deep brown-red solutions coloured by the iodine.

*Anglesite and pyromorphite* are completely decomposed in the cold, with formation of a yellowish-white precipitate of plumbic iodide.

*Cuprite* is also completely decomposed in the cold, with formation of a yellowish-white precipitate of cuprous iodide, and a colourless solution. If, however, heat be applied at the outset, the same precipitate forms, while the solution is of a blue colour.

We also examined the behaviour of natural sulphides with a mixture of citric acid and potassium bromide. The latter does not, however, appear to be so easily decomposed as the iodide, and no characteristic phenomena were observed; nearly all the metallic bromides being soluble in water, no precipitates were obtained. In order to avoid repetition, we may briefly summarise the results by stating that, in general, the action of the bromide is less energetic than that of the iodide. Those minerals which yielded only with difficulty to the latter reagent resist the former even on heating. *Cinnabar*, whose behaviour with the iodide is so remarkable, is but feebly attacked by the bromide. *Argentite, galenite, sphalerite, chalcocite, pyrrhotite, pyrite, and chalcopyrite*, are attacked in the cold, with or without liberation of sulphuretted hydrogen. *Molybdenite* resists this mixture of reagents, as well as the others previously mentioned.

In studying the behaviour of minerals with organic acids, we obtained results which were embodied in a Table\* exhibiting the eleven groups into which minerals are divided by the action of citric acid alone, and with reagents. We are now able to add a twelfth group, viz: "minerals decomposed by heating with citric acid and

\* On some Improvements in the Preparation of Hard Minerals for Analysis, read before the A. A. A. S., at the Baltimore meeting. *Am. J. Sci.*, [2], vol. xxvi., p. 190.

† Dr. Rudolph Behm, in his *Handbuch der Spec. Pathologie und Therapie*, vol. xv., p. 21, quotes Struve's discovery that even hydrosodium carbonate decomposes potassium iodide in dilute aqueous solution. This power of carbonic acid has also been observed by Kammerer (*Virchow's Archiv*, lix., 1874), and Binz (*ibid.*, lxii).

potassium iodide," and to transfer thereto, from the list of "minerals not decomposed by the above reagents," four species—cinnabar, magnetite, hematite, franklinite.

Thus of the ninety minerals whose behaviour with organic acids and reagents has been examined, only nine resist these methods of attack.

Trinity College, Hartford, Conn.

## LABORATORY NOTES FROM THE UNIVERSITY OF CINCINNATI.

By F. W. CLARKE, S.B., Professor of Chemistry.

### ON SOME SELENIOCYANATES.

IN 1855 Buckton discovered and described the double sulphocyanates of platinum.\* Of these the potassium salt is perhaps the one best known, partly because of its beauty, and partly because of the ease with which it may be prepared. Recently, my attention having been called to this compound, it occurred to me that it might be interesting to prepare the corresponding seleniocyanate. Accordingly I assigned the task to Mr. W. L. Dudley, a student in the University of Cincinnati, who had little difficulty in attaining to success.

When an alcoholic solution of potassium seleniocyanate is added to a similar solution of platinic chloride, a heavy reddish brown precipitate is immediately formed. This, upon boiling, becomes darker in colour, and apparently in part dissolves. The filtered liquid deposits crystals of new salt, mixed with a reddish sediment of selenium; and these, although they are slightly unstable, may be purified by re-crystallisation from alcohol. The crystals are usually very small, mere scales in fact; although on one occasion they separated out as regular six-sided tables, several millimetres in diameter. By reflected light they are nearly black, but by transmitted light deep garnet red. Specific gravity, 3.377 at 10.2°, 3.378 at 12.5°. The weighings were made in benzol. Determinations of platinum and potassium came out as follows:—

	Found.	Theory.
Potassium .. ..	8.57	8.61
Platinum .. ..	21.64	21.73

There is, therefore, no reasonable doubt that the new salt is represented by the formula  $K_2Pt(CSeN)_6$ , and that it is strictly analogous to Buckton's sulphocyanate.

An attempt to prepare gold salts resembling the sulphocyanates described by Cleve† was only partially successful. When alcoholic solutions of potassium seleniocyanate and neutral gold chloride are mixed, a red precipitate falls, which consists in large part of free selenium. The pale orange-yellow filtrate from this precipitate yields by spontaneous evaporation a crystalline crust, which, under the microscope, is seen to be made up chiefly of minute deep red prisms. These crystals are so very unstable that we could obtain but a very small quantity of them, and in a somewhat impure condition. They yielded 48.31 per cent of gold, whereas the salt  $KAu(CSeN)_2$ , analogous to the potassio-aurous sulphocyanate of Cleve, should contain but 43.94. As the new salt was prepared by a method precisely similar to that which gave Cleve his sulphocyanate, there can be little doubt that we had to deal with the corresponding seleniocyanate, mixed with free gold. If we had been able to command larger quantities of material, we might have been able to prepare the compound in a state more nearly approaching purity.

No seleniocyanate resembling Roesler's potassium chromo-sulphocyanate,  $K_6Cr(CSN)_{12} \cdot 8H_2O$ ,‡ could be obtained. When aqueous solutions of chrome alum and

potassium seleniocyanate are mixed, selenium is precipitated, and no trace of any double salt seems to be formed.

### ON THE ELECTROLYTIC ESTIMATION OF MERCURY.

In 1865 Wolcott Gibbs published his well-known method for the electrolytic estimation of copper.\* More recently Merrick has shown that a modification of the same process is applicable to nickel and to zinc.†

Having occasion recently to make a number of copper determinations by this method, it naturally occurred to me that it might be extended still farther, especially to the cases of cadmium and mercury. With cadmium I was disappointed, but with mercury successful. Cadmium may indeed be completely precipitated by electrolysis from an ammoniacal solution, but it comes down in a spongy porous form, enclosing various impurities which cannot be readily washed out. Accordingly the results came out several per cent too high. The mercury, however, gave results in every respect satisfactory.

A solution of mercuric chloride, slightly acidulated with sulphuric acid, was placed in a platinum dish connected with the zinc pole of a six-cell Bunsen's bichromate battery. The wire from the carbon pole terminated in a thin slip of platinum foil, which dipped into the solution. At first mercurous chloride was precipitated, but this by degrees was reduced to the metallic state, so that after an hour or so there remained in the dish a clean mass of mercury, covered by a solution in which ammonia failed to produce the slightest turbidity. When I poured off this clear acid solution the mercury became covered with a thin tarnished film, which at first annoyed me considerably. I soon found, however, that this annoyance could be avoided very easily. I simply drew off the solution from above the mercury by means of a pipette, and replaced it with clean water; doing this several times before disconnecting the platinum dish from the battery. Then, upon decanting the very feebly acid supernatant liquid, the metal remained perfectly bright and clean. It was only necessary after this to rinse thoroughly with pure water, then with alcohol, and lastly with ether, and to dry under the receiver of an air-pump. Two determinations made with mercuric chloride gave respectively 73.76 and 73.85 per cent of mercury. Theory, 73.80. There are no difficulties in the process, and no appreciable sources of error. Although I have made actual determinations of mercury only with chloride, I have tested other salts of the metal and have found that the precipitation is similarly perfect. In one instance I employed a solution of mercury containing a heavy precipitate of basic sulphate. This precipitate was readily and completely decomposed by the electric current, so that ultimately nothing but metallic mercury remained visible in the solution. In every case mercurous compounds appear to be thrown down first, so that their final disappearance furnishes a sharp end reaction to indicate when the operation is complete.—*Am. Journ. Science.*

## SYMBOLIC POINTS OR GRAPHIC RELATIONS BETWEEN THE ATOMIC WEIGHTS AND THE ATOMIC VOLUMES OF SIMPLE BODIES.

By A. F. NOGUES.

FOR some years the author has been occupied with an important problem in atomic physics "on crystallisation and on changes of structure induced by molecular movements." It is well known that iron is capable of crystallising when raised to a temperature sufficiently high to soften it. Platinum is also capable of crystallising by

\* *Chem. Soc. Quart. Journ.*, vii., 22.

† *Jahresbericht*, 1865, p. 295.

‡ *Journ. für Prakt. Chem.*, cii., 316.

\* *Am. Journ. Sci.*, xxxix., 64.

† *Am. Chem.*, October, 1871; *CHEM. NEWS*, xxiv., 100, 172.

molecular movements without previous liquefaction. This study of crystallisation of molecular movement has necessarily led the author to researches on the properties of solid bodies. He describes a graphic table formed by placing upon squared paper the atomic weights and atomic volumes upon the lines of the abscissæ and ordinates. He gives some remarkable lines of symbolic points. In the first place the five metals, manganese, iron, nickel, copper, and cobalt, form a close and numerous group which may be called the group of the magnetic metals. If we then draw a straight line, passing by iron and very near manganese, and afterwards very near phosphorus and sulphur, the same series comprehends titanium and chrome. Another straight line through nickel and cobalt passes afterwards by zinc, tellurium, arsenic, and selenium. A straight line taken through manganese and iron passes by molybdenum, ruthenium, cadmium, osmium, and bismuth. There are therefore three remarkable linear series which intersect each other in a narrow space in the midst of the group of the five metals. But among these three we must distinguish the one which takes a mean direction between the two others (nickel, cobalt, zinc, tellurium, arsenic, selenium), and which is parallel to three other important linear series—the four parallel series are, in fact, composed of the following elements:—

1. Carbon, aluminium, sulphur (and phosphorus very near).
2. Nickel and cobalt, zinc, tellurium, arsenic, selenium (by the group of the magnetic metals).
3. Palladium, rhodium, cadmium, tin, antimony.
4. Platinum, gold, tungsten, iridium, mercury, lead, silver, bismuth (precious metals?).

Sulphur and phosphorus are situated very near the intersection of the oblique line passing by titanium and the magnetic metals. But the most remarkable is the line which connects the magnetic metals with bismuth: the precision with which it passes through manganese, iron, cadmium, and bismuth is very singular; further, this linear series is connected with that of the precious metals by bismuth, and with the palladium and antimony series by cadmium.

It is easy to comprehend the importance of this method of grouping simple substances, both for classification, for the study of certain special properties, and for detecting the analogies of the elements.—*Correspondance Scientifique.*

#### VERIFICATION OF GRADUATED GLASS VESSELS AND AREOMETERS FROM 4° to 45° C.\*

By P. CASAMAJOR.  
(Concluded from p. 158)

WE may now proceed to eliminate the condition of weighing *in vacuo*, by considering that a body, placed in a medium, loses a weight equal to that of the medium displaced.

Therefore, if we subtract from the numbers of the second column the weight of 100 c.c. of air at the atmospheric pressure, and at the various temperatures from 4° to 45° C., we obtain quantities expressing the number of grms. of distilled water which, at the pressure of the atmosphere, would occupy a space in a glass vessel which at 15° is equal to 100 c.c. We have done this for the pressure equal to 760 millimetres of mercury, the normal pressure of the atmosphere. At this pressure, and at 0° C., 100 c.c. of air weigh 0.1293 gm., and we might take this weight as the base of our calculations; but we may take into account the weight of air displaced by the brass weights, placed on the other pan of the balance, which is to be subtracted. As all the larger weights used by chemists

are made of brass, where specific gravity is 8, we should take seven-eighths of 0.1293 = 0.1132 gm., which is the difference of the weight of air displaced at 0° C. by 100 c.c. of water, and by the corresponding brass weights.

The expansion of air for every degree Centigrade is equal to 0.00366, and, therefore, the weight of air, which at every degree of temperature occupies the same volume as 0.1132 gm. at 0° is—

$$\frac{0.1132}{1 + 0.00366 t},$$

*t* being the degree Centigrade.

By subtracting the numbers thus obtained from those of the second column of Table No. 2, we obtain in a third column the number of grammes of distilled water, which at the normal pressure of the atmosphere and for every degree from 4° to 45° C., we are to weigh, so as to fill up a volume in a glass vessel, which at 15° is equal to 100 c.c.\*

In conclusion of this first part, which relates to graduated measuring-vessels, I propose to repeat what I have said on a previous occasion (*Proceedings of A. C. S.*, vol. i., second part, p. 23, foot-note), to show the accuracy of the numbers in Table No. 1. I do this because, if I have been successful in explaining what I had to say, you must be satisfied that if Table No. 1 is correct Table No. 2 is equally so.

A long time before calculating Table No. 1, I found directly by experiment (*American Chemist*, June, 1874, p. 449) that the total relative expansion of water from 5° to 45° C. was 0.00021. Now, if we calculate this same quantity from Table No. 1, by adding the total contraction at 5° (0.000612) to the total expansion at 45° (0.008312), the sum 0.008924, divided by 40, will give 0.000223, which is as near 0.000210 as could be expected, if we remember that the extreme numbers, 0.000612 and 0.008312, contain the accumulated errors of this table.†

#### Verification of Areometers.

The areometer whose correctness we have to verify may either indicate specific gravities, or its scale is one whose divisions are equal to one another. In the latter case, the specific gravity corresponding to any division of the scale may be found by the formulæ which were given in the paper "On Areometers," which I had the honour of reading before this Society in the month of April of last year.

In these formulæ *N* is the total number of degrees of even scale, *d* a degree of this scale, and *P* the corresponding specific gravity. We have—

$$N = \frac{Pd}{P-1}$$

$$P = \frac{N}{N-d}$$

$$d = N - \frac{N}{P}$$

If, for instance, we take for the specific gravity of sulphuric acid, H<sub>2</sub>SO<sub>4</sub>, the number 1.845, found by Dr. Ure, and use Beaumé's areometer, in which this specific gravity corresponds to 66°, we have—

$$N = \frac{1.845 \times 66}{0.845} = 144.02,$$

which is as near as possible the generally accepted standard for Beaumé's areometer in Germany and in this country, in which *N* = 144. As, however, graduation of even scale can never be anything but a conventional matter, any other number, *N*, founded on any other specific gravity, as determined by any other chemist, would be equally

\* As the capacity equal to 100 c.c. at 15° in a glass vessel varies with the temperature, a further correction might be made for this variation, but it is so insignificant as not to affect the fourth decimal at 45° C.

† The table of Dr. Hermann Kopp agrees still more closely with the result I found; it gives for the mean expansion for 1°, between 4° and 45° C., 0.000209. (See *American Chemist*, June, 1874, p. 449.)

good, provided this other number, N, was generally accepted.

In the paper to which I have referred mention was made several times of the verification of areometers by ascertaining the corresponding specific gravity by the balance; but I did not enter into any details as to the manner of taking these specific gravities. I propose to do this now, as the subject is one of great importance, and more open to misunderstandings than I had supposed.

We must, in the first place, recal the definition of the specific gravity of a liquid, which is—the quotient obtained by dividing the weight of a certain volume of the liquid by the weight of the same volume of water, both weights being taken at the same temperature and the same pressure.

If our measuring vessels retained a constant volume at all temperatures, and if the dilatation of all liquids was the same for equal variations of temperature, the specific gravity of a liquid, which is its weight compared with that of water, under the same volume, would be the same at all temperatures. If at 4°, and *in vacuo*, 100 c.c. of a liquid, whose specific gravity is 1.5, weigh 150 grammes, at 25°, and *in vacuo*, the weight of 100 c.c. of water being—

$$\frac{1}{1.003067} = 99.69 \text{ grammes,}$$

the weight of 100 c.c. of the liquid in question would be  $99.69 \times 1.5 = 149.535$  grammes.

As the volumes of glass vessels increase by heat, and as the expansions of liquids are different for the same variation of temperature, it is customary in areometers, as in measuring vessels, to specify that the graduations are taken at a certain temperature, which is generally 15° C.

For the purpose of testing areometers, and, in general, for taking the specific gravities of liquids at 15°, it is very convenient to have a glass flask, which, at 15° and at the pressure of the atmosphere, holds 100 grammes of distilled water up to a line on its neck. Then the number of grammes gives directly the specific gravity, at 15°, of any liquid, occupying the same space, without further calculation.

Now, I wish to call to your attention, that, if we have a flask graduated in this manner, we may, at any temperature, obtain indications to verify the scales of areometers.

If the temperature of the liquid is different from 15°, and the areometer marks 1.5 specific gravity, the indication is not correct on account of the variation of the volume of the liquid and of the areometer. But if we keep the liquid at the same temperature, and place it in the flask, so as to fill the volume, which, at 15°, holds 100 grammes of water, and we find that the weight of the liquid is 150 grammes, we may conclude that the areometer which showed 1.5 sp. gr. was correct.

The reason for this conclusion is, that, although both indications are incorrect, the error depends on the expansion of glass and the expansion of the liquid, and these are exactly the same in both cases; therefore, if these errors were eliminated, the equality would still persist.

To express this preposition algebraically, suppose that *a* and *b* are the indications that we would have at 15° with the areometer and the flask respectively, and that *x* and *y* are the errors in each case from operating at a temperature different from 15°. If  $a + x = b + y$ , and if at the same time  $x = y$ , then  $a = b$ .

## CORRESPONDENCE.

### HISTORY AND WORKING OF THE ALKALI ACTS OF 1863 AND 1874.

To the Editor of the Chemical News.

SIR,—In your article on the above subject in the CHEMICAL NEWS of 27th instant, you mention my name as objecting to the clause of the 1874 Act which fixes the limit of

escape at one-fifth of a grain of hydrochloric acid, and continue—"Mr. Maclart seems, however, to be alone in this opinion, and it seems to be pretty generally agreed amongst other manufacturers that the new mode of testing is superior to that in the original Act."

The Report of the Commissioners on Noxious Vapours does not give the evidence in full, and while you are justified in your statement by the extract in the report, I trust you will afford me the opportunity of saying that my opinion, as given in evidence before the Commission, is quite *contrary* to that ascribed to me, as you will see from the following extract from the printed evidence I prepared and laid before the Commission.

"Am of opinion that the Act of 1874 bears very unequally on manufacturers, and more heavily in many cases on those who are most anxious to condense well, and who have spent large sums for what, in many cases, is little more than an idea

Does not object to inspection—on the contrary, would be much pleased to see it largely extended and made more efficient. A large amount of the Inspector's work has at present to be done by the manufacturer. Witness's firm employs five chemists and two lads at their various works, constantly testing the escapes. Without this constant testing it would be impossible to keep the escape down to the 0.2 gr. per cube foot limit. Submits note of testings, which will show amount of work required.

There is an idea that the Act of 1874 reduced the escapes from 5 per cent to 2.5 per cent. This is an utter mistake. In a few works like our own, and those of Messrs. Chance, of Oldbury, the total escape has been reduced, but in many works it has actually increased.

I approve highly of the fixing a limit in the chimney, as being a simple and convenient means of getting at the escapes, but, as at present carried out, the honest manufacturer is at the greatest disadvantage.

Notwithstanding that our condensation is fully 99 per cent, it is quite impossible to keep our chimney escape down to 0.2 gr. per cube foot without what I consider to be a distinct evasion of the spirit of the Act, viz., diluting the gases with air.

This diluting the gases with air I object to most strongly, for many reasons, of which—

- 1st. It renders it much more difficult to attain accurate tests of the escape.
- 2nd. It necessitates the consumpt of more coal to heat this air up to the average chimney temperature; and
- 3rd. This extra coal increases the evil the air is to cure by giving off sulphur acids nearly equal to the reduction in HCl.

Take, for instance, two works of the same capacity and class, decomposing the same amount of salt, and consuming the same amount of fuel, working in exactly the same way:

No. 1	No. 2
Has only <i>one</i> chimney into which all the gases escaping from the works pass.	Has <i>ten</i> chimneys, into only <i>one</i> of which the escape of HCl passes.

It can at once be seen that on the present principle of rating escapes per cube foot, the No. 2 works are placed at an enormous disadvantage, as it is quite possible for the No. 1 works to send out nearly *ten* times more *weight* of HCl and yet comply with the required limit of 1874.

As a matter of fairness to those manufacturers who are anxious to do well, the escape ought to be taken on the total chimney gases; and I do not think there would then be a single work that could not honestly comply with the limit, because I know of cases where 15 per cent. of the HCl has been escaping, and yet the test of the chimney was not over 0.2 grain per cube foot.

Have spent very large sums of money in alterations and repairs, and would willingly do more if we could see what would be of benefit.

Feel aggrieved that after the expenditure of large sums of money and a large amount of time and attention, are not rated as being better than those who may be sending out the full 5 per cent.

No allowance is made for height of chimneys, as causing dilution, and if dilution is to be the measure surely this should be considered, as it has been seen from the case of coke ovens that the erection of a higher chimney has reduced the damage very much indeed.

No more stringent limit per cube foot could be complied with by us.

Would not object to a reduced limit of percentage, but think the Act of 1874 quite sufficient, if carried out, to prevent nuisance.

Think increased inspection urgently required, and inspectors of a high class necessary; also, that all works should be brought up to the standard of the best works of the present day before further legislation takes place. It is notorious that some works are very badly conducted, and undeniably do a great amount of damage.\*

A lower limit of escape per cube foot might be borne if taken on the total gases escaping from the works.

In these works the escape taken at the extreme limit of 0.2 in the chimney containing HCl is only equal to 0.023 on total chimney gas, as they would be if led into one chimney, which is quite impossible, owing to the large extent of ground covered by the works."

To illustrate further my ideas, suppose, for instance, that instead of using one tall chimney for all my salt-cake furnaces, I were to erect a small chimney of say 30 or 40 feet high for each furnace, I would have little difficulty in keeping them all down to the limit of one-fifth of a grain, even when sending out a much greater weight of hydrochloric acid than before, at a much lower level. It does not require much consideration to show that while this might comply with the requirements of the Act of 1874, it would enormously increase the cause of complaint, besides increasing the inspection (to, in my case, some 25 times more than is at present required.—I am, &c.,

JAMES MACTEAR.

St. Rollox, Glasgow,  
September 30th, 1878.

#### SUNDRY NOTES.

To the Editor of the Chemical News.

SIR,—The article in your journal for August 30, by Dr. Phipson, upon a new mineral white pigment, leads me to say that eighteen months, and one year ago, I did a great deal of work upon this pigment. My experiments were made upon ounces, pounds, and tons, and I can confirm what is said about its excellent qualities, with one exception. It was only by accident that I succeeded in getting it *pure white*. There would be, in nine cases out of ten, a faint yellow tint, sometimes more marked than at others; but too often visible enough to hurt the paint for the market. Oxide of zinc, made by combustion, becomes yellow on heating, and recovering its whiteness on cooling. The precipitated oxide, after having been heated, never becomes, I believe, fully white,

The beauty, covering property, and other excellent qualities of the paint, are all your correspondent asserts.

The editorial remarks in the same number under book notices, in regard to the neglect of inorganic chemistry, are very refreshing. It is melancholy to take up the journals and the *Jahresbericht*, and find them full of pictures of the position of atoms of carbon in dinitrodiphenylmethane, and similar bodies, side by side with guesses about the probable constitution of some complex, useless, and needless organic substance, while important practical matters in inorganic chemistry are calling aloud

\* Compare Dr. Smith's figures for escape of Sulphur Acids from Vitriol Chambers (Eighth Annual Alkali Inspector's Report for 1871), where escapes vary from under 1 per cent. to 27 per cent.

for investigation—e.g., there is abundant opportunity for research in making a comparison of the chlorides of iron and metal, in investigating the change of colour in zinc oxide under heat, in working out the metallurgy of cobalt, and in solving hundreds of practical and trying questions in the chemistry of the metals.

I am not sorry to see you have a word to say against the pretty pictures of molecules of bodies in Dr. Frankland's book. Nobody, I suppose, can disprove the accuracy of the pictures, but I never was able to derive, as student or lecturer, much, if any help, from these ingenious puzzles.

Frankland himself sees the danger "that students will regard them (the diagrams) as representations of the actual physical position of atoms." Such a regarding is not only likely, but inevitable.

I have been in hopes that my notes in June and July numbers of the CHEMICAL NEWS upon the absorption of sugar by bone charcoal would bring out some replies or cause some discussion. Perhaps the question is regarded as thoroughly settled, and that I am engaged in re-slaying the slain. Here, in spite of the evidence, the question is in some sense, an open one. For my part I regard the fact of the absorption of sugar by animal charcoal as well confirmed as the insolubility of sulphate of baryta in water.—I am, &c.,

J. M. MERRICK.

Laboratory, 59, Broad Street, Boston, U.S.A.,  
September 14th, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 12, September 16, 1878.

**New Telephonic Transmitter.**—P. Dumont.—This system, which has given the author results superior to those of any other apparatus of a similar kind which he has been able to try, is a combination of the pack-thread telephone and of the electric charcoal microphone. A parchment membrane of 12 centimetres in diameter is stretched over a vertical frame. In its centre is fixed a thread secured by a knot on one side, and which taking, on the other side, at first a horizontal direction, passes round a small pulley and supports at its other extremity a small cone of brass suspended by a hook fixed to the centre of its base. This piece, which is relatively speaking tolerably heavy, plunges its point to the depth of about 1 millimetre into a metallic cube full of powdered gas-coke, and fixed upon the horizontal plate, which, forming the foot of the apparatus, supports the stem of the frame fitted with the diaphragm. One of the poles of the battery (a Leclanché of four elements) is connected with the metallic cone, and the other with the cube containing the coke-dust. The slightest vibrations imparted to the membrane by sound-waves suffice to modify the pressure of the cone in the coke-dust, thus determining variations in the intensity of the current.

**Process Proposed for Effecting the Analysis of Milk.**—E. Marchand.—Referring to the paper presented by M. Adam the author points out that as far back as 1854 he proposed a new method of determining the butter in milk by treatment with ether and alcohol in presence of a couple of drops of caustic soda. In the hands of M. Adam the method has lost in simplicity without gaining in exactitude.

*Chemiker Zeitung.*

No. 36, September 5, 1878.

At Mantua, on July 25, during a violent shower, some children in the Piazza Virgiliana thought that hail was falling. The supposed hail-stones were pieces of salt, some of which are in the hands of the Director of the Observatory, Prof. Agostini.

**Cupriferous Food.**—Holdermann found in the ashes of six middle-sized cucumbers which had acquired a brilliant green colour by being moistened with vinegar, placed in a copper vessel, and exposed to the air (a favourite process with cooks), not less than 0.045 gm. cupric oxide. Four such cucumbers would contain copper equal to the maximum dose of the German Pharmacopœia.—*Archiv. Pharm.*, x., 98.

**Determination of Manganese as Pyrophosphate.**—Munroe determines manganese as pyrophosphate similarly to magnesia. The solution of a manganic salt is boiled for five minutes in the water-bath with an excess of sodic pyrophosphate; the precipitate is dissolved in a minimum of hydrochloric acid, and then boiled for fifteen minutes with ammonia, avoiding excess. The precipitate is re-dissolved in hydrochloric acid, re-precipitated with ammonia, and the white crystalline precipitate, which turns partially brown on exposure to the air, is boiled for more than an hour. Mere traces of manganese remain in the filtrate. An excess of ammonia makes the result inaccurate. The precipitate is treated exactly like the corresponding magnesian precipitate.—*Archiv. Pharm.*, x., 165.

**New Method of Detecting Arsenic.**—The substance in question is mixed with a little water, or its solution is poured into a small beaker, and a piece of sodium amalgam as large as a grain of wheat is introduced. The beaker is then covered as rapidly as possible with a piece of white filter-paper or a porcelain lid, previously moistened with a weak feebly acid solution of silver nitrate. The presence of arsenic is indicated by a blackening of the paper or of the porcelain. As antimony hydride is not given off—or in mere traces—from strongly alkaline liquids, the solution should be rendered distinctly alkaline. In this manner the confusion of antimony and arsenic is rendered improbable, though not quite excluded. Organic matter does not interfere.—*Archiv. Pharm.*, x., 170; *American Journal of Pharmacy*, vii., 126.

**Determination of Alcohol in Wine.**—The liquid is agitated with a mixture of 4 vols. amylic alcohol and 1 vol. of washed ether, and the proportion of alcohol is calculated from the decrease in volume, according to a table based upon experiment.—*Arch. Pharm.*, x., 176.

**Volumetric Determination of Phenol.**—Degener employs the reaction of phenol and bromine, both in aqueous solution. From 10 to 30 c.c. of the liquid to be tested, which must be free from SO<sub>2</sub>, are titrated with solution of bromine. As soon as all the phenol has been deposited as snow-white flocculent-curdy tri-brom-phenol, the supernatant liquid, especially if seen against a pale blue surface, appears of a distinct yellow colour. The value of the bromine solution must be re-determined before every operation.—*Journ. Prakt. Chemie*, xvii., 390.

Hydrogen peroxide is formed, according to Prof. Bœttger, on the explosion of oxyhydrogen gas. Its presence may be shown by exploding the gaseous mixture in a glass containing  $\frac{1}{4}$  litre, and adding immediately a few c.c. of starchy cadmic iodide solution, and a few crystalline fragments of sulphate of iron and ammonia. On agitation a deep blue colour shows the presence of hydrogen peroxide.—*Polyt. Notizblatt*, xxxiii., 233.

**Adulteration of Straw.**—According to Stromayer, "straw-stuff" for paper makers is weighted with sulphate of magnesia.—*Industrie-bl.*, xv., 318.

No. 37, Sept. 12, 1878.

Prof. A. Fischer, of Prag, has been poisoned by a mixture of cyanide of potassium and sal-ammoniac, whilst

experimenting on the means of rendering the former salt innocuous.

An important bed of guano, 8 miles in length, by a breadth of from 50 to 500 metres, and a depth of  $1\frac{1}{2}$ , has been discovered at Huata Bay, in Peru.

No. 38, Sept. 19, 1878.

**Meeting of the German Sanitary Union at Dresden.**—Prof. Neubauer, of Wiesbaden, read a paper on the "Treatment of Wines from a Hygienic Point of View," and laid down the following propositions. The name of wine belongs exclusively to the beverage formed by the fermentation of the juice of grapes. Sulphuring with sulphur free from arsenic is permissible. As regards the admissibility of the bisulphite of lime, which, in animals, produces severe intestinal catarrh, further experiments are needed. The addition of chemically pure sugar to the must is allowable. The addition of alcohol can scarcely be prohibited if kept within certain limits, and if no amylic compounds are introduced. The neutralisation of the acids in wines by means of the salts of lime, magnesia, and potash can only be allowed within very narrow limits. "Plastering" can only be permitted if the amount does not exceed a certain legalised limit, in France 2 grms. per litre! (Why permit it at all?) Our knowledge concerning the physiological action of glycerin and salicylic acid does not justify their absolute prohibition, especially as the former is a normal constituent of natural wines to the extent of 6 to 8 grms. per litre. The addition of alum or of sulphuric acid is to be prohibited as pernicious. The artificial production of red wines from white wines, by the addition of tannin and extraneous colouring-matters is to be prohibited. All alcoholised or sweetened wines, and all artificial wines, are to be sold only under names which can lead to no misunderstanding as to their nature. (We may be permitted to remark that these principles here laid down assuredly do not err on the side of severity. To forbid such innocent additions as the juice of cherries and bilberries, and yet tolerate gypsum to the alarming extent above mentioned, seems also scarcely consistent.)

Prof. Hofmann read a paper on the "Food of Children." He suggested the establishment of dairies under medical supervision, and proposed that, on all packets, &c., of prepared foods, the chemical composition should be expressed, so as to show the proportions of water, albumen, fats, soluble and insoluble carbohydrates, and the salts most important for nutrition.

**Detection of Extraneous Starch in Chocolate.**—Dr. Wittstein.—The aqueous decoction of pure chocolate gives no reaction with iodine, whilst the contrary is the case if starch or the meal of any cereal has been added.

*Justus Liebig's Annalen der Chemie,*  
Band 193, Heft 3.

**Experimental Researches on Hydrogen Peroxide.**  
—Em. Schœne.

**Behaviour of Hydrogen Peroxide with the Alkalies.**—(Second Treatise).—The author concludes that the "catalysis" of hydrogen peroxide in alkaline solutions is essentially dependent on (1) the property of the alkalies to form compounds of the composition R<sub>2</sub>H<sub>4</sub>O<sub>6</sub>, or R<sub>2</sub>O<sub>2</sub>.2H<sub>2</sub>O<sub>2</sub>; (2) the tendency of the alkaline metal to become more highly oxidised within this compound, namely, to tetroxide; (3) by the reduction to dioxide, under the influence of the water. That potassa effects the decomposition of hydrogen peroxide more rapidly than soda is explained by the fact that the disposition of potassium to form a tetroxide is greater than that of sodium.

**Communications from the Laboratory of the University of Würzburg.**—These consist of a paper by Dr. M. Conrad and W. R. Hodgkinson, on the synthesis of phenylated acids of the fatty series.

Chemical Composition of Yeast.—Prof. C. Nägeli and Dr. O. Loew.—“Bottom yeast” has the following chemical composition:—

Cellulose with vegetable mucus .. .. .	37
Proteinc matters:—	
<i>a.</i> ordinary albumen .. .. .	36
<i>b.</i> unstable compound resembling gluten and casein .. .. .	9
Peptones precipitable by acetate of lead ..	2
Fat .. .. .	5
Ash .. .. .	7
Extractive matters, &c. .. .. .	4

100

The last mentioned item includes a peptonoid body and small quantities of invertin, leucin, and glucose, and still smaller traces of glycerin, succinic acid, cholesterolin, guanin, xanthin, sarkin, and probably inosit, and traces of alcohol.

Communications from the Chemical Laboratory of the University of Kasan.—These comprise a paper on the conversion of diethyl-carbinol into methyl-propyl carbinol, with the synthesis and properties of diethyl- and methyl-propyl-acetic acid, by Alex. Saytzeff, and a memoir, by P. and A. Saytzeff, on diallyl-propyl-carbinol.

On Nitro-butylene. — L. Haitinger. — Nitro-butylene,  $C_4H_7NO_2$ , is a faintly yellow oil of extremely pungent odour and burning taste, heavier than water, and almost insoluble. It boils at  $150^\circ$ — $158^\circ$ , with slight decomposition, but can be distilled unchanged in a partial vacuum. The author has examined its reduction, its behaviour with water, with caustic soda, bromine, and hydrochloric acid. He sums up his results as follows: nitro-butylene is formed by the action of nitric acid upon trimethyl-carbinol or isobutylene. With reducing agents it yields ammonia; with water, acetone and nitro-methane: and with alcoholic soda, sodium nitro-butylene. It is capable of taking up two atoms of bromine.

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*Biedermann's Central-blatt,*  
June 6, 1878.

Thermo-conductibility of Bad Conductors, especially Rocks and Wood.—Dr. E. A. Less.—In stones, density and compactness greatly promote the conduction of heat, but other properties have also an influence. Stones of a crystalline texture conduct better than amorphous mechanical mixtures, and those with fine granulations better than such as are coarse. Definite laws can scarcely be as yet laid down. The observations made upon wood proves that it conducts heat much better in the plane of the fibres than in a vertical direction.

The Fertility of Volcanic Soils.—Prof. M. Truchot.—The author points out the remarkable richness of soils formed from the decomposition of lava as compared with granitic and trachytic earth. In these three classes of soils the phosphoric acid occurs in the respective proportions of 1 : 4 : 26. He doubts the influence of potash in determining the fertility of a soil, since it is more abundant in the trachytes than in the lavas.

Phosphorite Beds of Estremadura.—Drs. Egozene and L. Mallada.—The principal of these deposits at Lagrosan was discovered by Bowles at the end of the last century, but was neglected till between the years 1840 and 1850. The phosphatic minerals have been raised in a very unscientific manner, and the expense of transport is often so great that a ton of phosphorite, which at the mines can be bought for 12s., costs in England upwards of £3. The phosphitic deposits occur in a triangular space of 16,800 square kilometres, and are found in granite in the Cambrian slates, or in the Devonian transition limestones.

Manurial Experiments with Potash Compounds.—Dr. W. Engling.—The author finds that on calcareous

soils containing abundance of silicate of potash, a dressing with common salt may partially be substituted for potash. The most advantageous potassic manure for feeding-beets is chloride of potassium applied immediately on the melting of the snow.

Peruvian Guano and Ammoniacal Superphosphate with reference to the Quality of the Crop.—Dr. W. Engling.—In every experiment Peruvian guano produced a greater proportion of digestible matter.

On certain Fungoid Diseases of Vines, and on their Treatment.—MM. Pfau, Schellenberg, Schnetzler, Farlow, Macagno, Garcin, and Schmitt.—“Le blanc” is the French name of a vine disease which, in its outward appearance, much resembles the symptoms produced by the phylloxera, though differing totally in its cause. Some of the authors above mentioned ascribe the disease to deficient drainage, others suppose the fungi are transferred to the roots of the vine from the mouldering stakes which are made chiefly of the wood of coniferous trees. It is recommended that these should be coated with tar. As a remedy for Oidium, Schmitt recommends a solution of 3 grms. copperas in a litre of water. In the early stages of the disease 2 grms. suffice.

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*Archives Neerlandaises.*

Tome xiii., 2me Livraison.

A Pancreatic Telescope, by F. C. Donders.—The ordinary Dutch or Galilean telescope has for its focal distance  $F = \infty$ , a constant length, and a constant magnifying power. The author seeks to construct a telescope, with which we may obtain, by the displacement of the lenses within certain limits, all magnifying powers in a continuous series.

Theory of the Pancreatic Telescope of M. Donders.—J. A. C. Oudemans.—This paper consists almost exclusively of mathematical formulæ.

On Telescopes of Variable Magnifying Power.—J. Bosscha.—The author points out a defect in the telescope of Donders, and proposes an improvement.

Determination of the Focal Distances of Lenses of Short Focus.—J. A. C. Oudemans.—Incapable of useful abstraction.

Synthesis of Bromated Ethylic Ethers.—Fr. Kessel.—Only two tetra bromethans are known with certainty, as theory demands.

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Tome xiii., 3me Livraison.

Intensity of the Electric Currents of Bell's Telephone.—In a circuit of two connected telephones presenting together a resistance of 70 Siemens's units, or  $68 \cdot 10^{10}$  Weber's units, the quantity of electricity circulating, in consequence of the oscillation of the plate  $= 0 \cdot 000000091$  electro-magnetic unities. This quantity could only decompose  $8 \frac{1}{2}$  10-millionths of a microgramme ( $0 \cdot 001$  milligram.) of water. A sound of 880 simple vibrations, which would communicate to the plate vibrations of a micron of amplitude, would produce in the circuit currents whose mean intensity  $= 0 \cdot 0000792$ .

Albumen of the Serum and that of Egg, and on their Combinations.—A. Heynsius.—The alkaline albuminates differ according to the degree of concentration of the alkali employed. Weak alkalies give rise to a combination which does not yield in solubility to paraglobulin. The acid albumens differ equally according to the energy and degree of concentration of the acid. M. Aronstein had about the same time arrived at the following results:—“that by dialysis, albumen can be obtained free from salts; that the albumen, both of blood and of eggs, is soluble in water, and does not coagulate on boiling, even after the addition of an acid; that the coagulation of these two species of albumen under the influence of heat is due to the presence of foreign salts.” Thi

results are diametrically opposite to those of the author. He concludes that Aronstein and Schmidt regarded their dialysed albuminous solutions as free from salts, because they incinerated too small quantities of matter; that their solutions remained limpid on heating, because they still contained alkali, and that they did not obtain coagulation after the addition of an acid, because such acid was used in excess. He finds that after the most complete dialysis, there is obtained a combination of albumen with phosphate of lime and magnesia, which is soluble in water, but a really neutral solution of which abandons albumen in a coagulated form at the boiling temperature, that it is not possible to obtain by dialysis albumen free from salts, and that we are not justified in pronouncing it a compound soluble in water.

*Moniteur Scientifique, Quesneville,*  
September, 1878.

**Analysis of Wines: Detection of Plastering.**—H. Marty.—The author undertakes to answer the questions how plastered wines are to be recognised, and up to what limit can it be affirmed that a wine has been plastered or mixed with a plastered wine? The determination of the sulphuric acid and of the tartar offers the only answer. Plastering largely increases the quantity of sulphuric acid normally present in all wines in the state of alkaline or alkaline-earthly sulphates. This augmentation may proceed either from direct plastering in the vat, which when carried to its maximum coincides with the total disappearance of the tartar, or by simple adulteration with a plastered wine. The increase of sulphuric acid is then less considerable, and the tartar is merely reduced. The determination of tartar being a very delicate affair in plastered wines it is preferable to examine the sulphuric acid, the determination of which suffices in most cases for the recognition of plastering. According to numerous analyses made the proportion of sulphuric acid normally present in a pure wine per litre ranges from 0.109 to 0.328 grm. of monohydrated acid, or 0.194 to 0.583 grm. neutral sulphate of potash. If the proportion falls below these figures we may pronounce that the wine has not been plastered, though it may still have been mixed with a small quantity of a plastered wine. But if these limits are exceeded plaster is certainly present. The following volumetric process is recommended for the rapid detection of plastering. A standard liquid is made up with 14 grms. of pure crystalline chloride of barium, 50 grms. pure concentrated hydrochloric acid, and distilled water enough to make up 1 litre. To 50 c.c. of wine raised to a boil are added 3 c.c. of the standard solution just mentioned. It is thrown upon a filter, and the filtrate is tested with a further addition of the barytic solution. If the mixture remains limpid the wine may be considered natural, but if further turbidity arises we have to do with a plastered wine, or at least with a mixture containing plastered wine. Next we take 50 c.c. of wine as before, heat to a boil, and add 10 c.c. of the standard barytic liquid. If the filtrate is rendered again turbid by a further addition of barytic solution the wine contains more than 2 grms. sulphate of potash per litre.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*

No. 56, August, 1878.

Report Presented by M. P. Schützenberger on a Memoir by M. C. Vincent on the Manufacture of Chloride of Methyl.—This paper will be inserted *in extenso*.

*La Lancette Belge.* No. 27, September 1, 1878.

The Yellow Fever at Savannah.—J. C. Le Hardy, M.D.—The author considers it demonstrated that in the

dejections of the patients and in the dust floating in the atmosphere there exist minute fungoid plants not previously described, and which he seems to consider as the propagators of the disease. These plants require a temperature of 26.6° for their growth.

The Mosquito as a Vehicle of Disease.—The mosquito is found to be the medium for transferring *Filaria sanguinolenta* from the blood of one person to that of another.

## MISCELLANEOUS.

Russian Scientific News.—M. Kazanoff has made several experiments on gold amalgams. It was found that apparently fluid gold amalgams, containing different quantities of gold at ordinary temperatures, on being squeezed through thin leather bags, give as filtrates amalgams containing the same amount of gold; during these experiments amalgams of different concentrations gave filtrates containing 0.126 per cent of gold. These facts show that amalgams filtered through thin leather are similar to solutions of solids in water, the concentration of which chiefly depends on the temperature of the solution.

M. Letny, by passing naphtha residues through an ignited tube filled with charcoal, has obtained, besides gaseous products, also tar which was found to contain benzol, toluol, xylol, cumol, and a small quantity of amylene, hexylene, heptylene, and naphthalin. The specific gravity of the gas is 1.157; it consists of 53 per cent of ethylen, and of its homologous series, of acetylen and crotonylen. Tar obtained by the distillation of brown coal (lignite), when passed through an ignited tube with charcoal, is decomposed in a similar manner. M. Danilevsky found that protalbin obtained from albumen by the action of caustic potash without employing heat differs from albumen by its solubility in alcohol. On being heated with alcohol in a sealed tube, and next cooled protalbin is transformed into albumin.

SERGIUS KERN, M.E.

St. Petersburg.

### TO TAR DISTILLERS AND OTHERS.

The Directors of The Gas Light and Coke Company require the services of a duly qualified person as manager of their Tar Works at Beckton, under the supervision of the Resident Engineer of the Station.

He must possess a knowledge of Chemistry and be thoroughly acquainted with all the details of the distillation of Tar, and also be able, if required, to design and superintend any addition to the Works which may become necessary.

Salary, £500 per annum.

Applications in writing accompanied by Testimonials, stating age and experience, should be addressed to me on or before Thursday, the 10th October.

(By order)

JOHN ORWELL PHILLIPS,  
Secretary.

Chief Office,  
Horseferry Road, Westminster,  
September 20, 1878.

Wanted, a Young Man as Chemist. He must be intimately acquainted with fatty and Hydrocarbon oils, and have some commercial knowledge: applicants to state salary expected.—Apply to H. C., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, CHROME ALUM.—Apply, with Price and Sample, to Higgin, Lloyd, and Co., Little Peter St., Manchester

VITRIOL.—Advertiser (Tyne) desires an Engagement as Working Manager of Vitriol Plant. Knowledge of Manures. Best Tyne references.—Address, Vitriol, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Pure SULPHOCYANIDE of AMMONIUM, also Prussian Blue, For Sale.—Particulars from T. H. Woodman Dockhead Place, London, S.E.

# SUPPLEMENT TO THE CHEMICAL NEWS.

No. 984.—OCTOBER 4, 1878.

## CORRESPONDENCE.

### CYANOGEN COMPOUNDS IN ALKALI MAKING.

*To the Editor of the Chemical News.*

SIR,—Mr. Macltear's letter in to-day's CHEMICAL NEWS (vol. xxxviii., p. 162) would make it appear that I had contested the statement made in his first communication to you on this subject (CHEM. NEWS, vol. xxxviii., p. 130), that "The formation of the cyanogen compounds takes place towards the end of the balling operation, when a high temperature of the mass prevails." I certainly did not contest that statement. If that statement were not true, the Pechiney process would be impossible.

What I did contest I think will have been plain to most of your readers. To Mr. Macltear's opinion that the formation of cyanogen compounds in the black-ash furnace can be avoided by avoiding the exposure of the mass, at the end of the reaction, to a high temperature, I opposed six facts. Mr. Macltear says that these facts do not disprove—his "statement" above quoted. They do not disprove that statement. They were not cited to disprove it, and have no bearing on it whatever. But they have some bearing on Mr. Macltear's doctrine as to the conditions of the formation of cyanogen compounds in the black-ash furnace. How far, if at all, his criticism of them lessens their force against that doctrine I am content to leave your readers to judge for themselves.

"The cyanogen compounds," Mr. Macltear now declares, "are not formed from the nitrogen of the mixing coal, . . . but are produced by the action of the highly heated nitrogen in the gases of combustion from the fuel upon the alkalis carbon in the mass in the furnace." No fact is given in support of this assertion. Allow me to give a fact on the other side.

Some years ago, the manager of a German alkali work, from a visit to which I have just returned, was using an exceptionally nitrogenous mixing coal, and his black-ash was exceptionally rich in cyanides. He was then making ash from fished salts, and caustic from the red liquors. The red liquors were so rich in cyanogen compounds that it was found advantageous to cool those liquors and allow the cyanogen compounds to crystallise out. This paid so well that endeavours were made to *increase* the already exceptional proportion of cyanides in the black-ash. Exposing the finished black-ash for a longer period, with constant working, to the action of furnace gases

was not found to do this to any perceptible degree; but adding to the finished black-ash a further quantity of very nitrogenous coal was found to augment the proportion of cyanides in the black-ash to very nearly the full extent of the nitrogen in the coal so added. This experience led to a search for the most nitrogenous coal that could be obtained, and it was found advantageous to fetch such coal from a very considerable distance. This method of obtaining, unquestionably from "the nitrogen of the mixing coal," cyanogen compounds for sale as such was very profitable for some years, and was only abandoned when the competition of ammonia ash had at length rendered it impossible to continue to sell soda products made from salts fished from highly cyaniferous liquors.

Cyanogen compounds *are* formed, then, in the black-ash furnace from the nitrogen of the mixing coal; but it does not follow that they are formed therein from the nitrogen of the mixing coal only. But, if the cyanogen compounds in black-ash are in part formed from other nitrogen than that of the mixing coal, neither does it follow that such other nitrogen is the nitrogen of the air. May it not be the nitrogen of the firing coal, existing in the furnace gases as ammonia? I shall shortly publish some facts which I think will prove that this is so, and that to the formation of cyanogen compounds in black-ash by the reaction thereupon of ammoniacal compounds in the furnace gases, moderate temperatures are more favourable than higher ones. I believe this is the true explanation of the facts given in my former letter, and that the reason why my German friend failed to increase his cyanides by treatment of his finished black-ash with furnace gases was that he performed that treatment at too high a temperature.

Mr. Macltear's statement, unsupported by evidence, that the cyanogen compounds in black-ash are *not* formed from the nitrogen of the mixing coal I have disproved, then, by a fact. To the other statement, unsupported by evidence, that they *are* formed from the nitrogen of the air I have opposed only a suggestion. But I will supplement that suggestion by facts hereafter, and I feel sure I shall be able to prove that with the formation of cyanogen compounds in the black-ash furnace the nitrogen of the air has nothing whatever to do.

In the meantime, there is a fact well known to the whole English alkali trade, from which practical men will draw their own conclusion as to the soundness or otherwise of Mr. Macltear's doctrine, that "reducing the melting-point of the mass" reduces the proportion of cyanides formed in the black-ash furnace. Mr. Macltear's licensees,

before they adopted his mixing, used a larger proportion of limestone than they use now. Consequently the melting-point of their charges is now lower than it used to be. *Do they make whiter ash now than they used to make?* And who are the English manufacturers who make the *whitest* ash: those who use Mr. Macfear's low melting-point mixing, or those who use mixings having higher melting-points? Everyone in the trade knows the answers to these questions.

Mr. Macfear "protests" against my statement that, since the introduction of the Pechiney process, "more attention has been given by English alkali makers to the question of the cyanogen compounds in black-ash than they had previously given to it since the commencement of their industry." But that statement is true. During the last ten years I have spent a very large part of my time in going to and fro among alkali makers. Having an interest in nearly every work in the world in which chlorine is manufactured, and it being my duty to visit such works as often as I can, except my assistant, Mr. Cockburn, no one living is so familiar with so many alkali works as I am. Scarcely a day passes but he or I visit one or more alkali works. For the last ten years, then, I can speak from my own knowledge; for the longer period I appeal to the patent list. I have not time now to refer, but I believe I am right in saying that Mr. Williamson's patent of 1866 is the only patent for destroying the cyanogen compounds formed in black-ash making ever taken out by any English manufacturer before the introduction of the Pechiney process; whereas, within three weeks of my making that process known to any other manufacturers than the two who have been working it since the beginning of the year, three English manufacturers, Mr. Macfear being one of them, had applied for patents relating to that object.

Take Mr. Macfear's own case. I introduced the Pechiney process to him on the 23rd July. He had not then patented anything on the subject. On the 3rd of August he filed an application for a patent.

But Mr. Macfear says that the statement against which he "protests" is "unjust" to him. How so? Because his "experiments on the destruction of cyanides have been carried on since early in 1874?" The statement in question neither asserts nor implies anything to the contrary of that. And as to his having told me, "many months ago," of his destruction of cyanides in black-ash by caustic soda, his memory certainly deceives him.

And is it not a misuse of language to say, either of caustic soda put into the black-ash furnace, or of Mr. Williamson's heating the vat liquors to 310° F. under pressure, that they have been "perfectly successful?" I have not the smallest doubt that the cyanides can be destroyed completely by either method; but can a process of industrial chemistry be said to be "perfectly successful" when it has never been brought into regular industrial operation? As regards Mr. Williamson's process, I can speak from personal experience as to its perfect success in the laboratory; and though I do not think it could now compete with Pechiney's process, seeing that it requires a special operation, which Pechiney's process does not, I feel sure that, at the time it was proposed, it might have been industrially realised. But, as a matter of fact, it never was applied industrially. During the first experiment on the large scale something happened to the boiler, and Mr. Williamson did not pursue the matter further.

While admitting that "to M. Pechiney clearly belongs the honour of applying these known reactions to alkali making," Mr. Macfear says that it "is not a new fact in chemistry" that "sulphates of the alkalies added to cyanogen compounds destroy the cyanides," and that "the reactions involved" in Pechiney's process were described in "Watts's Dictionary" in 1864. It is very rarely that an improvement in alkali making is based on "a new fact." For example, the fact that for black-ash to dissolve readily it must contain free lime was not only known but acted upon long before Macfear's

process, only people got their free lime into their black-ash, as most manufacturers do still, by other means than Mr. Macfear's method of adding it thereto just before the charge leaves the furnace. But is it quite certain that "the reactions involved" in Pechiney's process are the "known reactions" to which Mr. Macfear refers? What "Watts's Dictionary" says on the subject is simply that, according to Liebig, "Cyanide of potassium fused with sulphate of potassium yields cyanate and sulphide of potassium." But when Pechiney's process is properly performed, there are no cyanogen compounds at all in the resulting black-ash, and cyanate of sodium would still be a cyanogen compound. It is true that it would be sufficient for all practical purposes to convert the cyanide in black-ash into cyanate, seeing that by solution and evaporation cyanate of sodium is converted into carbonate of soda and carbonate of ammonia; and at one time I thought that that was how Pechiney's additional sulphate really acted. But well-made Pechiney black-ash does not contain any cyanate, nor any cyanogen compound whatever. Therefore "the reactions involved" in Pechiney's process must be other than the "known reactions."

Mr. Macfear declines to accept my "dictum" respecting the reason why cyanogen compounds are not found in the black-ash furnace till near the end of the operation. But I indulged in no mere assertion on that point. I simply drew what seemed to me the only reasonable conclusion from two established facts. That Pechiney's additional sulphate, intimately mixed with a charge of otherwise finished black-ash containing cyanide of sodium destroys that body, practically completely, is placed beyond dispute by the continuous results of several works in which the process has now been employed for considerable periods—in two cases for periods of nearly nine months. That is fact the first. Fact the second is that cyanide of sodium is not found in a charge of black-ash so long as any large proportion of sulphate remains therein undecomposed. Is it a mere "dictum" to suggest that the two facts are correlated? Admitting, as Mr. Macfear does, "that sulphates of the alkalies added to cyanogen compounds destroy the cyanide," how can he reject the obvious inference that either cyanide of sodium cannot form in a black-ash furnace while there is yet much undecomposed sulphate present, or that if it does form, the undecomposed sulphate instantly destroys it?

But Mr. Macfear says that he has "been able to obtain black-ash with considerably under 1 per cent of undecomposed sulphate, which was free from cyanogen compounds," by simply modifying his ordinary process by the reduction of his mixing-coal to under 29 per cent, and so enabling himself to effect the decomposition of his sulphate "at a temperature much lower than is usually employed." I can only congratulate Mr. Macfear upon having obtained such a result.

No one, however, knows better than Mr. Macfear how extremely difficult it is to get a fair sample of black-ash, and how great a difference there consequently nearly always is between the results of laboratory analysis of a black-ash and the tests of the vat liquors made from the same ash in the works. Will Mr. Macfear publish a week's tests of St. Rollox and Hebburn *vat liquors*, the details given to include  $\text{Na}_2\text{S}$ ,  $\text{Na}_2\text{SO}_4$  before oxidation, total  $\text{Na}_2\text{SO}_4$  after oxidation, and  $\text{Na}_4\text{FeCy}_6$ —if any? If he will do that, I will gladly publish corresponding figures of Pechiney vat liquors.

Mr. Macfear throws doubt on my statement that Pechiney makes regularly by his process, and without separating any red liquors, soda-ash as free from iron and as good in colour as ammonia ash. I deliberately repeat the statement, and stake on it my credit for veracity. But it is *not* done by the means he suggests, and M. Pechiney's vat-liquors do *not* contain, as a rule, "a very large amount of NaCl." Mr. Macfear's statement that they do is based on a solitary analysis of a Salindres ash made at a time when an excep-

tionally hard kind of salt, corresponding to what I believe is called in England "pan-scale," and extremely difficult to decompose completely, was being used in his works. His ordinary sulphate is exceptionally rich, and his ordinary vat-liquors are correspondingly low in NaCl.

This is the analysis in question:—

Na <sub>2</sub> CO <sub>3</sub> .. .. .	85.4
NaHO .. .. .	8.0
Na <sub>2</sub> SO <sub>4</sub> .. .. .	3.2
NaCl .. .. .	4.0

Mr. Mac'tear throws doubt on my statement that Pechiney's additional sulphate "is decomposed into carbonate," as he puts it. To my distinct affirmation, based on figures supplied by all the works in which the process is being carried on, he opposes his—"I cannot see how it can be so." From "Watts's Dictionary," cyanide of potassium reduces sulphate of potassium to sulphide. Cyanide of sodium similarly reduces sodic sulphate, and sulphide of sodium and carbonate of lime, under the conditions which obtain in a black-ash furnace, decompose each other. The sulphate added at the end in Pechiney's process is reduced to sulphide, partly by the cyanide of sodium, partly by the free carbon, which are both usually present when it is added; and the sulphide so produced is converted into carbonate; when Pechiney's own mixing is used, by carbonate of lime still remaining in the charge at the moment of adding the final sulphate, and when the Pechiney-Weldon mixing is used by carbonate of lime added, usually in the state of "dust," at the same time as the final sulphate itself.

Mr. Mac'tear denies, "most emphatically," that it is to M. Pechiney that English manufacturers will be indebted—if ever they come to it, as I think they will—for the advantages resulting from the diminution of their mixing-coal to a minimum. To whom, then, is Mr. Mac'tear himself indebted for the recent diminution of his mixing-coal to "under 29 per cent?" He finds that he was "down to 28 per cent so far back as September, 1874." The way in which, in the last paragraph but one of his letter in your to-day's issue, Mr. Mac'tear speaks of his "ordinary process," distinguishing it from his 29 per cent process, is an admission that of his hitherto "ordinary process" the use of a minimum of mixing-coal was not a part. Mr. Mac'tear has therefore changed his process since the 23rd July.

A few English manufacturers, and notably the Messrs. Muspratt, have long used very small proportions of mixing coal, if not regularly, at least from time to time, for the production of special qualities of ash; but, to the mass of English alkali makers, that such decomposition of his sulphate as M. Pechiney gets can be got with the proportion of mixing coal he uses, has been quite a new revelation, and it is one which has reached them only in connection with my exploitation of his process for destroying cyanides.

Much of the French practice with very small proportions of mixing coal has been due to the fact, which till recently was unexplained, but of which I think we see the explanation now, that black-ash containing a large proportion of undecomposed sulphate contains no cyanides. To get black-ash free from cyanides, and therefore capable of yielding a perfectly white finished product, French manufacturers have been accustomed to deliberately use less mixing coal than would completely decompose their sulphate, and have been content in many instances, for the sake of getting perfectly white ash, to leave as much as 20 per cent, or even more than 20 per cent, of their sulphate undecomposed. M. Pechiney set himself to work out the problem of how, while decomposing his sulphate practically completely, to get a black-ash at once free from cyanide and containing so little sulphide that he should be able to make from it, without separation of any red liquors, as white an ash as had previously been got only

when decomposing the sulphate very imperfectly. The means at which he ultimately arrived of dealing with the cyanide part of the question your readers already know; but he wanted also a means of obtaining, while decomposing his sulphate practically completely, a black-ash containing far less sulphide than is always contained in black-ash made with the proportion of mixing coal necessary to completely decompose the sulphate under the ordinary conditions of working. He found that means in the combination of a diminution of the mixing coal with a higher than the ordinary temperature at the finish, and a longer exposure thereto: "*Une cuisson un peu prolongée et à plus haute température à la fin.*" The advantage of this combination is what I claim for M. Pechiney the credit of having discovered, and for myself "of introducing a knowledge of;" and I challenge Mr. Mac'tear to find in the published researches of either Unger, Scheurer-Kestner, or my friend M. Kolb, anything which can render that claim invalid.

Great, however, as are the advantages of Pechiney's method of decomposing his sulphate, that method cannot always be adopted in England; nor, to the production of black-ash free from cyanides, is it essential that it should be. Whiter 58 per cent ash than had ever been made before without refining is now being got regularly in this country from black-ash made with over 60 per cent of mixing-coal, but freed from cyanides by Pechiney's final sulphate, and to a certain extent from sulphide by my final limestone dust.

In his final reference to the question of destroying the cyanides in black-ash, Mr. Mac'tear expresses the conviction that "something may be gained" by destroying those compounds instead of by sulphate of soda, by sodic hydrate, by the earthy sulphates, or by oxide of iron. When the cyanide of sodium in black-ash is destroyed by sulphate of soda, both the cyanide destroyed and the sulphate which destroys it are converted into carbonate, so that the destruction of the cyanide is not the only advantage obtained. The earthy sulphates, by reason of their infusibility, act so much more slowly than sulphate of soda that they are out of the question on that ground alone; moreover, they cost something, if not much, and whereas sulphate of soda employed for the purpose in question is converted into a product more valuable than itself, earthy sulphates so employed would simply be converted into more "waste." As regards oxide of iron and caustic soda, most people try to keep iron out of their black-ash instead of putting it in; while to convert sulphate of soda into sodic hydrate, and then employ that sodic hydrate to do what the original sulphate could have done just as well, is a proposal which no one would assent to.

I come now to what will be the last paragraph of what I intend shall be my last letter in reply to Mr. Mac'tear. He has fallen into error in reporting a part of what took place at our last interview. Although we did discuss the Pechiney process on that occasion, I had not gone to Glasgow to discuss that, but had made the journey thither from Liverpool, ill as I was, for the friendly purpose of communicating to Mr. Mac'tear some information affecting his interests, which had reached me by chance, which I thought might not have reached him from any one else (I found I was mistaken on that point), and which I believed (though I was mistaken on that point too) that it was important he should have without an hour's avoidable delay. It was he, and not I, who then proposed that we should work together; and he is mistaken with respect to the opinion as to "the process of the future," which a few courteous expressions of mine, imperfectly recorded, as was but natural, in a memory crowded with things of more moment, have misled him into attributing to me.—I am, &c.,

WALTER WELDON.

Rede Hall, Burstow, Surrey,  
September 28, 1878.

[We can print no more letters on this subject.—Ed. C.N.]

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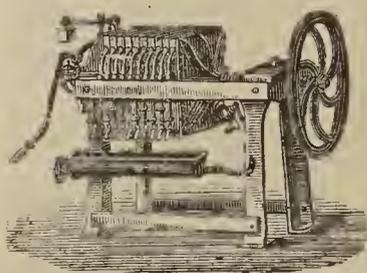
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# THE CHEMICAL NEWS.

VOL. XXXVIII. No. 985.

## THE NOXIOUS VAPOURS COMMISSION.

IN a recent number of the CHEMICAL NEWS we gave a short account of the working of the Alkali Works Acts of 1863 and 1874, which will serve as an introduction to the present article, in which we intend to describe the causes which led to the appointment of the Commission on Noxious Vapours in 1876, and give a sketch of the evidence laid before them. The witnesses examined belonged to almost every class of the community, and the information given by them is extremely detailed and voluminous, plainly showing that the Commission have spared no pains to complete their task in the most thorough manner possible. Numberless witnesses repeated the oft-told tale of acres of fertile land laid waste by the action of alkali and copper fumes. Mr. Stow, a landscape gardener, describes the effects of these vapours on Halsnead Park, an estate about 5 or 6 miles from Widnes. The older trees were becoming stag-headed, and were no longer ornamental, while the oak, ash, beech, birch, and pine plantations were seriously damaged. Of the fir trees, for whose beauty the estate had at one time been famous, there is not a vestige now remaining. Bold Park, a couple of miles nearer to Widnes, presents a still sadder spectacle. Sir Richard Brooke, whose woods and park are within 8 miles from Widnes and 2½ miles from Runcorn, tells a similar pitiful story. The trees are nearly all destroyed, and up to the time he spoke more than three thousand had been cut down. The bark from the destroyed oak trees was also rendered completely valueless by the action of the vapours. There was hardly a healthy shrub on the entire property, and the hedges had been all destroyed and were replaced by fences at great cost. In the neighbourhood of the Tyne the damage done seems to have been just as great, a once-famous wood growing at Hepburn having been completely annihilated by the alkali and copper works.

The farmers are just as loud in their complaints as the owners of landed property. The growth of grass seems to be suddenly arrested by the passage of these vapours over it, and even hay, after it has been cut, was rendered unfit for food. Owing to the deleterious matter deposited on the grass, it acted injuriously on the cattle and sheep fed upon it, the former becoming hide-bound in a couple of years if not moved to a distant pasture. In some cases there was actual loss of life. The consequence of all this was the frequent surrender of farms by good tenants, which were re-let with difficulty to inferior tenants, the rents being either reduced or maintained only on condition that the landlord took the risk of damage caused by the works.

The effects on milch cows seem to be even more serious still. A farmer, whose farm was about three-quarters of a mile from Widnes and other works, kept fifty milch cows. Of these he had sometimes to kill ten or twelve in the year, owing to their livers and lungs becoming affected, at a loss of £5 or £6 per head. Five of his horses had also been killed from the effects of eating the poisoned fodder.

Sir R. Brooke had recovered £130 of an alkali manufacturer for damage done to corn valued at £240. Another farmer valued his annual loss in wheat at 12 bushels per statute acre. A nurseryman in the same neighbourhood described the gradual destruction of his fruit trees. He had not gathered a gooseberry for eight or ten years. He had claimed £250 damages, but only recovered a fifth of that sum. The damage done to similar crops in Tyne-

side is of the same character. Fruit trees, hedges, gorse, bramble, and thorn have all disappeared, the only plants which maintain the struggle for existence being the common elder and the deadly nightshade, which seem to be vapour-proof. Horses fed on hay and straw grown in this part of the country go wrong in their wind, while those fed on fodder brought from a distance are sound and healthy.

The evidence of the effects of the vapours on the human subject does not seem so conclusive, much of it being of an exaggerated character. The depressing influence of the vapours is borne witness to by several clergymen and medical men, but the manufacturers speak uniformly of the good health of their workmen, and Dr. B. W. Richardson—an exceptionally high authority on this subject—declares himself entirely unable to discover any evidence affording proper proof of any special deterioration of health in the neighbourhood of Widnes and St. Helens. On the other hand, Dr. Richardson says that the view so often advanced, that epidemics are prevented by the presence of the vapours, must be given up as untenable.

Thus much the evidence, so to speak, for the prosecution. The counter evidence is, however, particularly strong in some respects. One point is that the damage done is not due to the vapours from the alkali and copper works themselves, but to the acids contained in the ordinary coal-smoke of the district, and to the sulphuretted hydrogen produced by the contact of acids with the drainage of the alkali waste heaps. Another is, that the damage caused by alkali works was chiefly due to preventable accidental escape of gas, which could generally be traced to their authors and compensation made by pecuniary payments. The witnesses for the defence also declared that great improvements in vegetation had taken place since the 1863 Act had been in force, and in a still greater degree during the two years following the Act of 1874, due regard being had to the short time it had been in operation. Statements were also made to the effect that the value of the land in the neighbourhood of works had been largely increasing instead of diminishing, and that this increase fully compensated for such damage as was inevitable. A large amount of the mischief done was also stated to be due to the imperfect enforcement of the Act of 1863 and to the stringency of that of 1874, and the impossibility of complying with its provisions on such short notice. Some valuable evidence was given on this side by Major Cross, who is an alkali manufacturer and chairman of the Widnes Local Board. While admitting that a large amount of damage has been done, even so late as 1872-74, he ascribes it mainly, if not entirely, to one or two works constructed hastily to meet a large rise in the market, and carried on in a most reckless manner. There were some manufacturers, too, upon whom no reliance could be placed, and large amounts of gas were allowed to escape at night, one field of wheat on his own farm having been destroyed by such an escape of chlorine. While, however, making these important admissions, he maintained that the selling and letting value of the land about Widnes had positively increased, and that great good had already been done by the Act of 1874. In 1854 the selling value of the land on which the present town of Widnes is built was worth £60 per acre; at present no land within half a mile of Widnes post-office is worth less than £1200 per acre, and some choice plots are worth four times that sum, land at 2½ miles from Widnes even fetching as much as £600 per acre. The letting value has also increased. Some agricultural land in possession of Sir Richard Brooke, at Cuerdley, which fetched £1 12s. 7d. per acre, now fetches £2 3s. With regard to the working of the Act of 1874, he stated that previous to 1872 he grew peaches in his garden a mile and a half from Widnes, but that in 1872, '73, and '74 the gases from his own and other works killed all the fruit and forest trees round his house, but that since the passing of the Act of 1874 he had fair crops of fruit and roses, and

that flowers grew luxuriantly. Major Cross's evidence, it must be remembered, referred entirely to the Lancashire side of the Mersey, the strongest cases of damage being on the Cheshire side. Other witnesses asserted, still more strongly, that the great amount of damage done was effected before 1863, and that both the value and rental of land had largely increased through the extension of alkali and other works.

In Tyneside, although it is asserted that a great improvement has taken place since the Acts of 1863 and 1874 have been in operation, the same increase in the value of land does not seem to have taken place.

The evidence of Dr. Angus Smith with reference to the destructive properties of ordinary coal-smoke is most instructive. According to him it is impossible to distinguish between the damage done by true smoke from that done by sulphurous acid proper. The soot carries away this acid, retains it, and, being deposited bodily on the trees and other vegetation, the destructive effects of the acid are localised and intensified.

When we estimate the good effects wrought by the Alkali Acts we must make allowance for the mischief effected by all works consuming large quantities of coal, which have hitherto been neglected by our legislators, except in certain districts. As to the amount of sulphurous acid produced by the combustion of coal, Mr. Eustace Carey adduced calculations which proved that the amount of sulphurous acid which escapes from his vitriol works is only one-sixth of that emitted by the combustion of coal used in his factory. Other witnesses produced similar figures, while others again—Dr. Richardson amongst the number—asserted that the acids produced by coal-smoke were comparatively harmless, instancing the more flourishing condition of vegetation in the neighbourhood of iron works as compared with alkali or copper works,

With regard to the mischief done by the sulphuretted hydrogen escaping from alkali heaps, Dr. Angus Smith is of opinion that it does but little harm to vegetation, except the drainage of the waste heaps overflows on grass. In the Tyneside district, where the working of the Acts seems to be regarded with greater favour than in Lancashire, the manufacturers have been in the habit of disposing of their alkali waste by throwing it into the sea—a process which one witness believes to be the only practical solution of the difficulty. We must leave it, however, to Mr. Frank Buckland to tell us what the crabs, lobsters, oysters, and other inshore Testaceæ and Crustaceæ, say to this invasion of their unmanorial rights.

Mr. Brook, an alkali manufacturer, who naturally pleads *pro domâ suâ* with much eloquence, persists that insufficient time has been allowed for compliance with the Act of 1874. The Act, he very justly observes, has forced on manufacturers a large expenditure of capital, and has required what is far more difficult to accomplish, namely, the education of all engaged in the manufacture to a pitch of refinement hitherto undreamt of. This refinement in working necessitates increased supervision; the more frequent repairs, and consequent stoppage of the plant, already entail a heavy extra charge. In spite of all this care it is still found impossible to carry out the provisions of the Act to the letter.

The evidence *pro* and *con* with respect to the Welch copper works is of a similar nature, the manufacturers fighting bravely for their cause, while candidly admitting the mischief done on the one side, and the good effected by the Acts on the other.

Mr. Hussey Vivian paints a sad picture of the decline of the copper smelting trade in North Wales, and begs hard that he and his brethren may not be interfered with. In twenty years the number of furnaces in work have dropped from 324 to 262, the value of the ore sold in Swansea from £698,000 to £393,000, and the quantity from 46,981 tons to 25,000 tons. On the other hand, the annual imported copper has risen from 5478 tons to 41,335 tons, the price of manufactured copper having fallen from £120 to £70 per ton. The Commission, how-

ever, decided against conceding to the Swansea copper works the exemption so eloquently pressed by Mr. Hussey Vivian, on account of their being situated in a deep valley, and their having been established so long that "the population which has planted itself around the works has accommodated itself to their condition." The latter plea reminds one of that of the vivisecting eel-seller of ancient days.

Coke-ovens were the next nuisances that claimed the attention of the Commission. Mr. Isaac Lowthian Bell gave valuable evidence on the mischief effected in this direction, and made a number of practical suggestions which were in part adopted by the Commission, as we shall see hereafter.

Salt works visited by Dr. Richardson seem to be, *per se*, comparatively harmless, the great damage being done by the smoke escaping from the boiler-flues. They are, however, to be inspected.

The Commission lastly transferred their labours to the London District, and visited Lambeth Potteries, Greenwich, Northfleet, and Battersea. The evidence given in these localities was sensational and conflicting, the medical men of these places generally telling pitiful stories of the sad effects of bad smells on themselves and their patients. Gold-refiners and glass-works were let off with a caution, and the Commission separated in August, 1878, after having done two years' heavy and valuable work.

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## NOTES FROM THE PARIS EXHIBITION.

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### ON SOME OF THE CHEMICAL PRODUCTS.

MESSRS. Griffiths, Fletcher, and Berdoe show, amongst other things, their new zinc-white, for which they have received the award of a silver medal. This zinc-white, the base of which is sulphide of zinc, is at present manufactured on a large scale by the Silicate Paint Company, of London and Liverpool. At the latter place, where the industry in question was originated, the factory produces 25 tons of Griffith's zinc-white per week, and a new factory, opened on the banks of the Thames, gives an output of 50 more tons for each seven days' work. Land has been secured for a still further increase in the output, and the manufacture will shortly reach 200 tons of paint per week. It has been subjected to a number of experiments, comparing its properties with those of white-lead and zinc oxide, and judgment has been given in favour of the zinc-white in all respects. One of the principal advantages in the employment of this paint instead of white-lead is that it is not injurious to the health of people who use it. It is also said that this zinc-white has a whiter tint than white-lead, and the colour is not affected by sulphuretted hydrogen. Another advantage is that the zinc-white covers better than either white-lead or zinc oxide; that is to say, that the same quantity of colour will cover a space 25 per cent larger than the former, and about 100 per cent larger than the latter, and it will not either blister or crack even if exposed to the most violent heat.

The Silicate Paint Company exhibit what they call a "Petrifying Solution," to be used as a wall distemper, to keep the damp out; it is a solution of silica, which has the property of closing up the pores in bricks, stone, cement, &c., and thus rendering the surface impervious to the rain. Plaster coated with the solution becomes hard, like cement; and stone or brick floors which have had a coating of the liquid prevent the damp rising.

Young's Mineral Oil and Paraffin Company has a very good exhibition of paraffin and the different oils and essences which they make. There are two very large blocks of paraffin, and samples of all the oils (of which the quantities made are given below). The manufacture of paraffin was first commenced in 1850 as a private undertaking, and it went on increasing in importance till, in

1866, the works were transferred to the above mentioned company, who have, since then, successfully carried them on. The raw material used was first taken from the Bog Head coal mines, but as that source became exhausted, the company began using bituminous schist, for the supply of which they have now twelve pits. They employ about 2100 men, and their annual production is very great. Below are given some of the quantities of oil, &c., which are made in a year.

Shale distilled .. .. .	233,000 tons
Crude oil made .. .. .	8,040,000 gallons
"    purified .. .. .	9,680,000 "
Naphtha made .. .. .	500,000 "
Burning oil made .. .. .	4,000,000 "
Heavy mineral oil made .. .. .	1,055,000 "
Crude paraffin made .. .. .	6,190,000 lbs.
Refined paraffin made .. .. .	3,940,000 "
Candles made .. .. .	3,000,000 "

The total annual value of what the company produces is £500,000.

Messrs. James Chambers and Co. exhibit a quantity of colours, varnishes, and chemical products of their manufacture, also various chemical manures.

George Atkinson shows a quantity of colours which are specially prepared for printers' use; they are principally vermilion in different shades.

Messrs. Burgoyne, Burbidges, Cyriax, and Farries, who are wholesale manufacturing druggists, exhibit a quantity of chemicals and drugs which are used in pharmacy and medicine. They have been awarded a silver medal.

Messrs. Morson and Sons' case contains a very interesting collection of some of the finer chemical products; among them may be mentioned benzoate of ammonia, citrate of iron and quinine, pyrophosphate of iron, and a good quantity of salicine and pure iodine; they also show various salts of a number of poisons, as well as essences of different fruits, such as pine apples, and Jargonelle pears.

The Runcorn Soap and Alkali Works Company exhibit in their case some of the materials used in the manufacture of soap, they show some large crystals of soda and other products.

Messrs. Tennant and Sons have a large and interesting exhibition of the process for the refining of soda-ash by Maclear's method, they show bottles of soda, soda-ash, soda-ash refined, caustic soda, &c. They also exhibit the steps in the process of sulphur recovery by Maclear's method, and the manganese recovery by Dunlop's process. Messrs. Tennant and Sons have received the award of a gold medal.

Mr. James Readman exhibits several different compounds of phosphorus, and had in his case, at the commencement of the Exhibition, a large quantity of pure phosphorus, but it was removed on the 9th of May, at the request of the British Commissioners, owing to the danger incurred in exposing so great a quantity to the heat of summer; it was a wise precaution, as one of the bottles has had the top burst out, owing to the expansion of its contents. He also shows specimens of the different raw materials, and the stages in the manufacture of phosphate of soda.

The Washington Chemical Company exhibit a large block of magnesia, about 5ft. high, by 2½ft. wide, and 2½ft. thick. They have also several other specimens of magnesia in different states.

Messrs. Savory and Moore exhibit a number of medicinal compounds and chemical chests. One of their exhibits worthy of notice is a series of medicines, mixed with gelatine, to make them easier to apply; they are divided into four classes.

(1.) Ophthalmic, (2) hypodermic, (3) internal, and (4) external. The first, as may be seen by its name, is for affections of the eye; the gelatine mixture is applied so as to do away with irritation as much as possible. The second is for keeping, in a compact form, decomposable liquids.

The third is for internal administration; it hides any unpleasant taste that the medicines might have. The fourth is for application on the skin to form blisters, &c.

The St. Bede Chemical Product Company (Limited), show in their case principally different samples of soda and its manufacture.

Britten's Patent Glass Company (Limited) exhibit specimens of what they call a new industry, viz., the utilisation of the slag from iron blast-furnaces. Many attempts have been made to utilise this product, which covers so many acres of once fertile ground in the iron districts, but it is generally considered as waste. It has been broken up for road paving, or made into blocks for building purposes; but as the product will not pay for its own transport, only a small quantity can be employed, and that only in the neighbourhood of the iron works. Several people have tried making glass of it, and have succeeded by adding the constituents which were wanting; but to get the slag to a condition in which the matter can combine, it has to be liquefied by heat, which involves very great expense. After many experiments, Mr. Britten has succeeded in utilising the material, and also the heat from the furnaces, and an English company has been formed to work his patent. The company has erected glass works in Northamptonshire, close to a set of blast-furnaces, and they are now in operation. The slag flows into a tank at one end, and is there mixed with the required ingredients for making the glass, fused and fined; the melted metal then flows through a bridge to the other end of the tank, where it is worked, and afterwards blown into bottles, &c. As the slag is already melted, it does not require so great a heat for the combination with the other substances, and also it furnishes more than half the material of the glass. Thus this glass costs less than glass made by the ordinary method. The natural tint of the glass is greenish, but it can be bleached or coloured at will. The furnace now at work produces 90 gross of bottles a day. It can be seen that it will be cheaper for iron-masters to have glass works attached to their own works, as the cost will not be so much as the always increasing cost of ground to dispose of their slag on. Below are one or two analyses of glass compared:—

	Britten's patent glass.	Sunierland glass bottles.
Silica.. .. .	64.4 per cent	53.25 per cent
Potash and soda	6.31 "	4.25 "
Lime .. .. .	16.37 "	25.5 "
Alumina and oxide of iron ..	11.87 "	15.0 "
Magnesia .. ..	0.64 "	2.0 "
Various .. .. .	0.41 "	0.0 "
	100.00	100.00

*Analysis of Different Specimens of Britten's Glass.*

	Glass suitable for bottles.	Glass injurious.
Silica.. .. .	58.4 per cent	52.4 per cent
Potash and soda	11.7 "	4.4 "
Lime .. .. .	18.6 "	32.1 "
Alumina and oxide of iron ..	11.0 "	11.1 "
Various .. .. .	0.3 "	0.0 "
	100.0	100.0

It is the excess of lime that is injurious; not more than 20 per cent should be present.

H. C.

Recovery of Gold from Old Cyanide Baths.—The liquid is super-saturated with hydrochloric acid, when a part of the gold is deposited. The rest is thrown down by means of zinc. Both precipitates are melted with 5 parts of ignited soda.—*Chemiker Zeitung.*

ON SCHUTZENBERGER'S PROCESS FOR THE  
VOLUMETRIC ESTIMATION OF OXYGEN  
IN WATER.\*By CHRISTOPHER CLARKE HUTCHINSON,  
Royal Exhibitioner, Royal College of Science.

In judging of the character of a water for domestic uses, one of the most important points to be ascertained is the question of its pollution by sewage and other deleterious matters.

The determination of this pollution, its extent and nature, is at present rather unsettled. It is, however, believed by many chemists that a contamination, such as referred to, will exercise an effect upon the gaseous bodies held in solution in a water. It is the opinion of many that the relative quantity of oxygen present in a water affords the key to its deterioration by organic matter; because it is unlikely that a large quantity of oxygen can be held in solution by a water containing oxidisable matter. Waters which contain their normal proportion of oxygen, in relation to their other gaseous constituents, would be regarded as free from sewage and decaying matter; a diminution in the quantity of oxygen would indicate a corresponding increase in the amount of injurious matter present.

The late Dr. Miller's analyses of the gases present in the water of the Thames at various points clearly proved that as the amount of sewage increased, the amount of carbonic acid increased, and the amount of oxygen decreased.

The Rivers' Pollution Commissioners state in their Sixth Report that the proportion of oxygen in water is deprived of much importance, since it has been discovered that deep well-waters, which cannot contain putrescent organic matter, contain little or no dissolved oxygen. The absence of oxygen in deep well-waters, may, however, be owing to its having oxidised and destroyed the organic matter the water previously contained during its percolation through the strata.

In the presence of this conflicting testimony I was induced to undertake an investigation, in the hope of throwing some light upon this important question—whether or not the amount of oxygen present is, or is not, an indication of the freedom of a water from injurious organic bodies.

In commencing the inquiry I was desirous of employing some accurate and yet rapid method for the estimation of the oxygen present; for although the gasometric operations by Bunsen's method leave nothing to be desired in point of accuracy, yet on account of their somewhat tedious nature some other plan, if even slightly less accurate, but at the same time more rapid, would be desirable.

Such a method as this I thought might be afforded by the process devised by Schutzenberger for the volumetric estimation of oxygen in oxygenated liquids.† As the estimation is made without the removal of the oxygen by boiling, and in the condition in which it exists in the water, such a plan would seem to be more desirable than its expulsion from the liquid, together with the other gases held in solution, and their subsequent determination.

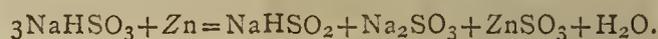
I now proceed to give the results I have obtained by means of this volumetric process.

Briefly described, the method consists in adding a known volume of the water under experiment to a solution which is capable of being oxidised (accompanied by a change of colour due to such oxidation) by the oxygen held in solution. The extent to which this has occurred is then determined, by the addition of a powerful reducing agent, which, acting upon the coloured compound so formed, reduces it to its former condition—the amount necessary being, of course, indicated by the reverse change of colour

to that which occurred in the first instance. This last solution being standardised in terms of the oxygen it is capable of taking up, from the amount used in the experiment we arrive at the volume of oxygen contained in the volume of water taken.

The reagents used I will now describe with the method, and proportions for their preparation I found most advantageous.

The reducing agent used is sodium hyposulphite—not the commonly so-called "hyposulphite," but the sodium salt of the acid  $\text{H}_2\text{SO}_2$ ; its formula as given by Schutzenberger is  $\text{NaHSO}_2$ . I prepared this as follows:—A concentrated solution of caustic soda ( $\text{NaHO}$ ), sp. gr. 1.4, was taken; sulphurous anhydride ( $\text{SO}_2$ ) was passed through it, until the liquid was thoroughly saturated, and smelt strongly of the gas. The yellow liquid (which was kept cool during the process of saturation by immersion in cold water) is sodium bisulphite ( $\text{NaHSO}_3$ ); it increased slightly in bulk, and was reduced to the sp. gr. of about 1.34. 100 grms. (75 c.c.) of this solution was then briskly agitated in a flask with 6 grms. of powdered zinc, air being excluded; an elevation of temperature occurred, the bisulphite being converted partly into the hyposulphite, together with the formation of sodium sulphite and zinc sulphite, according to the following equation:



After agitation for about five minutes, the liquid was allowed to cool; 400 c.c. of water recently boiled were added; 35 c.c. of milk of lime, containing 200 grms. of  $\text{CaO}$  per litre, were also added, and the mixture allowed to stand until clear, when it was decanted off into well-stoppered bottles, and kept in the dark. The lime solution not only precipitates the zinc salt, but also renders the solution less absorbent of free oxygen, although it acts very rapidly upon dissolved oxygen. Before use this was further diluted with three times its bulk of distilled water, recently boiled.

The liquid recommended by which the change of colour detects the completion of the process is either carmine indigo (sulphindigotate of soda,  $\text{C}_8\text{H}_4\text{NaNOS}_3$ ), or Coupier's aniline blue. 10 grms. of the carmine indigo are recommended to be dissolved in one litre of water, the product being kept in well-stoppered bottles also in the dark.

An ammoniacal solution of pure copper sulphate is also recommended to be made, containing 4.46 grms. (or, more correctly, 4.471 grms.) of the crystallised salt per litre. This is to be used for the standardisation of the above two solutions.

Since the reducing agent is so sensitive to the presence of oxygen, it is necessary to make the estimations in an atmosphere of pure hydrogen. To ensure the purity of the hydrogen, I passed it through a solution of nitrate of silver, in addition to the sulphuric acid, and the tube containing pieces of caustic potash.

We begin by finding the volume relation between the indigo and hyposulphite. The burettes of the apparatus are filled, one with indigo carmine solution, the other with hyposulphite; a rapid current of hydrogen is passed through the apparatus, a small quantity of warm distilled water added, and this coloured by the addition of a small quantity of indigo. We now add cautiously the hyposulphite; the blue solution turns first green, and finally to a clear yellow tint. If the whole of the air has been expelled from the apparatus, the yellow tint will remain unchanged; the slightest trace of oxygen causes the surface of the liquid to become blue. A known volume of indigo (25 c.c.) is now added, and the hyposulphite solution again run in until the yellow tint appears, indicative of the reduction of the whole of the indigo. The colour change is exceedingly sharp, one drop being sufficient to change the colour from green to yellow. If the solution be acid, the blue colour changes first to red, and finally the yellow tint appears.

We next require to find the reducing power of the

\* A paper read before the Royal Irish Academy, December 10, 1877.

† *Bulletin de Chemie et Physique*, vol. xx.

hyposulphite in terms of oxygen, finding from this the amount of oxygen any volume of the indigo will yield. This being a stable solution, the hyposulphite (being liable to change) can be readily standardised at any future time.

Two methods can be used, by which this reducing power can be found:

First. By finding the quantity necessary to reduce the ammonia copper solution, *i.e.*, the amount which brings the blue solution to a colourless state, by the reduction of the cupric to cuprous oxide; 10 c.c. of this solution yield 1 c.c. of oxygen (0° C. 760 m.m.s. pres.) to the reducer. 25 c.c. are operated on in a smaller apparatus, similar to the one used for the water estimations. I find, however, that the colour change in this plan is so indefinite and difficult, even to the practised eye, to detect that the exact point cannot be determined with any degree of certainty.

The second method consists in obtaining a pure water saturated with air, and then finding the quantity of hyposulphite capable of abstracting the whole of its oxygen.

This water is obtained by agitating in a large flask about one litre of distilled water with free access of air; the agitation is continued for about a quarter of an hour. To find the amount of oxygen in a given volume of the water, I made the following formula, from the consideration of the relative quantity of oxygen present in the air, and its coefficient of absorption in water:

$$v = 0.0262 \times a_p \times V \times \frac{P}{95}$$

in which we have—

- $v$  = vol. of oxygen in c.c. at 0° C. and 760 m.m.s. pres.
- $a_p$  = coefficient of absorption of oxygen in water at temp.  $t^\circ$  C., given by Bunsen's Tables.
- $V$  = volume of water employed, temp.  $t^\circ$  C.
- $P$  = barometric pressure in m.m.s.

The relation between the saturated water and the hyposulphite is found in exactly the same way as the method, hereafter described, for the oxygen determination in waters. I found that, although the hyposulphite solution was about the strength recommended, the volume relation between it and the indigo, instead of being one to ten, was equal. As the indigo solution thus appeared ten times too concentrated I further diluted it for use.

The following is an example of standardisation by the above method. The apparatus was in every way regulated as described for water estimations:—

*Comparison of Hyposulphite and Indigo.*

Mean of five experiments gave—  
25 c.c. indigo = 7 c.c. hyposulphite.

*Comparison of Saturated Water and Hyposulphite.*

Mean of five experiments gave—  
75 c.c. of water = 2.4 c.c. hyposulphite,  
from which is found—  
25 c.c. indigo = 218.75 c.c. of water.  
Temperature of water = 12.6° C.  
Barometric pressure = 744 m.m.s.

We therefore have—

$$v = 0.0262 \times 0.031024 \times 218.75 \times \frac{744}{95} = 1.392;$$

therefore—

25 c.c. indigo = 1.392 c.c. oxygen.

I made determinations on different days at different conditions of temperature and pressure. The following shows the quantity of oxygen 25 c.c. of indigo was calculated to yield in each case:—

Temp., 12.6° C.	}	= 1.392 c.c.
Pressure, 744 m.m.s.		
Temp., 15.5° C.	}	= 1.448 "
Pressure, 771 m.m.s.		
Temp., 14.75° C.	}	= 1.354 "
Pressure, 752 m.m.s.		
Mean .. .. .		= 1.398 "

The same amount of variation under widely different conditions shows this method of standardisation to be a reliable one.

I now proceed to give the method for the estimation of oxygen contained in a water. Owing to the change which the hyposulphite undergoes, it is necessary that a comparison between it and the indigo should be made each day. After this has been done and the apparatus freed from air by means of the hydrogen, 200 c.c. of warm water (temp. about 50° C.) are then added; 50 c.c. of indigo are now run in. This I usually effected in portions of about 15 c.c. at a time, decolourising each portion by means of the hyposulphite, thus utilising this step for the comparison of the two reagents; effecting thereby a saving of time and material. The liquid in the apparatus being now brought to the yellow neutral tint, a measured volume of the water under experiment is added—75 c.c. I found a convenient quantity—taking care that no air is admitted at the same time. The bleached indigo will now become re-oxidised, turning from yellow to blue, in proportion to the amount of oxygen present in the water. The hyposulphite is now cautiously added until we again arrive at the yellow tint, free from green; a single drop of the reagent is sufficient to effect the colour change at the proper point. From the quantity used we find the amount of oxygen present in this 75 c.c. of water. The operation can be repeated over again on another volume of the water until the apparatus becomes inconveniently full. I usually made from four to six such experiments in each case. The temperature of the apparatus must be kept at about 50° C. by the addition of warm water at intervals; the amount of hyposulphite required becomes gradually less as the apparatus cools, giving the results too low.

To test the accuracy of the method I took a measured volume of the same water at the time of the experiments, expelled the gases by boiling, collected this gaseous mixture, and determined its volume and composition by the usual methods of Bunsen's gasometric analysis.

The following examples are taken to illustrate the method of analysis.

*Volumetric Method.*

Mean of four determinations gave—  
25 c.c. indigo = 8.21 c.c. hyposulphite.

This quantity of indigo we before found to yield 1.391 c.c. of oxygen. Therefore—

8.21 c.c. hyposulphite = 1.398 c.c. of oxygen.

Mean of five determinations gave—  
3.55 c.c. hyposulphite = 75 c.c. of water.

From this we find the quantity of oxygen contained in 2.420 litres of water—the volume used in the gasometric method.

2.420 litres of water contain 19.505 c.c. of oxygen.

*Gasometric Method.*

Volume used .. .. . 2.420 litres.  
Temperature of water .. .. . 13° C.

	Volume.	Temperature in 0° C.	Pressure in m.m.s.	Col. of Mercury above that in trough in m.m.s.	Corrected Vol. at 0° C. and 760 m.m.s. pres.
Total vol. of gas evolved .. .. .	302.560	13.9	737	268.8	237.719
After absorp. of CO <sub>2</sub> .. .. .	316.149	14.9	745	229.2	193.959
After admission of H .. .. .	503.600	14.4	765	55.2	439.066
After explosion .. .. .	325.960	12.4	771	230.5	217.337

*Percentage Volume Composition.*

Carbonic acid .. .. .				18.408
Oxygen .. .. .				31.091
Nitrogen .. .. .				50.500
Total .. .. .				99.999

*Absolute Volume Composition in c.c.*

Carbonic acid .. .. .	10·238
Oxygen .. .. .	17·294
Nitrogen .. .. .	28·087

Total .. .. . 55·619

Volume of oxygen by volumetric method	19·505 c.c.
"    "    "    gasometric    "	17·294 "

Excess given by volumetric method .. 2·211 c.c.

Other samples from the same source were also experimented upon, the results being variable.

Water of a different character to this last was also experimented upon with the following result:—

*Volumetric Method.*

Mean of three determinations gave—

25 c.c. indigo = 7·25 c.c. hyposulphite ;  
therefore—

7·25 c.c. hyposulphite = 1·398 c.c. oxygen.

Mean of four determinations gave—

3·42 c.c. hyposulphite = 75 c.c. water.

From this we find—

2·420 litres of water contain 12·486 c.c. of oxygen.

*Gasometric Method.*

Volume used .. .. .	2·420 litres.
Temperature of water ..	11° C.

	Volume.	Temperature in °C.	Pressure in m.m.s.	Col. of Mercury above that in trough in m.m.s.	Corrected Vol. at 0° C. and 760 m.m.s. pres.
Total vol. of gas evolved .. ..	612·73	8·4	736·5	211·8	403·950
Gas used .. ..	369·04	8·4	736·5	211·8	243·294
After absorp. of CO <sub>2</sub>	240·16	8·8	729·5	327·5	123·063
After admission of H	364·97	8·8	729·5	187·5	253·313
After explosion ..	261·20	8·7	729·5	296·0	141·584

*Percentage Composition.*

Carbonic acid .. .. .	49·418
Oxygen .. .. .	15·308
Nitrogen .. .. .	35·274

Total .. .. . 100·000

*Absolute Volume Composition in c.c.*

Carbonic acid .. .. .	46·715
Oxygen .. .. .	14·471
Nitrogen .. .. .	33·343

Total .. .. . 94·529

Volume of oxygen by volumetric method ..	12·486
"    "    "    gasometric    "	14·471

Difference .. .. . 1·985

In this case the volumetric method shows a *less* volume of oxygen than the gasometric method. This, I think, is attributable to the large quantity of carbonic acid present; for, as Schutzenberger points out, when an acid is present in appreciable quantity, even such a weak acid as carbonic acid, the results given are invariably too low; hence this method would not be applicable, with any degree of accuracy, to waters in which a large quantity of carbonic acid is present.

I made numerous determinations, from which the two foregoing examples are selected; but none of them showed any trustworthy results; in some cases the volume of oxygen obtained being in excess, and in others less than that obtained by the gasometric method.

The variability of the results led me to inquire into the

source of these discrepancies, and how they might be avoided.

Noticing that a change of colour in the yellow neutral tint seemed to occur to a greater extent than it should do on the addition of recently boiled distilled water, I made the following experiments:—

Distilled water was boiled in a flask fitted with a cork and exit valve so as to avoid contact with air, for over four hours. The apparatus was prepared as usual with indigo and hyposulphite, the temperature being kept at 50° C. The boiled water, which was kept in well-stoppered bottles, was then added in successive portions of 75 c.c. at a temperature of 55° C. On each addition a blue colouration was produced in the yellow neutral liquid, just as if oxygen had been absorbed by the reduced indigo. The amount of colour change was determined as usual by the addition of hyposulphite. The mean of five experiments showed that 2·9 c.c. were necessary to bring back the yellow tint. This quantity was found to be equivalent to 3·86 c.c. of indigo, or 0·201 c.c. of oxygen.

Unwilling to think that this was due to oxygen which had been left unexpelled by ebullition, I boiled recently-distilled water in long-necked flasks fitted with corks and exit valves for over five hours. The apparatus was prepared as usual, but in this case water at 100° C. was used, and the body of the apparatus immersed in water kept at 100° C. Portions of 75 c.c. of water were removed from the flasks whilst in a state of ebullition, and introduced into the apparatus; each addition caused a change of colour from yellow to blue. The mean of five experiments showed that 1·25 c.c. of hyposulphite was necessary to destroy the colour.

1·25 c.c. hyposulphite = 1·66 c.c. indigo = 0·08 c.c. of oxygen.

After boiling for over six hours the water was allowed to cool, out of contact with the air, and in withdrawing portions from it coal-gas was aspirated in instead of air, so as to avoid as far as possible contact with oxygen.

The same experiments were tried at the ordinary temperature (16·75° C.), and the same volume of water (75 c.c.) used. The mean of four experiments gave the colour change equivalent to 1·3 c.c. of hyposulphite = 1·56 c.c. of indigo, or 0·087 c.c. of oxygen.

The same experiments were now made at the temperature 0° C. by cooling the boiled water previous to its addition, and immersing the apparatus in a bath cooled by a mixture of ice and salt. The results in this case were variable, the introduction of 75 c.c. of water requiring from 0·9 to 2·4 of the hyposulphite. I found this to be due to the length of time the apparatus was allowed to stand in the bath after the introduction of the water. The longer the time the less the quantity of the reagent required to destroy the blue tint produced. To make certain that such a change did occur I brought the liquid to a yellow tint, and then added a few drops of indigo so as to produce a distinct green colour. On allowing the apparatus to stand in the bath this gradually disappeared. I tried this several times, adding variable quantities of indigo in excess; but in all cases (within certain limits) when allowed to stand in the cold water the green colour was gradually replaced by the yellow tint, just as if a quantity of hyposulphite had been added.

I attempted to remove these errors by a modification in the method of procedure.

The burette used for the indigo was replaced by a larger one (100 c.c. capacity). After placing in the apparatus a quantity of indigo solution, expelling the air and bringing to the neutral point as usual, a known excess of the hyposulphite was added. Saturated water, as before described, was then added from the large burette, so as to oxidise the excess of hyposulphite, and just tinge the liquid green. From the volume required, by using the formula before given, the volume of oxygen contained in this can be found; hence the equivalence of the excess of hyposulphite in terms of oxygen. The same operation is performed with the water under experiment acting

upon the same excess of hyposulphite. The relation between the volume used and that of the saturated water gives the amount of oxygen in the liquid. Any errors resulting from change in the solution would thus be eliminated, and the calculations simplified. On trying this method, I did not find the results any more satisfactory than the original method, although performed with the greatest care; they gave quantities in excess of that given by the gasometric method. Thus, in 2.420 litres of water,

Volumetric modification gave.. ..	15.133 c.c.
Gasometric method .. .. .	12.650 "

Excess .. .. .	2.483 "
----------------	---------

Although this volumetric method possesses the great merit of exceeding rapidity, yet the many precautions necessary to be taken greatly detracts from the value and reliability of the results. It seems to be better suited for the determination of oxygen in small rather than in large quantities of a liquid, such as are desirable in water estimations. It is also valuable as a means of showing whether it would be desirable to estimate the amount of oxygen present in a water, by the more accurate methods. The process adopted by Schutzenberger for checking the results appears to have been submitting the liquid to the action of the mercury pump for fifteen or twenty minutes. I do not think this is sufficient, for, in expelling the mixed gases from a water by boiling, I have found that traces of gas are given off even after a considerable period.

The great drawback is the considerable amount of change the hyposulphite solution undergoes, even when excluded from the air and kept in the dark. The following give the volume ratios between it and the indigo, as taken on different days, showing the extent of this change:—

Oct. 23.—25 c.c. indigo = 7	c.c. hyposulphite.
„ 25.—25 „ „ = 7.84	„ „
„ 27.—25 „ „ = 9.8	„ „
Nov. 1.—25 „ „ = 13	„ „
„ 6.—25 „ „ = 20.75	„ „

These investigations were carried out in the Chemical Laboratories of the Royal College of Science, under the supervision of Professor Galloway.

## NOTICES OF BOOKS.

*Truths about Whisky.* London: Sutton, Sharpe, and Co.

IN one sense the little work before us must undoubtedly be regarded as a trade-publication, written to promote the business of the eminent firms under whose auspices it is issued. Were this its only object then, however truthful its statements, it would scarcely be entitled to notice in our pages. But as it is, at the same time, destined to expose an abuse in an important branch of chemical manufactures—an abuse injurious alike to the consumer and to the honourable producer—it comes legitimately within our cognisance. There is a popular notion that distilled spirits, and especially whisky, are merely dilute alcohol, and that the nearer they approach to this standard the better is their quality. Against this view the authors enter a decided protest. They define whisky as a spirit prepared from grain, whether malted or not, and distilled “in a so-called pot-still,” which brings over, together with the spirit, a variety of flavouring and other ingredients from the grain. Such a spirit, if carefully made from good materials, undergoes important chemical changes on keeping, and whilst it loses strength, *i.e.*, falls in its percentage of alcohol, it gains flavour and aroma from the development of certain ethers.

On the other hand, the rival liquor which has gradually, by reason of its lower cost of production, been supplanting whisky in the market, and which is known in the trade as

plain or silent spirit, is made from promiscuous vegetable products, by the aid of a “patent still,” which, if properly managed, brings over merely alcohol and water, leaving behind the flavouring matters, or rather the bodies from which they might ultimately be developed. This silent spirit undergoes no change on keeping; it never requires any aroma, and though admirably suited for use in the arts, it never can become whisky, though it may be imposed upon the public as such, by dint of certain mysterious drugging operations.

Having drawn this perfectly legitimate distinction between whisky and silent spirit, the authors proceed to give a history of the fraud against which they are contending. The whisky of the best Dublin distillers was first mixed by dealers with whisky, genuine indeed, but of a cheaper and coarser character, or as we may explain it, made in a pot-still, but from inferior materials, and by less skilful hands. The whole mixture was then, of course, sold at the price of the more costly of its components, and the public were taught that, by dint of this “blending” process, an article was produced superior to any of the original materials. Silent spirit was next introduced, mixed with the coarsest provincial whisky, and then sold as the genuine Dublin product. This malpractice was found highly profitable, as silent spirit can be manufactured at a much lower cost than true whisky. Hence the honourable manufacturers of whisky had only two alternatives left; either to enter into the blending system themselves, or to “fight it out,” by explaining to the public the frauds which were being practised, and especially by exposing the facilities for imposition afforded by the Customs Regulations.

In the most important points we are thoroughly at one with the authors of this pamphlet. We may, indeed, be scarcely able to repress a smile at the enthusiasm which appears in their description of genuine whisky, and we may be somewhat sceptical as to the position they assign to it in comparison with natural, *i.e.*, unbranded and unplastered wines. But we agree with them entirely in their implied admission, that the dietetic value of a fermented or distilled liquor is to be estimated by its percentage of alcohol, the very reverse being often the case. We applaud their remarks on “blending”—an evil by no means, limited to the whisky trade, but carried on to an equal extent in wines. Time was when the growths of different vineyards, differing as they do in flavour, were carefully kept distinct. Now, forsooth, instead of being asked to buy Marcobrunner, or Niersteiner, or Liebfrauenmilch, &c., we are offered our choice between Rhenish *a*, Rhenish *b*, and the like. In Burgundies and clarets all trace of the distinctive origin of the sample is disappearing in the same manner. Closely connected with “blending” is another modern mischief complained of by our authors, that the importer or other large dealer is gradually usurping the place rightfully due to the producer.

Attention is drawn in this work to a point of great physiological and sanitary interest, which has been far too little regarded. Our authors consider it strange that the leaders of the extreme temperance party “should have so completely left out of account, in the various experiments which some of their body profess to have conducted, the way in which the action of alcohol may be modified, by the various substances with which it may be combined. We read, for example, of experiments made with ‘brandy,’ but what is brandy?” We should be very reluctant to argue from the observed effects of pure alcohol, diluted merely with water, to those of a similar quantity of alcohol present in wine, beer, or true whisky.

A few statements are made to which, from a chemical point of view, we must object. Thus, rectified spirit is described as being a “solvent for gums.” True gums are insoluble in alcohol, though it readily dissolves the gum-resins—a distinct class of bodies. Again we read that the difficulties in the way of permitting the free use of alcohol in the arts have been overcome, “by the discovery

that spirit maybe impregnated with an offensive substance, called 'methyl,' which cannot be removed by rectification, and which is no nauseous that it cannot be drunk. This methylated spirit is allowed to be sold duty free, being wholly unfit for human consumption; and it has rendered possible the unrestrained employment in the arts."

Here are several errors; the liquid added to spirit is not methyl, but methylic alcohol, which is further required to be itself in an impure condition, otherwise—though at what limit the Revenue authorities have refused to say—it also is liable to duty. The mixture of ordinary spirit and methylic alcohol,—known as methylated spirit, though admittedly nauseous, is greedily drunk by workmen in the establishments where it is used, and so far from its employment in the arts being "unrestrained," unless the consumer is prepared to give security for £1000, the revenue insists on the further addition of a quantity of shellac, than which it would be difficult to devise an admixture more fatal for all purposes, save those of the varnish maker.

We will conclude this notice of a timely and useful pamphlet with quoting some not unmerited strictures levelled at certain members of our own profession:—"The case is not one for genuine chemists, although it is well suited for puffs, written by analysts whose business it is to find nothing but all sorts of negative and positive excellences in the preparations made by their employers. It is a pity that the heads of the profession of chemistry, which is every day becoming of more importance in the arts, cannot stop a use of chemical certificates, which is degrading not only to those who issue them but also to the general body to which such persons belong. There are some well-known analysts whose names are never advertised as testifying to the purity of somebody's black lead or ginger beer; but even the public utterances of these men are held of less account than they should be, by reason of the facility with which chemical certificates about anything may be obtained from men whose names are followed by all the letters of the alphabet.

*Préparation des Lins et Chauvres sans Rouissage Putride.*  
(Preparation of Flax and Hemp without Rot-steeping.)

Système J. T. LEFEBURE. Bruxelles: I. J. Baertsoen.

It is well-known that flax and hemp are ordinarily prepared for use by being laid to steep in water until the extractive and gummy matters are destroyed by putrefaction. The smell given off by the steeping pits is extremely offensive, and in flax-growing districts there are frequent complaints of rivers and wells being contaminated by the escaping waters. M. Lefebure first removes the so-called straw, the outer coating of the flax stem, by the aid of a machine, into which the flax enters in its green state, and comes out in a few seconds perfectly decorticated. It is then plunged in a solution of soda, which frees it entirely from gum without the least injury to the fibre. The duration of this second operation is from two to five hours, according to the more or less serious nature of the sample. In addition to the suppression of nuisance, the flax is obtained in a state of complete disaggregation, and without any injury to the fibre, and is necessarily finer, stronger, and more regular.

## CORRESPONDENCE.

### SUGAR TESTS.

To the Editor of the Chemical News.

SIR,—I observe that in the newest work on sugars I have consulted, viz., "De L'Analyse des Sucres," par M. Woussen, Paris, 1878, under the rules for preparing sugar solutions for the saccharimeter, directions are given for

rejecting an amount of sugar solution equal to three times the bulk of the bone-char employed.—I am, &c.,

J. M. MERRICK.

Laboratory, 59, Broad Street, Boston, U.S.A.,  
September 24th, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 13, September 23, 1878.

Dissociation of the Oxides of the Platinum Group.—H. Sainte-Claire Deville and H. Debray.—Platinum is distinguished from the other metals present in its ores by the fact that it does not combine directly with oxygen, in whatever condition the two bodies may be placed. With rhodium, palladium, and iridium the case is otherwise. If heated in a muffle, at a temperature not too elevated, these metals combine with oxygen, but their oxides are decomposed at a stronger heat. Osmium and ruthenium combine directly with oxygen. The product of this oxidation is volatile, and is formed at the highest temperatures. Osmium most strongly ignited, though less alterable than osmium obtained at a low temperature, is transformed into osmic acid, even at the common temperature. Ruthenium behaves exactly like osmium. The metal, after strong ignition, is oxidised in the muffle at a temperature scarcely above 400°, and is volatilised in abundance: it is difficult to say in what state, for the substance always gives off the odour of ozone, the formation of which always accompanies the decomposition of hyperruthenic acid. Possibly the product deposited in the muffle is the binoxide. This oxide is obtained in crystals, in a tube of porcelain traversed by a current of oxygen, in which matters containing ruthenium are heated. It is thus that M. Fremy has proved its volatility, and discovered the means of extracting it directly, and in the most beautiful forms, from amongst the products of the roasting of the osmide of iridium. Thus ruthenium, which in the metallic state is one of the most fixed matters known, evaporates rapidly in a muffle. These properties absolutely distinguish osmium and ruthenium from the other platinum metals. These two, by the manner of their behaviour in contact with oxygen, evidently approximate to arsenic and antimony, and, like these latter, might be placed amongst the non-metallic bodies. With rhodium, palladium, and iridium the case is different. Their oxides can be decomposed by heat, and thus the laws of their dissociation and the tension which it takes at different temperatures can be ascertained. For iridium the following numbers have been found:—

Temperatures.	Tension of Dissociation.
	m.m.
822°8	5'00
1003'3	203'27
1112'0	710'69
1139'0	745'00

Reply to the Observations of M. E. Marchand.—A. Adam.—The author defends the value of his process. He declares that—"The lacto-butyrometer estimates only the butter: I give the butter, the lactine (lactose), and the casein. M. Marchand does not determine the butter; he merely deduces it from an empirical formula based upon two hypotheses. In my process I isolate, collect, and weigh the three bodies. In the lacto-butyrometer everything takes place in the interior of a closed tube, and escapes control. In my process each is successively with-

drawn from the apparatus, collected without loss, and submitted to the balance."

*La Correspondance Scientifique.*  
October 1, 1878.

This issue contains an elaborate notice of the recent work of M. Th. Du Moncel, on "The Telephone, the Microphone, and the Phonograph." The writer quotes with approval the dispassionate and authoritative decision of M. Du Moncel on the controversy recently waged concerning the invention of the microphone. He urges that if the physical principle of the microphone may seem to be identical with that of Mr. Edison's telephonic carbon transmitter, its arrangement is entirely different, the manner of acting upon it is not the same, and the effects ordinarily required of it are of a totally different nature. There is more than what is really needed to constitute a novel invention. Further, Mr. Edison cannot claim, as specially belonging to himself, the discovery that certain bodies moderately conductive can have their conductivity modified by pressure." After pointing out three capital distinctions between the microphone and the telephonic transmitter, M. Du Moncel asks—"Why, if Mr. Edison has invented the microphone, did he not make known its properties and its results?"

**Civilisation among Ants.**—From this paper we learn that M. Berthelot, the illustrious chemist, is also a zealous entomologist, and has for a quarter of a century been engaged in studying the manners of ants.

*Chemiker Zeitung.*  
No. 39, September 26, 1878.

In France the number of workmen engaged in the manufacture of lamps is 4500, and the annual production is of the value of 35 million francs; 2000 workmen are concerned in the manufacture of gas-fittings, and their work represents a yearly value of 10 millions. About 400 dynamo-electric machines for the production of light are manufactured annually in Paris.

**The Future of Chemists.**—The writer gives his views as to the training of a "works' chemist." After his education at a "real" school—a kind of establishment which can scarcely be said to exist in England—he is to serve as a "volunteer" for some two or three years, according to the department of practical chemistry he intends to select, in brewery, tannery, alkali-works, print-works, &c. After this practical training he is to complete his studies at the University or the Polytechnicum, and in addition to theoretical and analytical chemistry, physics, and chemical technology, he is to make himself master of the differential and integral calculus, of descriptive geometry, mechanical technology, machine-making, architectural planning, and designing and land-surveying!

[Is not a knowledge of the patent laws of all civilised nations still more likely to be useful than many of these last-named studies? Does not this entire programme ignore the great principle of the division of labour which is continually becoming more important as each science and its application become more extensive and complicated?—*Ed. C. N.*]

The "International Association against the Pollution of the Rivers, the Soil, and the Air" held its Congress at Cassel, on the 9th and 10th of last month.

Borax-soap is recommended as the best agent for removing traces of grease from beakers, test-tubes, &c.

M. H. W. Langbeck proposes the following method for detecting the least traces of methyl in ether, chloroform, &c. He mixes 10 volumes of the suspected sample with 1 volume of a solution of silver nitrate, containing 1.7 per cent of the dry salt, and allows the mixture to stand for twenty-four hours. After the lapse of this time the line

of contact of the two liquids has assumed a faintly reddish violet colour, and a reddish brown precipitate of silver oxide is found, more or less abundant according to the proportion of methyl present.

Dr. E. Büchner has devised an apparatus for measuring the current of air in flues, vitriol-chambers, &c. His invention consists, first, of a kind of anemometer; and secondly, of an electro-magnetic apparatus. The former apparatus is fixed in the place where the draught is to be measured, and is thrown into rotation, quicker or slower as the case may be, which is transferred to the electric apparatus. The measurement is performed by noting the number of revolutions in a given time.

J. Cabot, of Boston, patents a mordant for aniline colours which may also be used with iron for the production of light greys, slates, &c., on cottons and on mixed goods. It consists either of gallic acid and an alkaline hyposulphite, or of finely-ground galls and sulphate of potash.

Paupert and Arnault propose to extract ammonia from liquids by distillation in a partial vacuum, lime being introduced into the stills, and the ammonia-vapours arrested by any known means.

*Bulletin de la Societe Chimique de Paris,*  
Tome 30, Nos. 4 and 5, Sept. 5, 1878.

At the last meeting of the society, M. Ch. Girard gave an account of the researches undertaken by M. Caventon and himself, on the action of azoxy-benzide and azo-benzide upon the primary, secondary, and tertiary monamines. On the action of nitro-benzin upon hydrochlorate of aniline, in presence of iron, there are formed several colouring matters—a mixture of violanilin,  $C_{18}H_{15}N_3$ , and of triphenylen-diamin blue,  $C_{18}H_{12}N_2$ , &c. These bodies may be obtained by one of the following processes, action of arsenic acid upon aniline; action of amido-azo-benzol upon pure hydrochlorate aniline; action of azoxy-benzide upon pure hydrochlorate of aniline. The blue colouring matter obtained by MM. Dechend and Wichelhaus, by the action of nitro-benzin upon diphenylamin, is very easily prepared, by allowing azo-benzid to react upon the hydrochlorate of aniline. In this reaction there is formed a certain quantity of hydrazobenzide, which is decomposed by heat into azo-benzide and aniline. The author remarks that whilst by the action of azoxy-benzid upon the hydrochlorate of diphenylamin, or methyl-diphenylamin, there are obtained substitution colouring matters of the violanilin class, another series of colouring matters may be obtained by operating with azo-benzide upon the hydrochlorate of diphenylamin or of ethyl-diphenylamin. M. Nölting communicated to the Society certain experiments undertaken by M. Reverdin and himself, to ascertain the influence of the alkaloids, which, in small quantities, accompany dimethyl-anilin in commercial methyl-anilin, upon the production of violet. These are mono-methyl-anilin, the two mono-methyl-toluydins (ortho and para), and the two dimethyl-toluydins. The three secondary amines were prepared by the reduction of the corresponding nitrosamines; the two dimethyl-toluydins by the distillation of the chlorides of trimethyl-tolyl-ammonium. The mono-methyl-anilin boiled between 191 and 193°. The mono-methyl-ortho-toluydin, which has not yet been described, boils at 207—208°; its isomer of the para series at the same temperature, dimethyl-ortho-toluydin at 182—183°, and dimethyl-para-toluydin at 288°. These bases were submitted to oxidation by the chloride of copper, under the conditions used for dimethyl-anilin. Mono-methyl-anilin furnished a red violet, though less red than the mono-methyl-rosanilin obtained by the action of the chloride of methyl upon rosanilin; mono- and dimethyl-ortho-toluydin yield also a reddish violet—that of the tertiary base being more blue than that from the secondary; the two methylated derivatives of para-toluydin,

on the contrary, do not yield violet but yellow colours of little lustre, whose presence in a violet degrades the shade. It appears, therefore, that in the industrial preparation of the violet, it is important to employ pure dimethyl-anilin, and especially to avoid the derivatives of para-toluydin, which, as their high boiling-point indicates, are to be found in the tailings. The authors have made some experiments on the part of meta-toluydin in the production of aniline red. They have first observed that commercial toluoydin contains traces of meta-toluydin, which they have not been able to isolate, but whose presence they have been able to ascertain with certainty by the examination of the nitro-toluol which had served for the preparation of this toluoydin. In fact, by oxidation with permanganate, they have obtained, along with ortho- and para-nitro-benzoic acid, a small quantity of meta-nitro-benzoic acid, proving the presence of meta-nitro-toluol. To prepare meta-toluydin in a state of purity, they have followed the process of Beilstein and Kuhlberg. The meta-toluydin was then oxidised with arsenic acid, both alone and mixed with aniline, and the two other toluoydins. The following are the results obtained: meta-toluydin alone, brown; meta-toluydin and aniline, violet; meta-toluydin and para-toluydin, brown; meta-toluydin and ortho-toluydin, a violet red and grey. Meta-toluydin is thus clearly distinguished in its colour-reactions from its two isomers; para-toluydin alone gives a yellow; chryso-toluydin, its mixture with aniline or ortho-toluydin, and the latter alone yielding a fine red.

**Dissociation of Metallic Sulphides.**—Ph. de Clermont and J. Frommel.—The authors establish that the hydrates of the sulphides are dissociated by heat, more or less rapidly, according to the tension of each of them. The sulphides of iron, nickel, cobalt, antimony, tin, arsenic, and silver are dissociated; whilst those of copper, zinc, mercury, cadmium, gold, platinum, and molybdenum resist.

**Correction of a Note on Ethoxy-acetonitrile.**—T. H. Norton and J. Tcherniak.—The authors recognise the priority of Prof. L. Henry, as regards the discovery of the substance in question.

**Bichloro-propionate of Ethyl.**—M. L. Henry.—The author points out an erratum in the published boiling-point of this liquid.

*Les Mondes, Revue Hebdomadaire des Sciences.*  
No. 3, Sept. 19, 1878.

Ammoniacal sulphate of copper has been found useful in the treatment of epileptical neuralgia of the face.

With reference to the explosion of objects of tempered glass, it is remarked that the future of this novel industry is fatally limited, and that the utility of articles so prepared is not greater than that of Prince Rupert's drops, from which they differ merely in form.

It has been proposed to illuminate harvest-fields, &c., by the electric light, so that agricultural operations can be carried on if necessary after sunset.

*Reimann's Färber Zeitung,*  
Nos. 34, 35, and 36, 1878.

These issues contain nothing of general interest.

## MISCELLANEOUS.

**The Awards at the Paris Exhibition.**—We have tried in vain to obtain an authentic list of the awards made to British exhibitors at the Paris Exhibition. The lists published by the daily press, which first appeared in the Paris papers, are incorrect and incomplete. Many exhibitors having received letters informing them that awards have

been made for their exhibits we shall feel obliged those who have obtained prizes for chemical products and philosophical apparatus will kindly send us particulars.

## NOTES AND QUERIES.

**Test for Anthracen.**—Will any chemist kindly give me the details of Fritsche's picric acid test for anthracen?—J. W. T.

**Estimation of Phosphoric Acid.**—Will any of your readers kindly give me working particulars of Sonnenschein's method of estimating phosphoric acid, through the medium of your valuable journal? By so doing I shall be greatly obliged.—SUBSCRIBER.

## TO CORRESPONDENTS.

J. H.—We do not know a better book. See article on the subject in "Watts's Dictionary."

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THE CHEMICAL NEWS.

Vol. XXXVIII. No. 986.

ON SOME  
PECULIARITIES OF THE VARTRY WATER,  
AND ON THE ACTION OF THAT WATER  
UPON BOILER-PLATES.\*

By CHARLES R. C. TICHBORNE, LL.D., Ph.D., F.C.S., &c.

THE water of the River Vartry, from which we get our supply in Dublin, has been repeatedly analysed, therefore I will not trouble the Section with a detail of its composition. It will be sufficient for my purpose to remind the Section of its general composition, which may be stated to consist of—

Organic matter of a peaty nature, 1.6 to 2 grains per gallon.

Mineral matter, 2½ grains.

Chiefly consisting of chlorides of the alkalies and the alkaline earths in equal proportions.

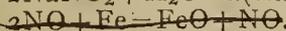
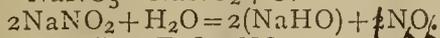
The hardness is nearly all permanent, as there is but a trace of carbonates present. The point I wish to draw attention to, however, is the presence of nitrates and nitrites. The first are always present, the latter occasionally in the summer and autumn months. They were present when last tried on the 3rd of August. I have never seen any published analysis which mentions the existence of these acidulous radicals. As my object is to determine the conditions of the nitrogen salts, and as heat seems to reduce nitrates when occurring in this water, I had recourse to evaporation by the aid of a vacuum and sulphuric acid, the test I used being the brucin test, an extremely delicate one if properly applied. For my nitrites I used a thin starch solution made with a little dilute glycerin to keep it, and a solution of tartaric acid preserved by a little salicylic acid, the iodide of potassium being carefully purified from iodate. The solutions keep very well, and are reliable. The iodide should be dissolved as required. The Vartry water does not give indications with the tests as a rule without concentrating it. I subjoin the results of my experiments on the 3rd of August:—

1. Water evaporated to one-third at 100° C. gave a very striking indication of nitrites besides nitrates.
2. Evaporated in a vacuum to one-third, it gave no indication.
3. Evaporated to a quarter it gave an indication of nitrites and nitrates.

In January, 1878, the Vartry gave no indication of nitrites, but contained as usual nitrates, and gave an indication on evaporating to one-half.

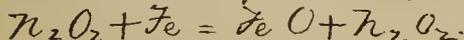
We see by these observations that evaporation tends to reduce the nitrates; also, that from fermentation action changes occur at certain periods of the year, which result in the reduction of nitrates to nitrites.

We see also that these nitrates and nitrites are present in very minute quantities. I have never found 0.1 of a grain per gallon said to be present in Loch Katrine water, the highest amount I have ever found being 0.06, determined by the aluminium process. But still when these salts are rapidly concentrated, as they are in the feeding of high pressure steam boilers, the nitrogen salts become very serious items of corrosion, owing to the ease with which the acidulous radicals are dissociated at high temperatures; e.g. :—



\* A paper read before the Chemical Section of the British Association at Dublin.

(Dissociation of the Salt.)



I exhibit a boiler plate, which is not only eaten away by the corrosive action of water, but the corrosion is determined by the steam of the Vartry water. I also exhibit glass corrosion produced by the same means. Some experiments were instituted in sealed tubes which bear strikingly upon this subject, and which I now beg to place before the section.

No. 1.—In this experiment distilled water was boiled down in a tube, and a piece of bright wire inserted. The tube was then sealed after the air had been exhausted. It is now some months old, and it will be observed that there is comparatively no action. We are to infer, therefore, from this experiment that at ordinary temperatures water is without the slightest action upon iron *in vacuo*. We all know how rapidly iron is oxidised in the presence of water containing air.

No. 2 is iron sealed up *in vacuo* with Bartry water, and submitted to high pressure steam at 30 lbs. to the square inch. The action is sharp and well marked, the results being the production of ferric oxide in considerable quantities and magnetic oxide. The latter can be recognised on applying a magnet outside the tube.

The third tube was a similar experiment with pure water, containing 0.1 grain per gallon of nitrate of potassium. This was also sealed *in vacuo*. The results are almost identical with the second experiment, only that more magnetic oxide seems to have been formed.

The fourth experiment was one in which a nitrite was substituted for the nitrate. Here nothing but ferric oxide was formed of a peculiar bright colour and in scales.

That the corrosion of the boiler plate mainly proceeds from the nitrogenous molecules, I think there can be little doubt. But the quantity of these acidulous radicals, being very small, any of the alkaline preservatives would remedy this corrosive action. If, however, neglected, these nitrogenous acidulous radicals would almost certainly lead to mischief, and, therefore, they are imminent sources of danger.

ON SOME COLORIMETRICAL EXPERIMENTS.\*

By JAMES BOTTOMLEY, B.A., D.Sc.

IF a white disk be sunk in a coloured solution, the intensity of the colour perceived will be a function of the depth of the disk and the quantity of the colouring matter present. If, in any set of experiments, we make the intensity of colour constant, then the depth of the disk will be a function of the quantity of colouring matter only. Occasionally in chemistry we have to deal with quantities so minute that we can no longer use the balance for their determination, and yet those small quantities when they yield coloured solutions are evidently comparable among themselves. In a short communication which I made to this Society (vol. xv., 63), I suggested that such a process as above indicated might be applied for the measuring of such traces, assuming that the depth of the disk would be inversely as the quantity of colouring matter present. Some experiments were made on colouring matter in solution. Glass cylinders were used about 10 in. high and 2 in. diameter. To one side of each cylinder was pasted a strip of paper marked with an arbitrary scale (each degree of the scale I afterwards found to be 27 m.m.): the white surfaces used were crucible lids. A piece of glass rod resting on one of the cylinders, having the string of the movable disc attached to it, served as a windlass for raising or depressing it. To avoid the use of many ciphers I have taken 0.001 grm. as the unit of measurement. In the following experiments column A denotes the amount of the colouring salt present, B the depth of the disc, and C the amount of the colouring salt thence derived by calculation. Standard solution, 35.2 of per-

\* A Paper read before the Manchester Literary and Philosophical Society, April 23, 1878.

manganate of potash in 500 c.c. of water; depth of disk, 8.3.

A.	B.	C.
53	6.1	48
70	4.1	71

Experiments were made with still stronger solutions, but the differences were considerable.

Standard solution, 24 of permanganate of potash in 500 c.c. of water; depth of disc, 8.3.

A.	B.	C.
36	5.4	37
48	3.6	55
60	2.8	71

Still stronger solutions were used with this standard, but the discrepancies between the true and the calculated quantities were considerable. Standard solution, 5.8 in 500 c.c. of water; length of column, 8.3.

A.	B.	C.
7.2	5.7	8.4

Some experiments were made with solutions of permanganate of potash, using a shorter column for the standard solution. Standard solution, 2.4 in 214.6 c.c.; length of column, 3.8.

A.	B.	C.
3.6	2.2	4.1

An experiment was also tried with a still weaker solution. Standard solution, 1.4 in 214.6 c.c. of water; length of column, 3.8.

A.	B.	C.
2.4	2.6	2.1

Some experiments were also made by looking through the column of fluid at a white surface external to the cylinder. Standard solution, 12 in 500 c.c.; length of column, 8.4.

A.	B.	C.
14.4	6.5	15.5
28.8	3.1	32.5
16.8	5.3	19

I prepared a fresh standard solution of the permanganate and compared the last solution with it. The new standard was similar to the last in composition.

A.	B.	C.
16.8	5.7	17.6

Thus the result was somewhat more favourable with a newly prepared solution. I used the permanganate on account of its great tinctorial power; but it is a salt of considerable instability, especially in contact with organic matter. The water used in the experiments was obtained by distilling Manchester town's water from a copper still lined with tin, and condensing in a tin condenser. Now such water would not be wholly free from oxidisable matter; hence in a little while there will be a depreciation in the tint of the permanganate solution. If the tint be strong, the error arising from this cause might be neglected, but when the tint is feeble the error is appreciable. If the depreciation in tint in the two solutions compared were proportional to the depth of tint in each this source of error might be neglected; but inasmuch as the same quantity of water has been used in making each solution an equal amount of depreciation is introduced into each. Some of the foregoing experiments will be affected by this source of error. Small sources of error, which may be neglected when we deal with ponderable quantities, become of sufficient magnitude to vitiate results when we deal with traces.

For experiments with a yellow solution I took a solution of bichromate of potash. Standard solution, 10 in 500 c.c. of water; depth, 8.3.

A.	B.	C.
15	5.4	15.4
20	4.4	18.8
30	3.5	23.7
40	2.5	34.0
50	1.7	48.8
60	1.5	55.3

Still stronger solutions of the bichromate were compared with this standard, but the discrepancies were considerable. Some of the results also given in the last table are not very good; this more especially applies to the third and fourth results. On another occasion I repeated some of these experiments with the following results (standard solution same as last):—

A.	B.	C.
30	3	27.6
40	3.2	37.7
50	1.6	51.8
60	1.4	59.3

Another series of experiments was made with the bichromate. Standard solution, 50 in 500 c.c., length of column, 8.3.

A.	B.	C.
60	6.7	62
70	5.3	78
80	4.5	92
90	4	104
100	3.7	112
110	3.4	122
120	3.2	130
130	3	138
140	2.8	148
150	2.6	160

In some of these determinations I felt considerable uncertainty at what depth equality of colour was obtained, and some of the results were likely to vary on repetition. In the table I put 5.3 as the depth after some hesitation, and with the intention to repeat the experiment on some future occasion. On repetition I made the depth of the disk 5.8, which would indicate the amount of the salt used as 71. In some other instances I felt uncertainty when working with a solution of the bichromate in determining equality of tint, so that whether the disk were elevated above or depressed below the position finally chosen the difference in colour was insensible. Perhaps with bright yellow colours the eye requires more experience to detect differences of shade than with colours not so glaring. Moreover, when there is a considerable difference between the quantities of the colouring salt in the two cylinders there is another difficulty to deal with. The colours to be compared differ not only in intensity but also in kind. A very dilute solution of bichromate gives a pale yellow with a slightly greenish shade, which passes, as the amount of salt is increased, into full yellow, orange-yellow, and finally orange. A similar observation holds with regard to several other colouring salts. Thus a very dilute solution of permanganate of potash is pink, passing, as the strength of the solution is increased, into crimson, and finally into violet. I also made some experiments with a blue solution. For this purpose I used an ammoniacal solution of sulphate of copper. The tinctorial power of this salt is not as great as I expected, and I made no experiments with a standard solution containing less than 150. On diluting 15 c.c. of an ammoniacal solution with sufficient water to make 500 c.c., I noticed after a little time that the solution was somewhat turbid. This was owing to the copper forming an insoluble compound, either hydrate or a sub-salt: further addition of ammonia was necessary to clarify the solution. Standard solution, 150 in 500; depth, 8.3.

A.	B.	C.
200	5.7	218
220	5.3	235
240	5.1	244
260	4.8	259
280	4.5	277
300	4.1	304
350	3.4	366
400	3.0	415
450	2.6	479

Some experiments were made with solutions of known strength, by sinking the disk to the depth assigned by

theory, to see if the given tint was attained, instead of moving the disk about until the tint was estimated to be the same and then reading off the result. A solution of bichromate of potash, containing 50 in 500 c.c., and depth 8.3, was used as a standard. Solutions containing 60, 70, 80, 90, gave similar tints at the calculated depths. Solutions containing 150, and increasing quantities, gave tints a little too deep at the calculated depths. Also a standard solution of permanganate of potash, containing 4.8 in 500 c.c. of water, and depth 8.3, was taken. Solutions containing 6 and 7.2 gave a similar tint at the depths assigned by the calculation. Solutions containing 9, 9.6, and higher quantities, gave tints a little too deep at the calculated depths.

Some of the foregoing results are fair approximations, and probably better results might be obtained with a more perfect form of apparatus than I employed. The surfaces used were not perfectly flat. Moreover, there was in some of the experiments the indecision arising from the coexistence of several distinct tints on the surface of the disk due to the formation of caustic curves. This I afterwards remedied by working behind a screen of lawn. The effect of this is to render the illumination of the disk much more uniform. Instead of a screen we might also use glass cylinders ground internally. Another difficulty is the indecision respecting the depth at which equality of colour takes place. The degree of indecision will be different for different persons, and I suppose represents want of sensibility and want of skill in detecting shades of colour. So far as it arises from want of skill it is likely to be diminished by more perfect experience with colours. It seems to me that it would be well to have some definite method for exercising the eye, or for testing one's skill in this respect. This might be done by having a series of cylinders filled with coloured solutions, the quantity of colouring matter increasing in arithmetical progression and endeavouring to arrange these solutions in their order, the arrangement being made according to the judgment of the tints. The various success attending such exercises would afford the experimenter some method for testing his skill from time to time. It would also show him under what conditions he could use neither this nor any other method of colorimetry; for when he has arrived at such a stage that he can perceive no difference of tint, notwithstanding an increase in the colouring matter, it seems as useless to try to do so as to use a balance of coarse sensibility to distinguish between two weights which are very nearly the same. By frequent exercise and concentrated attention I think the power of perception of difference of shade may be increased. If such a series of cylinders were taken containing, say, quantities of bichromate of potash, increasing from 1 to 30, the first members of the series would be easily arranged, towards the middle of the series the number of successful discriminations would diminish, and few would be able to detect differences in the higher members of the series; for an increment of the salt which produces a considerable difference in intensity when a small quantity of the salt is present produces a small difference when the quantity is large. This would follow from the approximate formula used, for—

$$\frac{dt}{dQ} = -\frac{c}{Q^2}$$

( $t$ =depth,  $Q$ =quantity of colouring matter,  $c$ =constant). So that for a given small difference in the quantity the difference in the depth would be nearly proportional to the inverse square of the quantity. Solutions whose quantities of colouring matter are so similar as to be beyond discrimination by colorimetry may be again brought within its range by the following device:—In each of the two cylinders destroy by some appropriate method an equal quantity of the colouring matter; then their differences will be increased relatively to the quantities of colouring matter remaining, and may be sufficiently sensible to be estimated. When I suggested this method of colorimetry I had not seen the article on Light by Sir John Herschel

in the "Encyclopædia Metropolitana." He there gives a probable formula for the intensity of light which has passed through an absorbing medium. His reasoning is as follows:—Let the intensity of the incident light be unity, and its intensity on emerging from a unit thickness of the medium,  $k$ ; then its intensity at incidence on a second layer will be  $k_1$ , and its intensity at emergence  $k^2$ ; hence, if  $t$  be the thickness of the medium the intensity will be finally  $k^t$ ; and if the original intensity were  $a$  the final intensity would be  $ak^t$ . Now, light consists of several species: hence if the composition of the incident light be  $a_I + a_{II} + a_{III} + \dots$ , the composition of the emergent light will be  $a_I k^t + a_{II} k^{2t} + a_{III} k^{3t} + \dots$ . If we use the letter  $I$  to denote incident light,  $T$  to denote transmitted light, and  $A$  absorbed light, Herschel's formula may be written more briefly as follows:—

$$\Sigma a = I, \Sigma ak^t = T.$$

$k$  will a function of the quantity of colouring matter present in a unit thickness. If  $g$  be that quantity we may write  $k=f(g)$ , or if we expand  $k=f(0) - f'(0)g + \dots$  higher terms in  $g$ . Now  $g$  is very small. Let, then, the terms higher than the second be neglected. The first term will be the light transmitted when no colouring matter is present. If the colouring matter were dissolved in an absolutely transparent medium the first term would be unity. In practice water or some colourless medium is used; but the amount of light absorbed by a thin layer of pure water is very small, so that we shall make only a very small error in writing  $f(0)=1$ . Hence  $k=1 - f'(0)g$ . Substituting this value in Herschel's formula, and expanding, we have—

$$\Sigma a - \Sigma af'(0)gt + \dots, \&c.$$

Now, as  $g$  is very small, we may neglect terms beyond the two first (unless  $t$  be very large. Hence—

$$\Sigma af'(0)gt = I - T = A.$$

If we assume the colour to be constant,  $A$  will be a constant term. Now, let  $Q$  denote the whole quantity of colouring matter in the cylinder, and  $L$  the whole length of the column, then—

$$g = \frac{Q}{L},$$

and the formula may be written—

$$\Sigma af'(0) \frac{Q.t}{L} = A, \text{ or } Qt = \frac{A.L}{\Sigma af'(0)} = \text{constant.}$$

ON THE  
TESTING AND VALUATION OF GAS LIQUOR.

By T. H. DAVIS.

GAS liquor, as the majority of our readers are aware, is produced as a by-product in the manufacture of coal-gas. The crude gas, on leaving the retorts, having been deprived of its tar and portion of aqueous vapour in passing through the condensers, is conveyed through pipes to a "washer," or a "scrubber," the former being a vessel through which the gas bubbles, and the latter an upright tower filled with coke, over which a stream of water flows. In the passage of the gas, therefore, through either of these it is exposed to a considerable surface of water, and by this water the ammoniacal compounds, existing in the crude gas in a state of vapour, are absorbed. This water, containing salts of ammonia in solution, is allowed to mix with that condensed in the condensers, and the whole product is called gas water, gas liquor, ammonia water, or ammoniacal liquor, all these terms being synonymous.

The liquor thus formed has a specific gravity ranging from 1.005 to 1.070, or even 1.100, or, in other words, from 1° T. to 14° or 20° T., and in colour varying from straw colour, through various shades, to dark brown, some

samples being quite clear, and others more or less thick and turbid.

This is the liquor from which nearly the whole of our ammoniacal compounds are formed, and hence it must be considered as a valuable product, especially (as will be shown hereafter) that the compounds of ammonia which it contains in solution are in great part decomposed by mere boiling, and wholly if the liquor be mixed with lime previously. This liquor has been and now is in most all cases bought and sold on the basis of its specific gravity, or, in other words, on its degree Twaddle; but I hope to show the fallacy of this test—as has already been pointed out by my friend Mr. Geo. E. Davis, in a paper which he read before the British Association of Gas Managers this year—for surely the time has come when such empirical methods of testing and valuing such valuable products should no longer exist. The specific gravity of a liquor does, it is true, give a rough indication of its "strength;" that is, a liquor standing at 5° T. would be considered to be a more valuable one than one standing at 4° T., and less valuable than one which stands at 6° T.; but on examination of the table given below it will be seen that the degrees Twaddle should not be relied on, for one manufacturer may purchase a liquor standing at, say, 4° T., and another, at a higher price (one standing at 5° T.), and yet it is quite possible that the first may contain as much or more ammonia than the one at 5°. The following table, which contains a few results taken from a great number, will show this in a clearer manner:—

NH <sub>3</sub> per cent.				
3° T.	4° T.	5° T.	6° T.	7° T.
1.00	1.74	1.97	2.31	2.39
0.92	1.66	1.89	2.15	2.29
0.84	1.28	1.56	1.88	2.23
—	0.84	1.49	1.65	—

These percentages of ammonia were determined by a simple titration method which I have used for some years. I presume it is known to most of our readers, but for the benefit of those who may not be acquainted with it I have fully explained further on.

Some gas companies have, it is true, made an attempt to supersede the test by Twaddle by one which is more chemical, namely, by selling the liquor on the basis of the number of ounces of sulphuric acid required to neutralise a gallon of it, the results obtained being stated as a liquor of so many ounces strength. Thus, a liquor which required 10 ounces of acid to neutralise a gallon of it would be called a 10-ounce liquor, and so on; and it happens in many cases that the number of ounces required is about twice the number of degrees Twaddle: but this rule must not in any way be depended on, although some manufacturers base their calculations on it. I have given a few results from my note-book, expressing in the first column the degrees Twaddle, in the second column the "acid strength" or number of ounces of sulphuric acid required to neutralise a gallon of the liquor, and in the third column the degrees T multiplied by 2:—

Degs. T.	Ozs. Acid.	T. × 2.
5.25	11.38	10.50
4.80	10.06	9.58
5.00	8.91	10.08
5.50	10.11	11.08
4.80	7.29	9.58
6.10	10.20	12.20
5.70	8.78	11.36
6.00	11.50	12.00
6.00	9.53	12.00

Here we see at once, even in this rough method, the fallacy of the "degree Twaddle" as giving data for a fair and proper valuation of the liquor, for of course the ounces of acid required represent in a much fairer way its value than does the physical test of its specific gravity.

I think I may with safety say that as long as a manufacturer bases his calculations on the specific gravity test, he must never expect them to turn out true ones.

This test, then, receiving condemnation, what test shall be suggested to take its place? It must be one that can be easily done, without much trouble with apparatus, and one that can be performed quickly. Obviously, as the ammonia is the article the manufacturer desires to obtain, it should be also the basis of the test for valuation; that is, the liquor should be bought and sold on a sliding scale, at so much per ton for each per cent of ammonia it contains; then the manufacturer will know what he is buying, and the gas companies what they are selling; moreover, the manufacturer will also know the quantity of ammonia he is receiving to his stock, and can work his calculations as to the quantity of finished product he may expect, whether it be sulphate or chloride of ammonia, or liquor ammonia, with confidence and satisfaction.

Now, to determine the quantity of ammonia (as NH<sub>3</sub>) in the liquor, my friend, Mr. G. E. Davis, recommends the distillation process, which consists of boiling a certain quantity of the liquor with lime in a flask arranged in a manner well known to us all, and passing the vapours into a known volume of standard acid, titrating back at the end of the experiment with standard soda. This we know to be a correct test, but, unfortunately, to be correct, it requires a considerable time, each test taking best part of an hour.

Before a contract is made between a manufacturer of ammoniacal products and a gas company this test should be carried through, so as to get at the actual quantity of ammonia to be obtained from the liquor; but I should not recommend a contract to be made embracing this test, for when each separate lot of liquor arrives at the ammonia works it would have to be subjected to that test in order to see that the delivery is of equal percentage to that stipulated for. Now in large works, as I know from personal experience, many separate lots of liquor from the same or different gas works will be arriving every day, each of which will of course require to be submitted to test; consequently, if the distillation process were to be adopted, the time occupied would be more than could be spared in a works laboratory.

As far as my experience shows me, the direct titration of liquor with normal sulphuric acid and calculation into ammonia would be a test sufficient to base a contract upon, and for the guidance of the manufacturer and for all practical purposes it may be looked upon as correct. Moreover, each test does not take five minutes, whereas, as I have before stated, the distillation process takes best part of an hour.

The titration method of testing is as follows:—Into a flask of about 300 c.c. capacity 10 c.c. of the sample to be tested are run in, and into this 15 c.c. of normal sulphuric acid. The contents of the flask are then raised to boiling over a naked flame, a few drops of litmus added and titrated back with normal soda. The number of c.c. of soda used are deducted from the 15 c.c. of acid employed, the result multiplied by 17, and divided by the specific gravity of the liquor. The result thus obtained represents the percentage of ammonia contained in the liquor. An example will make this clear:—10 c.c. of a liquor at 5° T. (sp. gr. = 1.025), boiled with 15 c.c. normal acid, required 5 c.c. normal soda to neutralise it, consequently the sample contains 1.658 per cent NH<sub>3</sub>; thus—

$$\frac{(15 - 5) \times 17}{1.025} = 1.658.$$

Now as to the valuation. Suppose we consider that 10s. per unit of NH<sub>3</sub> per ton to be a fair value, then the above sample would be worth 1.66 × 10.5 = 17s. 5d. per ton. Of course I do not wish to fix any price as the standard for valuation, that must be matter of arrangement. Such a system would induce gas managers to make the liquor as strong as possible, and ammonia manufacturers would do well if they were to refuse a contract for liquor containing less than 1 per cent of NH<sub>3</sub>; for if below this—unless the liquor were given them—they would barely clear expenses of manufacture.

I trust this paper will cause other chemists who have had experience in the matter to express their views on the subject, for I cannot but think that all such would be glad if such rule-of-thumb methods as are now employed in this branch of chemical manufacture were abolished.

ON A NEW CHEMICAL TEST FOR CARBOLIC ACID, AND ITS USEFUL APPLICATIONS.\*

By EDMUND W. DAVY, A.M., M.D.,

Professor of Forensic Medicine, Royal College of Surgeons, Ireland.

I HAD the honour, a short time ago, of bringing under the notice of the Academy, and of publishing in these *Proceedings*,† a new and exceedingly delicate chemical test for alcohol which I had at the time discovered; and I pointed out some practical applications which might be made of that test.

I subsequently directed attention to some further useful objects which may be attained by the employment of that alcoholic test, which latter have appeared in the *London Pharmaceutical Journal* for last year. I have recently discovered that the reagent which I employed for the detection of alcohol in the test referred to, viz., a solution of molybdic acid or molybdic anhydride in strong sulphuric acid, is a very delicate test likewise for carbolic, or as it is otherwise termed, phenic acid, a substance which is now one of considerable industrial importance, admitting as it does of so many useful applications, and one for which it is desirable to have a ready and at the same time a delicate test, for the detection of its presence under different circumstances. I have observed that when a drop or two of a dilute aqueous solution of carbolic acid is brought in contact with a few drops of the molybdic solution stated, there is immediately produced a light-yellow or yellowish-brown tint, which, passing to a maroon or reddish-brown, soon develops a beautiful purple colouration, which latter remains without further change for a considerable time. I should here observe that the application of a gentle heat will hasten the development of the purple reaction, though it will take place, but more slowly, at the ordinary temperature; and it is the production of this purple under the circumstances stated that constitutes the test for carbolic acid. The molybdic solution which I have chiefly used for this purpose is similar to the one I have employed for the detection of alcohol, and is made by dissolving, with the assistance of a gentle heat, one part of molybdic acid in ten parts by weight of pure and concentrated sulphuric acid. But the exact amount of molybdic acid dissolved appears to be a matter of indifference, as I have used other proportions with success, and in some recent experiments I found that a solution where there was only one part of molybdic acid in a hundred parts of sulphuric acid acted very well.

The mode of using this reagent is simply to add three or four drops of it to one or two of the liquid under examination, placed on any white porcelain or delf surface, when the effects already noticed will be produced, if carbolic acid is present. In carrying out this test, it will, however, be found the most convenient to use a small white porcelain capsule, furnished with a handle, which will admit of the application of heat when it may be desirable to hasten the reaction by that agent.

This test is one of great delicacy, for I have found that one small drop of an aqueous solution of carbolic acid, containing a thousandth part of its weight of that acid, and only absolutely about the one-seventy-thousandth part of a grain, when mixed with three or four drops of the molybdic solution, produced immediately the yellowish-brown effect, which, after a few minutes, passed into a very distinct and beautiful purple colouration, and

this colour remained quite perceptible on the fourth day afterwards, though it had each day become fainter from exposure to the air and its consequent absorption of moisture. But this is not the limit of its delicacy, for I have detected by its means the carbolic acid in one drop of an aqueous solution five times more dilute, or where it contained the one-five-thousandth part of its weight of that acid, and in which there was only about the one-three-hundred-and-fifty-thousandth part of a grain present.

For the success of this test, it is necessary to attend to a few particulars, one of the most important being, that only a drop or two of the liquid under examination should be employed, for if much more be used the reagent will be diluted too much, and the characteristic reaction will not take place: for so great an effect has water on it, that even when the purple colouration is fully developed, the addition of that substance will cause either the colouration to disappear almost entirely, if the quantity of carbolic acid present be exceedingly minute, or if more abundant it first changes the purple to red, and then into a light reddish-brown, which becomes more and more faint on further dilution; but the addition of a few drops of the test solution, or even of strong sulphuric acid, again reproduces the purple, though of course fainter in its colour in proportion to the previous degree of dilution; thus showing that the mixture must be very strongly acid for the production and continuance of this purple effect. Another point to bear in mind is this, that when carbolic acid itself, and not an aqueous solution of it, is acted on by the molybdic reagent, a dark olive, quickly changing to a very deep blue, will be produced, but not the purple colouration; a cold saturated aqueous solution, however, of carbolic acid when so treated will yield the purple reaction; but even here there will be a tendency to develop the olive or blue effect, especially where the reagent employed contains a large proportion of molybdic acid; and I may observe that weaker solutions of molybdic acid give more satisfactory results, as the action appears to be too energetic when the acid itself or very strong solutions are employed.

The last precaution I wish to direct attention to, for the successful performance of the test, is this, that in applying heat to hasten the reaction, it should be limited to a gentle heat that the hand can bear when applied to the bottom of the capsule, this being about from 120° to 130° F., which is quite sufficient for this purpose, besides not exercising any destructive effect on the purple reaction; for I may observe that if the heat be raised even to 212° F., and continued for some time, the purple colouration will be destroyed and a blue produced; moreover, where organic matters are present along with the carbolic acid, many of them will likewise, when heated with the molybdic reagent to that latter temperature, or even much below it, develop a deep blue colour, which would mask more or less completely the purple effect of the carbolic acid. Consequently it is better in most cases to let the test act on the liquid at the ordinary temperature, though the reaction may be somewhat slower in developing itself.

I have made a number of comparative experiments with this test, and with the principal ones hitherto employed for the detection of carbolic acid, and I find, in point of delicacy, it seems only to be surpassed by the bromine test of Dr. Landolt, which depends on the circumstance that when an aqueous solution of bromine is brought in contact with carbolic acid, there is immediately formed the tribromo-phenol ( $C_6H_3Br_3O$ ), a sparingly soluble white substance. But that test could not be successfully employed, at least immediately, in many cases, where the test just described might be still available, as, for example, in the case of different organic mixtures, where the presence of the tribromophenol formed would be concealed. It possesses likewise the great advantage of being apparently not interfered with, to any extent, by the presence of organic substances which mask or prevent the reactions of many of the other tests.

\* A Paper read before the Royal Irish Academy, May 13, 1878

† *Proceedings*, Second Series, v. l. ii., Science, p. 57

As to what is the exact nature or composition of the purple compound which is formed in carrying out the test, I have not yet been able to determine, owing to the difficulty of isolating it, or of obtaining it in a condition suitable for analysis; but I am inclined to think that it is not so much an oxidation product of carbohc acid as a deoxidation one of molybdc acid, and that it is a combination of one of the oxides of molybdenum, containing perhaps more oxygen than the blue compound which is formed where the molybdc reagent acts on alcohol and on some other substances; and one circumstance amongst others which seems to support this view is this, that I have failed to obtain by the action of other oxidising agents on carbohc acid a similar purple reaction.

Be this however as it may, I have satisfied myself that the purple compound formed in my test is a totally different substance from the red or crimson dye termed coralline, which is obtained by the united action of oxalic and sulphuric acids on carbohc acid, and is now largely used as a dyeing material; for the red colour of the latter substance is not affected by the caustic alkalies, and strong sulphuric acid changes it to a reddish yellow; whereas the purple developed in the new test is changed to green by caustic alkalies, and the purple again restored by strong sulphuric acid. I am, however, still engaged in this inquiry, and hope to be able yet to determine the exact nature of this purple compound, and of the changes which occur in this new reaction.

I shall now briefly notice some of the useful applications which may be made of this test. It is well known that carbohc acid is a powerful poison, and many instances are now on record where it has been the cause of death, such being generally either cases of suicide, or those where it has been accidentally taken by mistake for some other substance; as its odour and taste would render its administration, at least to an adult, by the assassin for the criminal destruction of life, a matter of some difficulty. The occurrence, however, from time to time of the cases referred to obviously renders it very desirable to be able readily to detect the presence of carbohc acid where it has been so used, either in the articles of food, drink, or medicine which have been taken, or in the ejecta or contents of the stomach; and this test affords a very easy and ready means of so doing, and of confirming the indications of other tests. According to my observations it will detect the presence of carbohc acid in different complex organic mixtures, even where the odour of that substance may be quite imperceptible; and I may observe, that the test of odour has hitherto been regarded as the most delicate for carbohc acid in such cases.

The great advantage this test possesses, especially for such applications, is this, that it does not appear to be much affected or interfered with, as already stated, by the presence of a number of organic substances which are likely to be present in such cases. Thus, as regards different articles of food—I have readily detected, by means of this test, the presence of carbohc acid when a small quantity of its aqueous solution had been added to the following articles, viz.: tea and coffee mixed with sugar and milk, porter,\* ale, wine, a solution of Liebig's extract of meat and albumen; also where it had been added to blood, olive oil, gum, and soap—the very diverse substances in the articles mentioned not preventing the indications of the test.

\* As alcohol acts on the molybdc solution, producing an intense blue colouration, the presence of that substance, at least in any quantity, would mask more or less completely the reaction of carbohc acid. In examining, therefore, alcoholic liquors for that acid, it is better to submit them to distillation or separate the alcohol, and then to test the later portions of the distillate or the residue for carbohc acid; or what answers even still better in such cases is, to render the liquid alkaline by the addition of either caustic potash or soda, to combine with and fix the carbohc acid, and then distil; and when all the spirit has been removed, to add diluted sulphuric acid to slight acid reaction to liberate the carbohc acid and after this distil again, when that acid will come over unmixed with any spirit, and give its characteristic reaction.

It will also afford a ready means of detecting the elimination of carbohc acid in the urine, when that substance has been taken internally, for the compounds present in human urine naturally do not appear to affect to any extent this test. I may also observe, that with it I was at once able to detect the presence of carbohc acid naturally occurring in the urine of a cow, without any previous treatment of that secretion, and thus confirm the correctness of the statement as to the occurrence of that acid as a normal substance in the urinary secretion of that animal. This ready means of discovering carbohc acid in different animal fluids where it may exist will render this test useful to the physiologist and physician.

Another useful application of this test is, that it affords a very ready means of distinguishing creosote from carbohc acid, which is a matter of some commercial importance, much of which is sold as creosote being, as is well known to chemists and those in the drug trade, little else than carbohc acid; for those two substances, though obtained from different sources—true creosote being procured from the distillation of wood tar, whilst carbohc acid is got from that of coal tar—and though they differ likewise from each other in chemical composition, still so closely resemble each other in several of their properties, that the cheaper substance, impure carbohc acid, is in whole or in part frequently sold to the public for the dearer article creosote. If, however, we take a drop or two of each, and agitate them well with about a quarter of a fluid ounce of distilled water, and, having filtered the liquid, test a drop or two with the molybdc solution as already described, we will get in the case of pure creosote only a brown or reddish-brown reaction, which on standing or warming slightly becomes fainter, passing to a light-yellowish brown: whereas in the case of carbohc acid the brown passing to a maroon soon develops a more or less intense purple colour. This treatment will be sufficient to distinguish creosote from carbohc acid, and also to detect the presence of that acid in creosote, where it occurs in considerable proportion; for if, on the addition of the molybdc test solution, the mixture, instead of fading away to a light-yellowish brown on standing a short time, or on gently heating, passes to a reddish brown or to a maroon, it is an indication that carbohc acid is present. But I have found that the following very simple proceeding gave more satisfactory results, especially where small quantities of carbohc acid had been added to a large proportion of creosote. From five to ten drops of the liquid under examination are taken, and agitated briskly with about half an ounce of distilled water for a few minutes, so as to dissolve out the carbohc acid; the mixture is then filtered, and the filtrate is put into a little flask furnished with a close-fitting cork, through which passes a small glass tube about ten or twelve inches long, and bent above the cork at a little more than a right angle. The contents of the flask are then heated, and when the liquid boils the first portions which distil over will be found to present a more or less turbid appearance as they pass down the tube, from their containing minute globules of creosote; and a drop or two having been collected and tested with the molybdc reagent will give only the brown reaction of creosote: but by continuing the boiling, that substance will be more or less completely expelled, and then it will be found that a drop or two of the later portions of the liquid which distil over will give the purple reaction of carbohc acid. I may here observe that as it is only a drop or two of the distillate which is required each time for testing, it is not necessary to use any condensing arrangement, for the vapour passing through the tube itself is cooled sufficiently to furnish the small quantity required for each trial; but when it is desirable to collect in larger quantities the different portions of the distillation, a very small Liebig's condenser, in which the delivery tube can be inserted, will be found the most convenient arrangement to employ. In this way, by distillation, I was enabled to detect the presence of carbohc acid in creosote, where I had mixed

only one part of the former with a hundred parts of the latter, which would be more than sufficiently delicate for any case likely to occur in commerce; for where such adulteration was practised, it is probable that a much larger proportion of carbolic acid would be used, to render the fraud sufficiently remunerative. In the same way, I have readily succeeded in detecting the presence of carbolic acid in oil of cloves, where I had purposely added a small proportion of that acid, as it is stated that this very objectionable fraud is occasionally practised, of adulterating the essential oil of cloves with carbolic acid.

The few applications that I have referred to are, I should trust, sufficient to indicate the practical utility of this test; which, being at the same time so simple and easily performed, will, I have no doubt, be found useful for the objects stated, as well as for others to which it may be applied.

#### REMARKS ON THE ESTIMATION OF SULPHATE OF LIME IN BEER.

By H. M. WILSON.

THE precipitation of sulphuric acid in the direct way—that is, by boiling a portion of the sample, adding hydrochloric acid and chloride of barium was found to yield results, which were lower than was anticipated, and which were further of a discordant nature. Three samples were treated in the following way:—

100 c.c. in each case was boiled with about 5 c.c. of hydrochloric acid; chloride of barium was then added. The mixture was again boiled, allowed to settle, and filtered. A slimy precipitate was thrown down, together with sulphate of barium, the effect of which was to protract very much the filtration of the precipitates.

The precipitates, after being well washed, were dried and ignited, whereupon they weighed respectively (calling them A, B, C)—

A.	B.	C.
0.077 grm.	0.064 grm.	0.060 grm.

Samples B and C were now treated in a different way: 100 c.c. of each was evaporated to dryness, after the addition of about 0.5 grm. of nitrate of potassium, and gently ignited over a Bunsen flame. The resulting carbon was filtered off, and the now colourless filtrate strongly acidified with hydrochloric acid, boiled, and precipitated with chloride of barium.

The weight of the sulphate of barium was—

B.	C.
0.093 grm.	0.092 grm.

These weights, calculated into grains per gallon, give 37.80 in the one case, and 37.59 in the other, whereas, by the first method, we have 25.9 grs. in the one and 24.50 in the other.

From this it would appear that the organic matter in beer interferes with the precipitation of sulphuric acid (in addition to its reducing action), and that the first method employed is not applicable in the case of beer, although it is recommended in the case of urine. The second method yielded perfectly homogeneous results on repetition.

29, Lansdowne-road.

#### ON THE CHEMICAL ANALYSIS OF STEEL.

By SERGIUS KERN, M.E., St. Petersburg.

THE author published, some time ago (CHEM. NEWS, vol. xxxvii., p. 964), a note on some results of his analysis of various steels, where it is shown that it is desirable that the mechanical test should precede the chemical test, as, at the present day, the searching out for 0.01 or 0.02

per cent of carbon, more or less in the steel specimen, seems to be the chief work of many metallurgists. Many think that steel containing 0.30 per cent of carbon distinctly differs from steel containing 0.29 per cent of carbon. In fact, at present, there is too much chemistry in metallurgy. The author had an opportunity of analysing six specimens of steel plates, which were rejected, as they gave inferior results on being mechanically tested. Supposing that this arose from the inferiority of the steel, analyses of these specimens were executed which, however, showed the contrary—the steels chemically were all very fine specimens of Siemens-Martin metal, and were, after rolling, annealed.

#### A. Mechanical Tests of the Samples.

Nos.	Breaking weight. Tons per square inch.	Elongation. Per cent.
1	26.35	14.24
2	25.05	14.92
3	24.01	15.05
4	23.74	13.08
5	25.52	12.60
6	25.42	13.40

The length of the specimen was 8 inches.

#### B. Chemical Analyses of the Samples.

Nos.	Carbon.	Manganese.	Silicon.	S.	Ph.
1	0.22	0.08	0.01	0.01	0.02
2	0.18	0.06	traces	0.02	0.01
3	0.14	0.05	—	traces	0.04
4	0.25	0.15	0.02	0.01	0.01
5	0.15	0.14	0.01	0.03	0.02
6	0.20	0.10	traces	0.01	traces

It appeared, as it was ascertained afterwards, that the plates could not stand the required mechanical tests, owing only to the inferior workmanship.

#### EXPERIMENTAL DETERMINATION OF THE VELOCITY OF LIGHT.\*

By ALBERT A. MICHELSON,  
Ensign United States Navy, Annapolis.

THIS paper was considered one of the most important before the section, but it is impossible to present a proper idea of it without the diagrams accompanying it. But three scientists, Foucault, Fizeau, and, more recently, Cornu, Mr. Michelson said, have sought to ascertain accurately the distance of the sun from the earth. Foucault used the method known as that of "Wheatstone's Revolving Mirror," the application of which was first suggested by Arago. Fizeau and Cornu both used another method, known as that of the "toothed wheel." In Foucault's experiments the distance traversed by the light was 20 metres. The result obtained by him was 185,200 miles per second. Cornu's stations were about 14 miles apart. The result obtained by him was 186,600 miles, which exceeds the former by 1400 miles. The objection to Foucault's method is that the displacement, which enters directly in the formula, is very small, and therefore difficult to measure accurately. The objection to Fizeau's is that the time of total disappearance of the light was necessarily uncertain. The object of Mr. Michelson's experiments is to increase the displacement in the first method. This can be done in several ways: (1) By increasing the speed of the mirror; (2) by increasing the distance between the two mirrors; (3) by increasing the radius of measurement, *i.e.*, the distant from the revolving mirror to the scale. In Foucault's experiments the speed of the mirror was four hundred turns per second; the

\* Read before the American Association for the Advancement of Science, Section A.

radius of measurement was about one metre, and the distance between the mirrors was about ten metres. The displacement obtained was about 0.8 millimetres. In Mr. Michelson's experiments the speed of the mirror was but one hundred and thirty turns per second, but the radius of measurement was from 15 to 30 feet, and the distance between the mirrors was about 500 feet. The displacement obtained varied from 0.3 of an inch to 0.63 of an inch, or about twenty times that obtained by Foucault. With a greater distance between the mirrors and a better apparatus he expected to obtain a displacement of 2 or 3 inches and to measure it to within one-thousandth part of an inch. Tables of observation of the velocity of light in air were given by Mr. Michelson, the mean result being 186,508 miles per second.

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## CORRESPONDENCE.

### TELEPHONE RELAY.

*To the Editor of the Chemical News.*

SIR,—In the CHEMICAL NEWS, vol. xxxviii., p. 138, I notice a counter-statement from Mr. E. J. Houston, of Philadelphia, regarding my assertion that the telephone relay which he has brought out was devised by me over a year ago. He says:—

“Now it would appear from a description of this instrument in the *Telegraphic Journal* of July 1, 1877, that Mr. Edison called his invention a pressure relay, and states that it is intended to be used in connection with his speaking telegraph. So far as I can hear this speaking telegraph is not an articulating telephone but a species of harmonic telegraph, in which vibrating pulses of electricity are employed in a manner somewhat similar to the system of Gray. Nowhere in this article, or indeed elsewhere that I can find, does Mr. Edison claim that his invention can be applied to relaying of rapidly varying currents of the articulating telephone.”

I quote from the article in the *Telegraphic Journal* of July 1, 1877, to which he refers—

“ . . . For instance, if a weak current circulates upon the line in which the relay magnet is inserted the attraction for the armature will be small; consequently a weak current will circulate within the second current; and, on the contrary, if the current in the first circuit be strong the pressure upon the plumbago discs will be increased, and in proportion will the current in the second circuit be increased, no adjustment is ever required. It is probably the only device yet invented which will allow of the translation of signals of *variable strengths* from one circuit into another by the use of batteries in the ordinary manner. The apparatus was designed by Mr. Edison for repeating *acoustical vibrations of variable strengths* in his speaking telephone.”

This apparatus is used now and was used at the date named to do exactly what the article says it was intended for, and it was seen in operation by hundreds of persons during the year 1877. The statement that a “speaking telegraph” is not an articulating telephone is a pretty fine distinction without a difference. Change of form and name appears to be an easy and favourite method now-a-days of making discoveries and inventions.—I am, &c.,

THOMAS A. EDISON.

Menlo Park, N. J., U.S.A.,  
Sept. 29, 1878.

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## CHEMISTRY IN THE UNITED STATES.

*To the Editor of the Chemical News.*

SIR,—I do not think it improper for me to caution chemical students and experienced chemists, through the

columns of a journal so widely distributed as the CHEMICAL NEWS, against coming to this country in search of employment. I can assure them that they can bring their wares to no worse market. The reasons are obvious.

First. For every vacancy that occurs, ten well qualified capable chemists, Americans, present themselves. This is the ordinary rule; and,

Second. Business is so depressed and dull here just now that now, of all times, it is next to impossible for a good chemist to find a place, whether he be a foreigner or native born.

Only yesterday I told a competent chemist, a pupil of Liebig, Wöhler, and Bolley, who spoke English fluently, and had studied chemistry in *this* country, that it was of no use for me to add his name to the list on my desk of chemists wanting places.

Our technological schools and our colleges are turning out ten times as many chemists, engineers, and geologists as we need, and those foreign scientists who come to this country in hopes of remunerative employment will be sadly disappointed.—I am, &c.,

J. M. MERRICK.

Laboratory, 59, Broad Street, Boston, U.S.A.,  
September 27, 1878.

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### “SILAONITE.”

*To the Editor of the Chemical News.*

SIR,—In the CHEMICAL NEWS, vol. xxxviii., p. 109, there appeared, among other notes of work by students of the University of Virginia, the results of an examination by Mr. H. D. Bruns, of New Orleans, of “Silaonite,” a mineral described as a new species by Prof. V. Fernandez, of Guanajuato, Mexico. Mr. Bruns found this to be a mixture and not a true species. Three days ago, on my return home from an absence of a couple of weeks, I found a letter from Senor Fernandez, dated June 18, in which he informs me that he had ascertained his supposed species to be but a mixture. His letter had been addressed to me to the care of Mr. E. S. Dana, of New Haven, who has been in Europe during a large part of the summer; hence, probably, the long delay in its reaching me.—I am, &c.,

J. W. MALLETT.

University of Virginia,  
Sept. 30, 1878.

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On Anthra-rufin, a New Bioxy-anthraquinon from Meta-oxy-benzoic Acid.—E. Schunck and H. Römer.—Anthrarufin,  $C_{14}H_8O_4$ , is almost insoluble in water, but sparingly soluble, with a yellow colour, in alcohol, whence it crystallises in yellow regular quadratic tables, decidedly iridescent. In glacial acetic acid it dissolves sparingly, the solution having a faint green fluorescence. In benzol it is freely soluble, but less readily in ether and bisulphide of carbon. In chloroform it dissolves with a yellow colour. All these solutions display no absorption-bands, but merely a darkening, chiefly in the highest portion of the spectrum. Soluble in concentrated sulphuric acid. Strong solutions appear of a cherry-red by transmitted light, but by reflected light they display a strong crimson fluorescence. Dilute solutions assume a splendid crimson colour. Very dilute solutions show two very well-defined absorption-bands, and a third one less distinct. One part of the colour in 10 million parts of sulphuric acid appears of a crimson colour in a stratum of 1 inch in depth. The absorption-bands are still visible when the solution is almost as colourless as water. Anthrarufin does not dye fibres mordanted with alumina or with iron. It yields crimson lakes with lime and baryta, but is not precipitated by alcoholic acetate of lead. If treated with potassa to fusion there is formed a deep-blue mass of a metallic lustre, which dissolves in water with a violet-blue colour.—*Ber. der Deut. Chem. Gesellschaft zu Berlin.*

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

AUGUST, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Ni- trates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine.	Sulphuric An- hydride.	Hardness on Clark's Scale.	
		Saline. Grs.	Organic. Grs.								Before Boiling. Degs.	After Boiling. Degs.
<i>Thames Water Companies.</i>												
Grand Junction .. ..	Slightly turbid	0·000	0·008	0·105	0·046	17·00	6·885	0·612	0·94	1·000	12·6	3·00
West Middlesex .. ..	Clear	0·000	0·008	0·105	0·050	17·60	7·400	0·576	0·94	0·966	12·6	2·80
Southwark and Vauxhall	Clear	0·000	0·008	0·096	0·053	17·30	7·700	0·612	0·94	0·930	12·6	3·00
Chelsea .. .. .	Clear	0·000	0·007	0·090	0·035	16·70	7·590	0·540	0·94	0·930	12·6	2·80
Lambeth .. .. .	Clear	0·000	0·008	0·129	0·050	19·10	7·950	0·504	0·94	1·030	13·2	3·00
<i>Other Companies.</i>												
Kent .. .. .	Clear	0·000	0·002	0·435	0·003	29·10	11·530	1·153	1·73	4·036	20·5	6·00
New River .. .. .	Clear	0·000	0·006	0·135	0·017	17·40	7·750	0·648	1·01	1·130	13·7	3·30
East London .. .. .	Clear	0·000	0·007	0·090	0·039	18·60	7·950	0·756	1·16	1·200	13·2	3·00

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 14, September 14, 1878.

Remarks on the Phonograph and the Telephone.—M. Bouillaud.—The author discusses the question whether the phonograph repeats words on a principle similar to that of the echo. He asserts that as regards force, tone, speed, and quality, the words of phonographic origin differ notably from those which have been uttered, which is not the case with words repeated by an echo. As to the telephone, he expresses doubts as to the part played by the electro-magnetic machine.

Industrial Utilisation of Solar Heat.—A. Mouchot.—The author describes several successful experiments made at the Exhibition on the conversion of solar heat into motive power.

Minima Produced in a Calorific Spectrum by the Refractory Apparatus and the Lamp which serve for the Formation of the Spectrum.—MM. Aymonet and Maquenne.—Not suitable for abstraction.

Rotatory Power of Quartz and its Variation with Temperature.—J. Joubert.—Quartz, by its rotatory power, constitutes a thermometer of extreme sensibility, fulfilling the essential condition of every thermometer, comparability. When once the apparatus is fitted up it is merely needful, in order to find a temperature, to read off an angle, and refer to a table calculated once for all. It may therefore be hoped that science, and even industry, may find in this new thermometer an instrument comparable to the mercurial thermometer for the simplicity of its use and the certainty of its indications. The author's experiments extend from  $-20^{\circ}$  to  $+840^{\circ}$ , or perhaps  $1500^{\circ}$ .

Presence of Isopropyllic, Normal Butylic, and Secondary Amylic Alcohols in the Oils and Alcohols of Potatoes.—M. Rabuteau.—The author gives in a table the nature, the boiling-points, and mean quantities of the products found in a litre of potato-oil.

*Biedermann's Central-blatt,*  
July, 1878.

Quantity of Ammonia in the Sea-Water, and in the Salt Lagoons near Montpellier.—Prof. M. A. Andoynaud.—The author concludes from his experiments that neither the sea-water nor the water of the salt lagoons contain volatile ammoniacal salts.

Drinking-Water of Friesing.—L. Aubry.—The author points out that a decrease of the total solids in water may proceed, *pari passu*, with increasing contamination, certain of the mineral salts present being precipitated by the organic impurities. Hence a determination of total solids is by no means sufficient to warrant an opinion on the quality of a water.

Mucoid Algæ in Drinking-Water, and the Application of Tannin for the Purification of Waters thus Contaminated.—Dr. H. Kämmerer and Dr. H. Hager.—The first-mentioned author proposes tannin as a reagent for water analysis. He considers it as a group-test for a great number of bodies of animal origin, such especially as pass most readily into putrefaction, such as the albuminoids, glue, &c., which in his opinion readily penetrate into subsoil water, pollute it, and, according to modern views, must be regarded as especially dangerous. He arrives at the following conclusions:—1. The occurrence of glue in the subsoil waters can no longer be doubted, and in some cases it is even found in relatively considerable quantity. 2. Tannin is a suitable reagent for the detection of glue and kindred substances, and its application should never be omitted in the analysis of water from a sanitary point of view. 3. The presence of salts and certain other compounds may delay the precipitation of tannin. The decision as to the result of this reaction should therefore not be given until twenty-four hours have elapsed. 4. Any water which is rendered turbid by tannin to a marked extent must be regarded as dangerous. As far as the decision is concerned it is indifferent whether a precipitate appears immediately or not until the lapse of some time. Hager refers to the above communication, and especially to Kämmerer's assertion of the presence of glue in subsoil waters, as inferred from the behaviour of the water with glue. He narrates that in the year 1866, at the time of the prevalence of Asiatic cholera in Berlin, he lived in one of the districts most severely visited by this disease, and was thus induced to examine the spring-

waters. He found that a bad water could be most simply and conveniently rendered potable by the addition of a solution of tannin, consisting of 2 parts tannin, 1 part sugar, 3 parts water, and 5 parts alcohol. The water from a spring in the court of No. 13, Alte Jakob-strasse, near which a churchyard is said to have formerly existed, was rarely clear, and contained ammonia and nitrates in abundance. On the addition of tannin, though often not until after the lapse of ten or fifteen minutes, it yielded flocculent precipitates which had not always the same volume. The author endeavoured to ascertain the cause of this diversity. Water drawn early in the morning almost invariably yielded, on the addition of tannin, a plentiful precipitate. This, when collected and mixed with alcoholic ether, gave a solution which on standing deposited a mucous flocculent sediment containing mere traces of lime, and which, when dried and carbonised, gave proofs of animal origin, but never of the presence of glue. The water drawn in the afternoon, after the well had been used by the numerous inhabitants of the house, appeared scarcely susceptible to the action of tannin, but after the lapse of two hours a copious precipitate was determined. The assumption that the tannin precipitate owed its origin to Algæ existing in the water, that the remains of the dead or dying Algæ were immediately precipitated, whilst the still living Algæ were first killed and then precipitated, gave a sufficient explanation of the behaviour of the water drawn at different times. The author does not conceal that he at first was inclined to admit the presence of glue in the water. Microscopic observation soon convinced him that Algæ were really present. The water drawn in the morning was rich in living and dead Algæ, whilst that obtained in the afternoon contained but few, though after it had been allowed to stand for a few hours they were formed in indefinite numbers. The Algæ were of various kinds. Some had an elliptical form (glocotheke and apanotheke), whilst others, and the most numerous, belonged to the *Oscillaria* (Vibriones).

**Studies on Basalt.**—Dr. J. Hanamann.—Basaltic soils are porous, warm, and moist, and even the subsoil is readily pervious to air and moisture. Upon no other mountain formation do we find so varied and luxuriant a vegetation. Basaltic tufa, basaltic wacke, and amygdaloid are still more fruitful.

**Absorptive Power of Arable Land.**—Prof. J. M. Van Bemmelen.—The chemical absorptive power of a soil treated with hydrochloric acid is not restored by the addition of soda or carbonate of lime; the increase of the absorption after such treatment (power of taking potassium from the chloride of potassium) must be referred to a decomposition of the chloride of potassium with the carbonates remaining in the soil; carbonate of potash is formed, which is absorbed by the soil as such.

**Detection of the Principal Adulterants in Ground Coffee.**—C. Krauch.—Coffee is distinguished by its high percentage of fatty matter (minimum 11 per cent as against 1.15 per cent of chicory) and by its low proportion of sugar (0.2 per cent as against 22 per cent in chicory).

August, 1878.

**Examination of a Number of Spring Waters of the Town of Münster.**—Dr. J. König.—The author remarks, "The potable waters of our provincial capital are among the worst known, and are occasionally so bad that many a farmer would hesitate to give them to his cattle. The analyses appended show rarely total mineral residues, organic matter, chlorine, nitric acid, and ammonia, the quantity of the last-mentioned impurity being in many cases expressed merely by such terms as "distinct," "much," "too much" (!) Dr. König adds—"A determination of the proportion of oxygen was executed in various samples in order to throw light upon their quality, but has hitherto led to no positive results, its quantity appearing to bear no fixed relation to the goodness of the water. Both in very bad and in good waters it has varied

during the past summer from 3 to 4.5 c.c. per litre. The spring-water at the Münster experimental station contained, in the spring of 1877, from 6 to 6.5 c.c. oxygen per litre; in July and August, 3 to 4.5; and in October and November, from 8 to 10."

**Distribution of Salts in the Soil.**—H. Pellet.—Referring to Joulie's classification of salts as ascending and descending, according as they rise or sink in the soil, the author finds that the majority of salts are ascending, and that those which descend are principally deliquescent, such as carbonate of potash, chloride of calcium, but not nitrate of lime.

**Action of Solutions of Gypsum upon Arable Soils.**—W. Kalmann and F. Böcker.—The soil absorbs more lime from concentrated than from dilute solutions of gypsum. On treating a soil with gypsum solution more magnesia and alkalies are dissolved than if distilled water was employed.

*Reimann's Färber Zeitung,*  
No. 37, 1878.

A certain Prof. J., who on a former occasion detected arsenic in green lamp-shades, has not discovered the same poison, in the state of Schweinfurth green, in the *inside* of pasteboard cigar-holders.

At the recent meeting of the "Association for Protecting the Interests of Chemical Industry in Germany," the question of legislative prohibition of the use of poisonous colours was debated at length. The conclusion reached was that no colour should be denounced as poisonous, or placed under legal restrictions, until a commission of qualified chemists and physiologists had declared its applications injurious to health.

**A New Colouring-Matter.**—The well-known firm of dye-manufacturers, Meister, Lucius, and Brüning, of Höchst, have brought out a series of colours for the production of ponceau in yellower and redder shades, and also of claret upon woollens. These colouring-matters are produced from the sulpho-naphthylates by treatment with the diazo-compounds of benzol and its homologues, as well as of naphthalin. These colours can be used for dyeing with the mere addition of sulphuric acid, but the shades are not so bright as when a solution of tin is employed. To 100 kilos. of wool, placed in a wooden or well-tinned dye-bath, are added 2½ kilos. tartar, and boiled. The colour, previously dissolved, is added as may be required, and 5 kilos. of tin-composition are gradually added. The wool is then taken out, cooled, and washed. The tin-composition is made by mixing 3 parts hydrochloric acid, 1 part nitric acid, and 1 part water, and dissolving ½ kilo. tin in 3 kilos. of this acid liquid.

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# THE CHEMICAL NEWS.

VOL. XXXVIII. No. 987.

## THE NOXIOUS VAPOURS COMMISSION: THE WORK OF THE FUTURE.

THE recommendations with regard to future legislation on the subject of noxious vapours appended to the Report of the Commissioners seem to be most reasonable and judicious, and if properly carried out by Government will no doubt work an important and beneficial change in the condition of those districts in which chemical manufactures are carried on. The recommendations of Scientific Commissions are not, however, always acted upon; those made, for instance, nearly three years ago by the Commission on Scientific Instruction have hitherto remained a dead letter. Let us hope that the same neglect will not be allowed to render nugatory the labours of the Commission on Noxious Vapours.

One of the first recommendations made by the Commission was with regard to coke-ovens. Bearing in mind the evidence of Dr. Angus Smith with regard to the particles of soot deposited by coal-smoke acting as carriers of sulphurous acid, we must not be surprised to hear that coke-ovens are looked upon as an intolerable nuisance wherever they are established. The evidence of Mr. Isaac Lowthian Bell on this subject is most valuable from its suggestiveness. He tells us that in the counties of Durham and Northumberland six million tons of coal are annually converted into coke, giving off at least two million tons of volatile matter. Where the beehive form of oven is used vast volumes of thick smoke are given off at a height of from 10 to 15 feet above the ground, the destructive effects of which, although not so extensive as those caused by alkali and copper works, are still very considerable, every blade of glass and every leaf being destroyed for several hundred yards around the works. With regard to such nuisances Mr. Bell takes very high ground. He told the Commission emphatically that he held it "to be a duty which every manufacturer owed to the neighbourhood that he should carry on the manufacture with the least possible destruction of property and with the least annoyance." Such sentiments as these merit the applause of every right-minded man, and form a strong contrast to the pettiness of spirit manifested by certain of the witnesses examined. That coke-ovens can be carried on without subjecting their neighbourhood to damage or even nuisance has been amply proved by Mr. Bell himself. By proper appliances the heat and smoke, instead of being allowed to escape, are utilised by being carried under the boilers, thus effecting a large saving in fuel; and manufacturers have found it so much to their interest to adopt this plan that already more than half the coke-ovens in the above districts have been converted, and a large number of others are in course of alteration. The yield of coke is not affected in any way by the change; fuel is economised; and the sulphurous vapours, which ultimately make their escape from a tall chimney, are so diluted as to inflict little or no injury on either plants or animals.

According to the recommendations of the Commission all coke-ovens should be placed under inspection, and that all those which are erected after the proposed additions are made to the Alkali Acts should be required to adopt "the best practicable means" of preventing the escape of black smoke and of diluting sulphur compounds. Further, in case complaints should be made against existing ovens, they should be compelled to adopt "the best practicable means" of abating the nuisance within three years.

The next offenders which engaged the attention of the

Commission were the Northwich salt works. During the process of evaporating the brine large volumes of dense smoke, charged more or less with sulphurous acid and saline particles are evolved. Dr. Richardson described the damage to vegetable life as extending to a distance of a mile and half from the works. The rural sanitary authorities of Northwich have again and again taken proceedings against salt manufacturers, but the only result seems to be the payment of heavy fines and no improvement as regards the quantity of smoke emitted. One manufacturer declared that he would go on paying fines until he was ruined before he would abate the nuisance, a statement that must be taken with the usual grain of his special manufacture. The general opinion of other witnesses seemed to be that it was a mere question of proper stoking, and that the nuisance might with care be greatly diminished if not entirely abated. It was ultimately recommended that salt works should be placed under inspection for the present, but that no further legislation should be applied to them yet.

Chemical manure works are also to adopt "the best practicable means" of preventing escapes of sulphuretted hydrogen.

The cement works about Northfleet and Greenhithe seem to be not only a nuisance to the inhabitants of this part of the world, but at times they emit such dense masses of smoke that the navigation of the Thames is interfered with. The Hoffmann kiln, in which complete combustion is effected, seems to be the proper remedy in this case. Professor Odling in his evidence described this kiln as effecting a large economy in fuel; cement works are therefore to be placed in the same category as salt works and coke-ovens.

The Lambeth Potteries were next brought before the Commission. Here again the evidence was most conflicting, the Archbishop of Canterbury declaring that the hydrochloric acid fumes from Mr. Doulton's tall chimneys corroded and otherwise injured the Archiepiscopal plate, steel, books, trees, and buildings, while so high an authority as Professor Odling declared that there is no real injury done by salt-glazing to stone, vegetation, or human beings. The number of salt-glazing kilns in Lambeth has been reduced from 83 to 34 during the last twenty-five years, and much less salt is used than formerly. Attempts have been made by Mr. Doulton at St. Helens to condense the hydrochloric acid fumes, and Dr. Angus Smith and Mr. Fletcher (one of his sub-inspectors) are of opinion that the experiments are sufficiently successful to justify legislation compelling potters to condense. The Commission thought otherwise, and contented themselves with recommending potteries for inspection.

Gold refiners, lead smelters, and glass makers escape interference for the present.

"Dry" copper works are also to be placed under inspection.

The system of inspection and the appointment of inspectors, whether by the central or local authority, took up a great deal of the time of the Commission. The question is apparently one of extreme difficulty.

The alkali manufacturers recommend almost unanimously that the inspectors, by whomsoever appointed and paid, should be wholly independent of local control, and removed as far as possible from local influence. They also unite in approving of the action of the inspectors up to the present, admit the great benefits derived from it, both in suggesting improvements and in other ways. They also recommend an increase in the number of inspectors. In this latter recommendation the landowners agree with them, but ask that they should enforce the law more strictly than they have hitherto done. The manufacturers whose works it is intended to place under inspection do not seem to make any very serious objection, always excepting Mr. Hussey Vivian, who condemns inspection in any form and looks on factories as fortresses. They ask, however, that the inspectors be made independent of the local authorities. The only witnesses that advocated local as opposed to

central control were all more or less connected with the Local Government Board.

The manufacturers favour central control on very strong grounds. The local sanitary officer, they are of opinion, however competent he may be for the ordinary work of sanitary inspection, would be certain rarely to possess the necessary scientific and chemical knowledge for the performance of his duties under the Alkali Acts, in which case his action could hardly fail to be partial and vexatious; besides which, he would necessarily fail in being able to make suggestions for those improvements which the knowledge and experience of the present race of inspectors enable them to make for the benefit alike of the manufacturers and the public. Again, the recommendations made with regard to the inspection of fresh descriptions of works should, argue the manufacturers, be looked on as merely temporary. The inspectors should make periodical observations on the progressive improvements in condensation, which would from time to time enable the Legislature to apply to each kind of vapour a compulsory standard of escape. This, of course, pre-supposes the formation of a complete staff of efficient inspectors working harmoniously with each other under a properly qualified head, a state of things which would be wholly unattainable if the local system were adopted. The works in which these industries are carried on are not very numerous, and are generally grouped together in a few districts, so that the staff would consist of a small number of highly qualified individuals.

The landowners also favour the central system. With the few exceptions we have named, there seemed to be a general consensus of opinion on this point. In any case it is a matter of fact patent to all that as a rule the local authorities do not do their duty, the evidence on this point being particularly clear and distinct. For example, the only town along the banks of the coaly Tyne in which the provisions of the Smoke Nuisance Act are carried on by the Local Board is Gateshead, and in every other town in the district the law is entirely disregarded, except in the case of Sir William Armstrong, who sets his neighbours a good example by complying voluntarily with the provisions of the Act. Local Boards are only too loath to do anything which may discourage the establishment and extension of manufactures which contribute to the local prosperity.

A plan was suggested by which the inspectors would be appointed and paid by the county, but this was objected to, large portions of most counties being unaffected by manufactures there would probably be an outcry and a refusal to levy the necessary rates.

Another suggestion was that the Local Government Board should form groups of districts including the works emitting the noxious vapours and the localities affected by them. But objections were raised to this also; in fact, the virtues of the central system seem so apparent that we venture to assert that it must ultimately be adopted. Its uniformity, the equal standard of inspection, the accumulation of the experience of a number of highly qualified men in one central point, the wholesome emulation amongst the inspectors (each to make his district the most perfect), and last, but by no means least, the readiness with which manufacturers and landowners alike seem willing to co-operate with the inspectors under the central system, drives all other plans from the field.

The Commissioners, however, were divided in opinion on the primary question. They were unanimous in holding that the inspection cannot possibly be entrusted to the local sanitary authorities for the reasons already given, but they could not agree with regard to the merits of the central system and the group system; they are obliged, therefore, to leave the matter in the hands of the Government.

Their recommendations with regard to the appointment and duties of inspectors are that a head inspector should be appointed by the Local Government Board at a liberal salary, so as to secure the undivided services of a thoroughly

competent man, who should be provided with a proper laboratory and assistants. He should examine, correlate, and average the sub-inspectors' reports, and satisfy himself by personal visits that "best practicable means" were being adopted to reduce to a minimum the escape of noxious vapours.

In taking leave of this very interesting Report, by far the most important to our readers that has appeared for some years, we cannot refrain from congratulating all concerned on the successful end of their labours, and from expressing a wish that their very judicious recommendations will speedily be adopted.

## ON A NEW METAL—PHILIPPIMUM.

By M. MARC DELAFONTAINE.

THE researches in which I have been engaged for more than two years on the Samarskite earths\* have led to the discovery in that mineral of a fourth earth belonging to the yttria group. This mineral is yellow like terbia, but its equivalent is lower. My researches on the gadolinite metals had formerly led me to a similar conclusion, which, however, I was prevented from establishing on account of the destruction of my laboratory in the great fire of Chicago.

As this new earth occupies an intermediate position as to colour and weight between yttria and terbia,† it might naturally be supposed that it is after all only a mixture of these two bodies. But the numerous and varied experiments that I have made convince me that such is not the case. Further, profiting by the examination which M. Soret has just made of the absorption-spectrum of erbium, and also by his recent study of the spectra of other earthy metals,‡ I have been enabled to confirm the correctness of my former conclusions.

I therefore announce definitely the discovery of the oxide of a new metal, to which I have given the name of Philippium (Pp) in honour of my benefactor M. Philippe Plantamour, of Geneva, the friend and pupil of Berzelius. I may remark, in passing, that this name adapts itself perfectly to the ordinary terminations of chemistry, not only in the French, but in the English, German, and Swedish languages. Thus the earth will be called Philippine in France, Philippia in England, Philipirde in Germany, Philipjord in Sweden.

The following are its distinctive characteristics:— Admitting provisionally that philippia is a protoxide, its approximate equivalent is comprised between 90 and 95. I cannot be more precise at present. The metals of the cerite and gadolinite groups are like fatty bodies or alcohols of the ordinary series; they are recognised easily in the pure state, but they are separated with great difficulty, and this difficulty is increased when they are from five to seven in number.

We have yet no means of knowing if philippia is completely free from yttria, although it is easy to reduce to a great extent the proportion of the latter. Erbia and philippia are mutually carried down and held by each other with such tenacity that I have not yet been able to obtain a complete separation of them.

The philippic formiate crystallises with great facility, either on cooling or by spontaneous evaporation, in small brilliant rhomboidal prisms less soluble than the formiate of yttria, which is deposited in mammillary form of a syrupy solution. The terbic formiate is anhydrous, and soluble in from 30 to 35 parts of water. The sodio-terbic sulphate dissolves with difficulty in a saturated solution of sodic sulphate, whilst the corresponding salt dissolves in it easily. I avail myself of this property to simplify

\* Archives des Sciences Phys. et Nat. de Geneve, March, 1878, p. 273.

† YO 74.5, TbO = 114.

‡ Archives des Sciences Phys. et Nat., August 1, 1878, p. 89.

the extraction of these bodies. The philippic oxalate is more soluble in nitric acid than the terbic salt, but less so than the yttric salt. The philippic nitrate becomes a deep yellow colour when it is dissolved; those of yttria and terbia remain colourless. The salts of philippium are colourless; the earth becomes white in a current of hydrogen, and also on being calcined, but it becomes yellow again on exposure to the air during cooling. This colour does not appear to be due to any mixture with terbia.

In the spectroscopic the concentrated solution of philippium gives in the indigo-blue ( $\lambda =$  about 450) a magnificent absorption-band, very intense, and rather broad, with well defined edges, especially on the right. This band, which strikes one at a first glance, is not seen in solutions of terbium, yttrium, and erbium. It is, then, characteristic of philippium, and thus M. Soret's conjecture, that it belongs to a new simple body, is confirmed. In the green I find two rather fine rays varying in intensity, the most refrangible of which belongs to erbium, as well as a faint ray in the blue near to the boundary of the green. The least refrangible of the green rays belongs perhaps to philippium, for if in some specimens it has been less intense, others, on the contrary, show it to be nearly as powerful as the erbium ray. Lastly, in the red there is at least one fine ray which I am not able to identify. By directing the slit of my spectroscopic to the sun I observe through a blue glass with the terbium solutions a very pronounced band situated in the violet ( $\lambda = 400$  to 405). This, however, is difficult of observation. It is half the width of the philippium band, and seems to be entirely absent in certain specimens of the latter, whilst in others a trace of it is visible. I have reason to doubt whether this really characterises terbium, as M. Soret believes; it is possible that it may indicate yet another element, the atomic weight of which is intermediate between that of terbium and erbium.

I have for some time been pursuing the parallel study of the compounds of philippium and terbium, and in a few weeks I shall be able to publish a memoir in which I shall describe at length the methods of preparation and purification which I have employed.—*Comptes Rendus*.

## THE METALLURGICAL USES OF TUNGSTEN.

MANY attempts have been made to improve the qualities of iron and steel by the addition of small proportions of other metals. The most promising of all the experiments made in this direction turn on the introduction of certain proportions of tungsten or of chromium; and although these alloys can scarcely be said to have acquired as yet a firm footing in commerce, still results of indisputable value have been attained. In these important investigations particular merit belongs to the eminent metallurgist M. E. W. L. Biermann, of Hanover, who has devoted a great amount of time and expense to a thorough study of tungsten and chrome, and whose labours are beginning to bear important results. He finds that either tungsten or chrome may be advantageously incorporated with iron in the Bessemer process. He melts 3600 kilos. of grey pig-iron in a reverberatory furnace, and decarbonises it in the converter in the usual manner. He then mixes with it from 200 to 300 kilos. of a previously prepared alloy of tungsten, or of chromium, and iron. By this procedure he escapes all loss of tungsten or chromium by oxidation, and obtains a tungsten or chrome steel, in which either of these metals appears to be substituted for the carbon ordinarily present. This tungsten steel has been found to resist a greater breaking strain than the best "Huntsman's" steel. Puddled steel and iron and cast metal can also be decidedly improved in quality by additions of tungsten. These results are certainly not in accord with those obtained by earlier experimentators. But this is easily explained if we consider that many so-called tung-

sten steels contained not a particle of tungsten, whilst the metal in others was accompanied by arsenic, sulphur, phosphorus, and other impurities noxious to the quality of iron and steel.

Tungsten further enters into the composition of other valuable alloys. Tungsten-bronze and an analogous compound of a rich violet colour are prepared by the reduction of melting tungstate of sodium (or potassium) with a further addition of free tungstic acid. Minargent, an alloy much used in America, and said to combine the colour and lustre of silver with the hardness of steel, is composed of 100 parts copper, 70 nickel, 5 tungsten, and 1 part aluminium. We feel no hesitation in calling the attention of metallurgists to an element which holds out such great promises, nor can we forget that its utilisation on the large scale would be a boon to the miners and mine-owners of Cornwall, where it exists in abundance.

We have received from M. Biermann specimens of his interesting preparations, and must congratulate him on their quality.

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### ON THE APPARATUS REQUISITE TO THE AMMONIACAL MANUFACTURE OF SODA, AND ITS USE.

By THORVALD SCHMIDT, Aalberg, Denmark.

ACCORDING to my promise I shall, in continuation of the article written by me (*CHEM. NEWS*, vol. xxxvii., p. 56), give a description of the method and apparatus used in the ammoniacal manufacture of soda, calculated to a daily produce of 1 ton of  $\frac{9}{7}$  per cent of soda, or  $1\frac{1}{2}$  tons of pure bicarbonate of soda.

There are wanted thirty-three different apparatus and eight pumps:—

#### 1. *The Still (Apparatus for Distillation)*

is a cylinder, standing erect, pointed at the bottom, made of iron-plate,  $4\frac{1}{2}$  metres high, 2 metres diameter, provided with a leading pipe that can lead the steam to the bottom of the vessel. At the beginning of the operation the steam is to be taken from the steam-boiler, whilst only the waste steam from the pumps is used when the manufacturing is in full activity. In this vessel is just so much quick-lime as is necessary to transform the solution of chloride of ammonium, which arises from the continuous operation, into free ammonia and chloride of calcium. The still is filled with about three-fourths of its contents from the vessel 6, connected with the former by a leading pipe with a cock, and the distillation commences as soon as this is done and the cock for the afflux is closed. The cock from the steam reservoir 24 is opened, and the waste steam from the pumps is led into the bottom of the still, by which progress the fluid, already strongly heated, will be brought to boiling, and force the gases of the ammonia into the bottom of the tower 2. The distillation being ended, the cock for the escape of the ammonia and the blow-off cock are opened. By this operation the solution of the chloride of calcium is pressed out, until the still is emptied; again quick-lime is added, the cock from the reservoir 6 is opened, the requisite quantity of solution is filled into the still, and the distillation begins again.

#### 2. *The Tower for Distillation*

is a cylinder standing upright, also made of iron-plate, 5 to 6 metres high, 1.3 metres diameter, and at a distance of 0.4 metre from the bottom it is provided with a strong iron grate, beyond which the steam from the still is led almost to the bottom of the tower, by which means the fluid contained in the boiler, and the height of which is regulated by the outlet-pipe, is brought to boiling; the hot

team will go through the grate, and the limestone, lying on the latter through the whole height of the tower, while, on the other side, the solution that comes from the reservoir 19—consisting of dissolved bicarbonate of ammonia, bicarbonate of soda, and chloride of ammonium—is pumped into the upper part of the tower, from whence it pours down over the limestone. The boiling-hot steam that meets the solution will force the latter to let free the carbonic acid and the ammonia, while the solution of chloride of ammonium and the hot solution of the chloride of sodium will run into the reservoir 6, which is again connected with the still. The gaseous ammonia combined with the escaping carbonic acid are led through the cooling apparatus, 28, 29, and 30, and further into one of the—

#### *Cylinders, 3 and 4,*

which are 3 metres high,  $1\frac{1}{2}$  metres in diameter, and also made of iron-plates. The pipes that lead the ammonia gas coming from the still and the tower 2 through the refrigerators 28, 29, and 30, into the solution of salt in the vessels 3 and 4, almost down to the bottom of the vessels, are in their ends provided with a funnel full of holes, that the gas may be absorbed by the fluid. A system of cooling pipes, with a surface of an extension as large as possible, prevent the fluid from getting hot. When the solution in 3 is saturated with 9 per cent of ammonia and 17 or 18 per cent of chloride of ammonium, it is shifted into 4, which is performed by closing a cock on 3 and opening the corresponding cock on 4. When the solution is quite prepared a cock is opened, and a leading pipe conducts the fluid into—

#### *The Reservoir 5,*

which is a horizontal cylinder, large enough to hold as much of the fluid as the cylinders 3 and 4 together. This reservoir is in connection with the pump *e*, that takes the solution to the upper part of the tower 8.

#### *The Reservoir 6*

is also a horizontal cylinder, receiving the fluid that comes from the tower 2, from which it is afterwards led into the still.

#### *7<sup>1</sup> and 7<sup>2</sup>. The Absorbers*

are two cylinders, made of iron sheets, standing upright on their one end, 7 metres high and 1 metre diameter, provided with a double bottom, the upper end of which is furnished with 2 m.m. holes. The carbonic acid from the pump, *a*, is pressed into the space between the two bottoms, and escapes through the holes in the uppermost bottom. The area of the said holes together is calculated thus—that there arises a pressure large enough to bear the fluid poured into the absorbers. The carbonic acid will rush through the holes during the working of the pumps, and will in this manner get into near contact with the column of fluid poured in from the reservoir 14, and standing  $6\frac{1}{2}$  metres high. There will come forth bicarbonate of ammonia, which again, in connection with chloride of sodium, will be converted into bicarbonate of soda and chloride of ammonium. During this process the apparatus is kept rather cool by means of the water circulating through the cooling-pipes, partly because the precipitating process then proceeds more beautifully and the result is more coarse-grained, and partly because there will be precipitated more of the bicarbonate of soda when the fluid is cooled than if this is not the case. The precipitated bicarbonate of soda will keep floating in the solution, which is caused by the carbonic acid striving upwards, and care must be taken that the precipitating process may go on as fast as possible, for which purpose 20 to 24 per cent of carbonic acid is necessary. Great motion through the fluid will break up the crystals if the precipitation should last too long, and we should have a clayey and greasy mass that would give bad bicarbonate of soda, difficult to calcine, and giving bad soda. Coarse-grained bicarbonate of soda will give the finest

and purest produce. As soon as the precipitation is finished the cock for the outlet-pipe, that leads the escaping gases into the tower 8, is closed; the cock that leads into the filter 18 is opened; and all the fluid, together with the bicarbonate of soda in it, is to be pressed out as fast as possible, that the absorbers may be filled again immediately with fresh lye and a new precipitation may begin.

#### *The Tower 8.*

All the gases that have passed the absorbers are to be led from them by means of a leading pipe into the bottom of the tower 8. This tower is 6 metres high and  $1\frac{1}{2}$  metres in diameter, but for the rest mark wholly as the tower 2; there is only the difference that above the grate is filled with round flint-stones instead of lime-stones. By means of the pump, *e*, the lye gathered in the reservoir 5 is pumped through a filter-press, 26, into the tower 8. When the lye thus filtered, in a pure and clear state, pours down among the stones, it will meet the carbonic acid not used, but escaped from the absorbers, 7<sup>1</sup> and 7<sup>2</sup>, by which progress the lye will be thus saturated, and we shall have chloride of sodium and carbonate of ammonia in the solution. This fluid will stream from the tower into the reservoir 14, and by the aid of the pump *g* it is to be pumped into the absorbers when the latter is to be filled.

#### *The Tower 9.*

Those gases escaping from the tower 8 have now given their carbonic acid to the salt-lye, saturated with ammonia, but they still contain some ammonia. In order to keep back the latter the gases are led into the bottom of the tower 9. This tower is quite like the tower 2, both in height and diameter, but, like the tower 8, is filled with flint-stones. From the reservoir 20 the salt-lye is led through a leading pipe into the upper part of the tower; it will trickle down among the stones, and absorb the upward-going ammonia gas. The fluid runs down into the reservoir 15, and is, by means of the pump *f*,—if it is necessary,—driven into one of the cylinders, 3 or 4, each time one of them is emptied.

#### *The Tower 10*

is made of wood lined with sheets of lead, 1 metre high,  $\frac{1}{2}$  m. in diameter, arranged quite like the aforesaid towers, 2, 8, and 9, but filled with coke. The gases escaping from the tower 9 are led into the bottom of this tower, and will here, when they ascend, meet a diluted sulphuric acid trickling down through the coke, to absorb the small quantity of ammonia that may still be left in the escaping gases, before they are led into the air. By means of this tower the whole working of the manufactory is to be controlled in a similar manner as is done in a manufactory of sulphuric acid, by examining the escaping gases.

#### *The Reservoir 11*

is an open box, made of wood lined with sheets of lead: in this is gathered the dilute sulphuric acid that has passed the tower 10 and absorbed the last traces of ammonia. By-and-bye, as the acid is saturated with ammonia, there is put more sulphuric acid, till it becomes so concentrated that no precipitation of sulphate of ammonia is to be feared; it is then led to the still by the aid of a leading-pipe provided with a cock. The reservoir 11 is, by means of a leading-pipe, connected with—

#### *Montajus, 12,*

made of iron, lined with sheets of lead, and is in connection with the—

#### *Air-Pump, 13,*

that presses the fluid gathered from the tower 10 in the reservoir 11 into the reservoir 27, from which it again trickles through the coke into tower 10.

#### *The Reservoir 14*

is a horizontal cylinder large enough to receive all the lye

running from the tower 8, with which it is connected by a pipe, and through a pump, *g*, is put in connection with the absorbers.

*The Reservoir 15*

is also a horizontal cylinder, and serves as a reservoir for the tower 9, for the salt-lye that is saturated with ammonia; and from here the lye is pumped through a pump, *f*, to the cylinders 3 and 4; by-and-bye, as one of them is emptied, it may be filled again.

*The Lime-Kiln, 16,*

is a round oven, whose inward measure is 4 metres high, at the bottom  $1\frac{1}{2}$  metres, and at the upper end 0.8 metre in diameter. It is constructed thus that the burning of the lime may go on without interruption, the lime-stones being poured in, mixed with coke, through a hole furnished with a closely shutting cover, while the burnt lime is taken out from underneath on one side of the oven. The current of air is produced by the carbonic-acid pump, *a*, sucking the air through the limestone and the coke in the oven, by which process the red-hot lime-stones give off their carbonic acid, which is sucked through a leading-pipe into a closed vault, where the ashes that are carried with the current of air get time to deposit. On this vault is placed—

*The Calcining Oven, 17.*

It is built of sheets of iron 10 m.m. thick, and is placed thus on the brickwork as to form the foundation for the oven, which is 3 storeys high, and fitted thus that the washed-out bicarbonate of soda that is to be calcinated is poured into the upper stove, from which it glides to the centre one, and from there into the last stove, where the calcining is completed. The oven is constructed thus that the almost ready soda meets the hottest carbonic acid, whilst the filled-up bicarbonate meets the already somewhat cooled carbonic acid. We may fill up bicarbonate from above, and draw out calcined soda from beneath. The quantity of carbonic acid we want to apply during the calcining process is to be regulated after our own wishes; we may let it pass between the interstices of the oven, or lead it around the latter; we gather it in a leading-pipe that leads to the washing-apparatus, 21, whilst the carbonic acid evolved by the calcining of the bicarbonate is led through a cooling apparatus, 32, direct to the absorbers.

*The Filter, 18,*

receives all the bicarbonate prepared in the absorbers, together with the produced lye of chloride of ammonium. It is a round reservoir, made of sheets of iron, at the bottom of which are fixed two strata of pieces of wood crossing each other; on the uppermost stratum is stretched a piece of light linen cloth, and the circular frame on which it is stretched fits accurately to the sides of the filter. The filter is, moreover, covered with a similar piece of linen cloth, which also is stretched over a circular frame. When the absorbers are to be emptied the uppermost frame is made fast, the cocks from the absorbers opened, and the pressure in the latter will force the fluid to rush out, taking with it all the bicarbonate. When the absorbers are emptied the cock is closed, and from the reservoir 14 is pumped new fluid in with the pump *g*, that it may be filled anew. The pump *h*, connected with the filter through a leading-pipe, sucks all the solution of chloride of ammonium from the bicarbonate which is left on the cloth, and the solution is pressed into—

*The Reservoir 19,*

which, like the rest of the reservoirs, are cylinders made of iron-plate. From this the fluid is taken out by the pump *d*, which, as we learned by the description of the tower 2, leads the fluid into the upper part of the latter.

*The Vessel for the Solution of the Salt, 20,*

made of wood, with a double bottom, the uppermost of

which rests on strong beams, to carry the weight of the salt. This vessel is always kept full of salt and water, and must be placed at so great a height that the tower 9 has the uppermost bottom about  $\frac{1}{2}$  metre lower than the uppermost plane of vessel 20. Along the side of this an iron leading-pipe goes up the vessel, and afterwards to the tower 9, from where the salt-lye trickles down over the flint-stones, to absorb the ammonia gas that escapes from the tower

*The Tower 21*

is made of wood or iron sheets. The hot carbonic acid coming from the lime-kiln is, through a leading-pipe, led to the bottom of this tower. The whole tower is filled with coke, over which cold water trickles. When the carbonic acid has passed the water it is washed and cooled; then it is sucked by the pump *a* into the upper part of the tower, and from there to the absorbers, 7<sup>1</sup> and 7<sup>2</sup>.

*The Sieve, 22,*

is only used in places where the lime is not good.

*The Well, 23,*

is a reservoir for the water.

*The Collector of the Waste Steam, 24,*

is furnished with a valve, so that the latter opens if the pressure should become too strong. All the waste steam from the pumps is gathered here, and gives the necessary heat to the still: if no distillation takes place the steam goes into the air.

*The Vessel 25,*

for the washing-water for the filter, is a small box with a leading-pipe.

26. *The Filter-Press.*

Through this press all the lye from the reservoir 5 is pressed into the tower 8. On this cleaning of the lye depends the quality of the produce.

*The Reservoir 27,*

from which diluted acid runs into the tower 10.

28, 29, and 30. *Cooling Trays,*

in which there are eighteen leading-pipes. The cooling process is arranged so that the hottest gas meets the hottest water and the most cooled gases the coldest water. The gas is ammonia-gas, coming from the tower 2, and is led to the cylinders 3 and 4.

31. *The Funnel for the Lime-water*

is only used where the sieve must be used.

32. *Cooling Tray,*

for the carbonic acid escaping from the calcining process is connected with the pump *b*.

33. *The Reservoir for Water*

for the leadings to all the cooling-pipes.

*The Pumps.*

- a.* For carbonic acid from the lime-kiln.
- b.* For carbonic acid from the calcination.
- c.* For water.
- d.* For the lye from the reservoir 19 to the tower 2.
- e.* For the lye from the reservoir 5 to the tower 8.
- f.* For the salt-lye from the vessel 15 to the cylinders 3 and 4.
- g.* For the lye from the vessel 14 to the absorbers, 7<sup>1</sup> and 7<sup>2</sup>.
- h.* For the fluid from the filter 18 to vessel 19, and at the same time for the washing-out water from the filter 18 to vessel 25.

For drawings, showing the details of a single apparatus, I have fixed the price at £10; of all the apparatus, £50; and for complete drawings, description of the whole

way of manufacturing, &c., £100. It must be mentioned for how large a produce the drawings are wanted.

The raw materials for 100 parts of 95 to 97 per cent soda are, using the latest improvements, 160 to 170 parts of rock-salt, or a corresponding quantity of salt-lye, 170 to 180 parts of coal, 120 parts of limestone, 2 to 3 parts of sulphate of ammonia, 1 part of sulphuric acid, and 30 parts of coke.

## ON THE PYROLOGICAL EXAMINATION OF ZEOLITIC SILICATES.

By Lieut.-Colonel W. A. ROSS.

THE term *Zeolite* is itself used to denote a silicate, but the adjective form is preferred because—

(1.) Many minerals other than these silicates fuse and “boil” before the blowpipe.

(2.) Difference of opinion as to what are and are not *Zeolites* seems to prevail among mineralogists. Nicol (“*Mineralogy*,” 1873) enumerates only twenty-two species of this “family,” in which he includes *Apophyllite*; Des Cloizeaux (1862), and Dana (1850), describe about sixty individuals, and do not include *Apophyllite*; Brooke and Miller (1852) ignore the term altogether, including it in the more general one, “Hydrous silicates.”

Apart from these technical distinctions, this peculiar kind of silicate appears to be at once interesting and difficult to chemically decompose so as to enable the field geologist or mineralogist to arrive rapidly at a sufficient knowledge of its constituent parts. I propose, therefore, to ask the attention of these and other scientific travellers to the merits of *Boric Acid* before the blowpipe as the quickest means known of obtaining a correct, if general, knowledge of the composition of the non-metalliferous rocks, more especially of those containing the alkaline earths, as lime, &c.

These, it will be remembered by readers of my published work on blowpipe analysis, called “*Pyrology*,” have the curious property of forming balls when fused upon a bead of boric acid before the blowpipe, which float in a very peculiar and striking manner within the bead, as internal spherules composed apparently of definite borates of these bases, while silica and alumina remain apparently unchanged by this operation, the former as transparent, the latter as fat-like fragments. The cause of this curious phenomenon seems to be shown by the behaviour of lime carbonate in a bead of boric acid. A pin’s head fragment heated by the blowpipe refuses to combine with the boric acid until its carbon dioxide has been completely eliminated, when, glowing brightly, it suddenly takes up exactly 4.5 times its weight of boric acid to form a calcium borate ball, which is almost as hard, transparent, and refractive as a first class diamond. This combination, being of a different density from the containing bead of boric acid, and yet like it fluid before the blowpipe, assumes a spherical form within the bead for “capillary” reasons; just as a drop of oil does, in water or milk.

Now, in some zeolitic silicates, the small proportion of lime present is counterbalanced by alumina and often an alkali, so that this ball formation in boric acid is spoiled, doubtless by this combination preventing the lime from becoming caustic, as the mineral generally fuses before the blowpipe, after which its powder applied B.B. to boric acid, merely floats like a piece of ice or jelly in the bead, and rapidly dissolves in it on further heating. That alumina is the chief cause of this phenomenon is shown by the behaviour of the lime silicate, *Apophyllite*, which, although containing considerable quantity of alkali but no alumina, at once forms balls in boric acid before the blowpipe, while *Zoisite*, which contains a large proportion of lime with alumina, but no alkali, will not form balls. In this difficulty, my friend, Mr. Hutchings of Freiberg, who has for some time devoted his leisure to the examination of boric acid re-

actions, suggested to me the previous use of ammonium fluoride gently heated in a platinum capsule with 1-10th bulk of mineral, in order to get rid of the silica; stating that it had been suggested to him by Capt. Dowler.

It being impossible to procure the pure salt commercially in London, I communicated my difficulties to Dr. Guthrie, F.R.S., who, with a kindness and courtesy I can never forget, made a considerable quantity of the treasured reagent for me in sealed tubes, and a little bottle of paraffin from which to use it, as, in his words, “it is an extremely dipsomaniac salt.”

After some fifty experiments with the ammonium fluoride process I was compelled reluctantly to give it up, because I found that, although it succeeded with definite mixtures of silica, alumina, and lime, and even with so perfect an artificial lime silicate as Bohemian glass, it failed completely with such zeolitic minerals as *Labradorite*, *Zoisite*, *Prehnite*, &c., which, after the fluoride treatment, gave precisely the same results in boric acid that they did without any treatment at all; viz., an icy mass in the case of *Labradorite*, &c., and a milky matter in the case of *Zoisite*, &c.

Mr. Hutchings, however, informs me that after many laborious quantitative experiments extending over some months, with lime, alumina, silica, and alkali, he has obtained such results by means of the fluoride process and boric acid as enable him to state confidently the constituents, and approximately the quantitative composition of any of these minerals in a few minutes.

For my part, after failing with ammonium fluoride, I thought there *must* be some preparatory process by which such a mineral as *Zoisite*, containing so much as 24 per cent of lime, could be made to exhibit balls in boric acid before the blowpipe, and, as I had long ago found that calcium phosphate forms opaque white balls in boric acid, much more difficultly dissolved by an added alkali than the clear balls formed by pure lime, it struck me to try *Zoisite* powder directly, in a mixture of boric and phosphoric acids, and to my great satisfaction, after the bead had remained red-hot before the blowpipe for same time, shining *white-hot* particles made their appearance, which through a lens were found to be white opaque balls, floating in the partly clear bead, and seemingly a double phospho-borate of lime and alumina, while the silica was diffused as a water-gruelly looking matter throughout the bead. The balls can easily be obtained separate by boiling the bead in water, and throwing the contents on a blotting pad.

*Labradorite*, which only contains about 10 per cent of lime, with half as much alkali, and a large proportion of alumina, was analysed in the same manner, only the resulting balls, in this case, were *clear* and transparent, like those formed by pure lime.

Thus, the geologist and mineralogist, with a blowpipe, pyrological candle, platinum wire, a lens, and a little boric and phosphoric acids in his pockets, may, after a little experience, analyse in a few minutes, in a shed, or any sheltered place near the scene of his operations, these complicated minerals, almost as minutely and correctly as the chemist in his laboratory.

The student may infer how unsatisfactory, and indeed, utterly worthless, is the present system of blowpipe examination of all such minerals, by referring to Plattner’s “*Examples*,” page 498. “*Probirkunst mit dem Löthrohre*,” (omitted in the pirated English translation), article “*Kieselsaure Kali-Thonerde (Feldspath, Adular)*,” while all that M. Des Cloizeaux—still incomparably the best writer on the silicates—can say on the subject with regard to *Labradorite*, is—“*Au chalumeau, fond un peu plus facilement que l’Orthose, en un verre blanc, semi-transparent, et colore légèrement la flamme en jaune.*”

As no zeolitic silicate contains sufficient alkali to decompose lime-balls in a bead of boric acid, it is obvious that such decomposition is a most delicate test for the presence of *alumina*; and it may be made quantitative by previously weighing the ball; all subsequent diminution

in weight being proportional to the amount of alumina present.

London, Oct. 24, 1878.

## NOTES FROM THE PARIS EXHIBITION.

### CHEMICAL PRODUCTS.

#### No. II.

Messrs. J. E. Williams and Co., who are colour and oil merchants, exhibit, besides a number of paints, &c., a new preparation called terebine, for mixing with oils, paints, and varnishes, for the purpose of making them dry more easily, especially when they are used for outside purposes or in damp weather. It will be very useful to house and ship painters, particularly the latter, as ships are nearly always damp. It is recommended to be used in the proportion of from 1 to 2 ozs. to every pound of paint, and about 10 ozs. to every gallon of oil or varnish.

Messrs. Southall Brothers and Barclay exhibit their "soluble meat," which they claim to contain all the constituents of the best lean beef; such as all the fibrin and albumen, as well as the extractive and saline matters. It differs from most extracts of meat in this respect, that the latter do not contain the flesh-forming materials, but only the saline and extractive matters. This firm has received the award of a Bronze Medal.

John Richardson and Co., manufacturing pharmaceutical chemists, show various quantities of their pills, which are enveloped in a substance which preserves the contents, and is easily soluble in the gastric juice of the stomach. They are said to have advantages over other pills of their kind, as the contents are not injured at all in the making. Messrs. Richardson and Co. also exhibit some phosphorised and simple cod-liver oil in a very pure state; the phosphorised oil is especially recommended for children. Their pocket medicine chests are arranged in a very compact form; they contain a few of the most urgent remedies for cases of need. A Bronze Medal has also been awarded to this firm.

The British and Foreign Mineral Water Company exhibit all kinds of artificial mineral and aerated waters, for which they have received the distinction of Honourable Mention. Analyses of many of them are given, showing that some of them contain 16, 18, and 20 ingredients, some in very minute proportions.

Messrs. Solvay and Co. exhibit some ammonia soda products, carbonate of soda, &c., which is made by their process. Solvay's process is about the only one which has yet been worked successfully on a large scale; many attempts have been made by various manufacturers to carry out practically this method of preparing carbonate of soda, but they have all failed, and their failure is attributed to the very delicate nature of the manufacture, or the imperfect apparatus devised for the operation. Some French inventors, however, were of opinion that their want of success was owing to the stringent laws regulating the use of salt in chemical works, but in this they were mistaken, as has since been proved. It may be known that the reaction which is the basis of the process takes place when chloride of sodium and bicarbonate of ammonia are brought together, the double decomposition which takes place forming bicarbonate of soda and hydrochlorate of ammonia; the bicarbonate of soda is afterwards decomposed by heat to form carbonate of soda, and the hydrochlorate of ammonia is distilled with a carbonate and the necessary bicarbonate of ammonia made. It would seem that this reaction, which is so easy to perform in the laboratory, should with care be successful on the large scale, but it is by no means an easy operation. The first idea of this reaction being applied to manufacturing purposes was in 1838, when a process was patented by Dyar and Hemming. Since then many patents have been taken out for the same purpose both in England and

France, and several of them claim the discovery of the principle; even Mr. Solvay's original patent granted in 1861 relates to the principle. Works have been started in various parts of England and the Continent at different times, but none of them succeeded. It was in 1863 that Mr. Solvay's first apparatus was patented; he had before that time carried on a series of experiments near Brussels, and as they turned out to be successful he determined to have permanent works erected, which was done at Couillet. Solvay's process is now worked in four different establishments; at Couillet, in Belgium, where 7500 tons of pure carbonate of soda are produced annually; at Varangéville-Dombasle, in France, where the annual production is 20,000 tons; and at Northwich and Sandbach, in England, where the total production amounts to 13,000 tons a year; thus 40,500 tons of carbonate of soda at 91½° Descroizilles are annually produced by Solvay's process. The works in France are the most important, and as they are built on a natural salt-bed, there is no expense in bringing that part of the raw material to the scene of the operation.

Dreyfus Brothers and Co. exhibit a quantity of Peruvian guano, of which they are the importers. As is well known this guano is a deposit left by seabirds on the islands and rocks in the Pacific Ocean, and not rarely the bodies and heads of birds are found buried in the deposit, which in some places is as much as 30 yards deep. It has been found by analysis and practical experiments that the Peruvian guano is very rich in nitrogen, lime, potash, and soluble phosphates, all of which play an important part in the nourishment of plants. The guano should be applied in damp, but not too rainy, weather, and not later than the month of April; it is also recommended to mix the guano with two or three times its own weight of cinders, charcoal, salt, or dry earth, &c., but never with lime, and in nearly all cases the mixture should only be made a day or two before it is required; mixing the guano with salt is specially recommended when it is only laid on the ground and not dug in. The reason of this is that the salt stops the carbonate of ammonia contained in the manure from volatilising when the weather is dry or windy. The Peruvian guano does for all kinds of crops, such as wheat, barley, oats, potatoes, carrots, colza, and even tobacco.

Mr. Peter Spence has a splendid exhibit of alum in the form of large cubical blocks, which are built up to about the height of twelve feet, forming a large square tower; at the four top corners of the tower are some very large crystals of the same substance. This alum is called the Turkey-red alum, as it is specially made for the Turkey-red dyers; it is in a very pure state, containing only one part of oxide of iron for every 500,000 parts of alum. Mr. Spence's only other exhibit is his patent aluminoferric cake. It is manufactured from the mineral bauxite, which contains aluminous and ferric oxides, together with a small quantity of silica. It is used for clarifying sewage waters, for which process it has been found very effective at the Native Guano Co.'s works at Aylesbury. Mr. Spence has been awarded the gold medal for his alum exhibit.

Messrs. Coquerel and Co., who are large manure makers, exhibit some of their chemical manures, as well as the raw materials with which the same are made. In their case may also be seen some paintings of the different parts of their works, which are very conveniently situated on the banks of the Seine, near Paris. This company was founded in 1874, but too late in the year to profit by the autumn sales, so the manufacture of the manures was not commenced until the following year, when only 800 tons of manure were sold; but as these manures gave most satisfactory results, the demand for them increased; so the works were enlarged, and in 1877 the sale had increased to 6000 tons for the year. The machines for making and mixing the manures are placed in a large three-storeyed building, while in other buildings and sheds are stored large quantities of raw material and

manure. The machines consist principally of—(1) a crushing or powdering machine, which will pulverise 80 tons of matter a day; (2) the mixing apparatus, capable of making 10 tons of manure an hour; (3) the sulphuric acid bath; and (4) the drying-pits, which are directly underneath the other apparatus. The machines for making the superphosphate and the phospho-guano (which are similar in composition) are composed of a cast-iron cylinder, in which revolves a spindle which has several arms projecting at right angles to it, a sulphuric acid bath, and a drying-pit. The phosphates are put into the cylinder at regular intervals and in measured quantities, while at the same time the sulphuric acid runs in from above, where it has been heated in a leaden bath with leather, feathers, or other organic bodies, which it partially dissolves. When the mixture is thoroughly made in the cylinder, a trap in the bottom is opened, and the contents fall down into the drying-pit beneath, where they stop for some hours, until formed into a hard mass, which is dug out and powdered, mixed with other ingredients, and put into casks ready for carriage to its destination. The apparatus just described is partially enclosed, and is put in connection with a powerful ventilator, which draws off and disinfects all noxious vapours. The works are directed by a chemist who makes all the formulæ for the manures, the quantities of the ingredients being fixed according to the results of the analysis of the raw materials: thus everything that goes in or out of the works is analysed in the laboratory attached to the building so as to be sure of its proper constitution. The manures made by Messrs. Coquerel and Co. are not all purely chemical manures; the great difference between them and those of most makers being in the form in which the nitrogen is applied. In purely chemical manures nitrate of soda is generally used, and with it excellent crops are obtained; but M. Coquerel has shown by practical experiments that the ground is not in such good condition after the crop, when the nitrogen has been applied as nitrate of soda, as it is after the nitrogen has been applied in the form he recommends, viz., obtained from some organic body (preferably leather) by treatment with sulphuric acid. In this way M. Coquerel is enabled to make as good a manure at a lower price than those makers who use nitrate of soda; and, further, he leaves the ground in a better condition for the next crop. The manures made at these works are eight in number: they are suitable for all kinds of agriculture and climates. A great quantity is exported annually to the West Indies for the sugar-canes, and agents are employed all over France. Below is given a table showing the percentage of the principal constituents in the manures:—

Name of Manure.	Nitrogen.	Phosphoric Acid.	Phosphate of Lime.	Salts of Potash.	Lime.
1. Phospho-guano .. ..	3 to 4 p.c.	12 to 13 p.c.	25 to 28 p.c.	—	25 to 30 p.c.
2. Do. rich in nitrogen ..	5 6	8 9	17 19	—	15 20
3. Chemical .. ..	5½ 6	7½ 8	17 18	—	15 20
4. For beet-root .. ..	7 8	4 5	8½ 10	10 to 12 p.c.	10 15
5. For potatoes.. ..	4 5	4 5	19 20	25 30	15 20
6. For maize and flax ..	3½ 4	9 9½	10 12	15 16	20 25
7. For grass fields .. ..	3 4	5 6	15 17	6 8	20 25
8. For vegetables .. ..	½ 1	7 7½	8½ 10	15 16	25 30

Messrs. J. Laureau and Co., who are also makers of artificial manures, exhibit several kinds, the most important of which are the Fish Manure, Phospho-guano, and the Breton manure. The fish manure is made from the residue left after the manufacture of fish oils: the cakes thus obtained are said to be very rich in phosphoric acid. The Breton manure is prepared from different animal and vegetable matters, together with a small portion of sea-salt. It is specially prepared for vines, its composition being such that the vines can easily draw their nourishment from it. It also serves to protect the vines in a certain degree from some of the maladies which are continually ravaging vineyards.

The North British Chemical Co. (Limited) have a very interesting exhibit of chemical products made from seaweeds. They consist chiefly of compounds of potash soda, iodine, bromine, and charcoal. The process now used is essentially different from the old one. The seaweed, instead of being burnt in open vessels—as was formerly the practice, when a great deal of iodine used to be lost owing to the high temperature—is subjected to destructive distillation in closed retorts, whereby about 50 per cent more iodine is obtained. After the distillation is finished, the constituents of the seaweed are found distributed as follows:—In the retort is a mass of charcoal containing several other matters; in the condenser a quantity of ammoniacal liquor; and in a suitable reservoir, fitted for its collection, is a gas which is used for lighting the whole of the works. The charcoal left in the retort is then subjected to lixiviation, and from the solution is obtained potash, soda, iodine, and bromine, which then undergo the several operations necessary for getting them into the desired form. The charcoal left after the lixiviation is found to be very much like that obtained from bones, and it has the property of being a very powerful deodoriser and disinfectant. The liquor which is obtained in the condenser after the distillation is decomposed, and ammonia and acetic acid are obtained from it. Most of the seaweed employed in this industry is collected on the coasts of the Hebrides during the winter months, thus giving employment to numbers of poor people who would otherwise be without means of subsistence, owing to the inclement state of the weather. There are two kinds of seaweed employed by this company, each having its special use. The first is drift-weed, which is washed ashore after storms or high winds; the second kind is called cut or tangle weed. It is cut or gathered from the rocks in calmer weather, hence its name. The former is particularly rich in iodine, and is therefore reserved for the production of that element. The latter is the material from which the other products of distillation are principally obtained, the percentage of iodine being much smaller. The first crude salts obtained from the charcoal are generally potassic chlorides, from which are obtained potassic chlorate and sulphate: from the potassic sulphate is obtained carbonate of potassium, from which iodide and bromide of potassium are formed. The iodine is sometimes re-sublimed, and is obtained in a very pure state. Various other products are made, and are exhibited in the case, together with samples of each of the salts and other materials above mentioned. The seaweeds are shown side by side with the several charcoals before and after lixiviation. Samples of sewage water are also exhibited, before and after being treated with the charcoal; the difference shows that the charcoa

employed is a good purifier. The Company also exhibit a new disinfectant, which bears the name of chloricalcium.

Messrs. Bowdler and Bickerdike, who, as it appears from the character of their exhibit, are large manufacturers of carbolic acid, show many different samples of that well-known disinfectant, and other phenic compounds. They have a large quantity of absolute phenol and picric acid, coralline, and creosol, and some very good crystals of pure carbolic acid.

M. Bobœuf, in the French Chemical Section, is also an exhibitor of carbolic acid. That prepared by him is the only carbolic acid that has been considered worthy of the Montyon Prize, awarded by the Institute of France. He

also exhibits some perfumed carbolic acid which is meant to be used for the toilet, as it does not leave behind it the peculiar odour that so many people object to in carbolic acid.

H. C.

### THE AWARDS AT THE PARIS EXHIBITION.

WE have now received the official list of the awards made to British exhibitors at the Paris Exhibition. From it we extract the following list of prizes for chemicals, chemical apparatus, &c. :—

#### GRAND PRIZES.

Johnson and Matthey, for Refining Machinery; and also for Platina.

#### GOLD MEDALS.

*Chemical Products.*—Brooke, Simpson, and Spiller, London, for Colouring-matters. E. Cook, London, Pure Soap. Hodgson and Simpson, Wakefield, Soaps. Charles Lowe and Co., Manchester, Products from Coal-Tar; Carbolic Acid and its Derivatives. T. and H. Smith and Co., Edinburgh, Alkaloids. Price's Patent Candle Co., Battersea, Paraffin, &c. Peter Spence, Manchester, Alum and Alumino-ferric Cake. Charles Tennent and Co., Glasgow, Chemical Products. Williams, Thomas, and Dower, Brentford, Artificial Colouring Matters. Wilkinson, Heywood, and Clarke, London, Varnishes and Colours. Young's Paraffin, Light, and Mineral Oil Co., Oils, Essences, Paraffin, Candles.

*Apparatus.*—Hargreaves and Robinson, Widnes, Apparatus for Manufacture of Sulphate of Soda.

#### SILVER MEDALS.

*Chemical Products.*—Burgoyne, Burbidge, Cyriax, and Farries, London, Pure Chemicals and Pharmaceutical Products. W. J. Bush and Co., London, Essential Oils. Griffiths, Fletcher, and Berdoe, Liverpool, Colours. R. S. Hudson, West Bromwich, Extract of Soap. Hurlet and Campsie Alum Co., Glasgow, Prussiate of Potash. L. J. Levenstein and Sons, London, Artificial Colouring Matters. J. Macfear, Glasgow, Chemical Apparatus, Products, and Preparations. J. F. Macfarlan and Co., Preparations from Opium, Beberin, and Salacin. T. Morson and Son, London, Chemical and Pharmaceutical Products. Mander, Brothers, London, Varnishes. North British Chemical Co., Glasgow, Iodine, Bromine and Derivatives. Runcorn Soap and Alkali Co., Liverpool, Bleaching-powder, Soda-ash, Soda Crystals, Caustic Soda, Sulphate of Soda, Refined Rosin. Savory and Moore, London, Chemical Products and Preparations. Simpsons, Payne, and Co., London, Paraffin, &c. C. Turner and Son, London, Varnishes, Colours, Gums, Turpentine.

*Apparatus, &c.*—F. S. Barff, London, Non-corrosive Iron. J. Cliff and Sons, Leeds, Crucibles and Retorts. J. Macfear, Glasgow, Soda Furnaces. Patent Plumbago Crucible Co., Crucibles.

#### BRONZE MEDALS.

*Chemical Products.*—Berger, Lewis, and Sons, London, Colours. Boyd, Son, and Co., Dublin, Chemicals. J. and J. Colman, London, Washing-blue. J. Chambers and Co., London, Chemical Products. Desoto Alkali Co., Widnes, Caustic Soda, Soda Crystals. Foster and Gregory, Streatham, Chemical Products. A. B. Fleming and Co., Edinburgh, Inks. H. Glover, Son, and Co., Bradford, Dry Soap. Golding, Davis, and Co., Widnes, Chemical Products. Gidney, Clark, and Co., Stratford, Varnishes. S. Hemingway and Co., Bradford, Dry Soap. T. Jennings, Cork, Magnesia. Liver Alkali Works Co., Liverpool, Caustic Soda. W. Lyons, Manchester, Inks. J. B. Readman, Glasgow, Chemical Products, Phosphorus. J. Richardson, Leicester, Chemical and Pharmaceutical Products. Rolls, Schweizer, and Co.,

London, Varnishes. H. Shaw and Co., Manchester, Dry Soap. Silicate Paint Co., Liverpool, Colours. H. C. Stephens, London, Inks. Tyne Alkali Co., Newcastle-on-Tyne, Chemical Products. Washington Chemical Co., Newcastle-on-Tyne, Carbonate of Magnesia. Wilson and Co., London, Colours.

#### HONOURABLE MENTION.

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## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 15, October 7, 1878.

**Singular Case of Heating in a Bar of Iron.**—M. Hirn.—The writer describes a case where a bar of iron, struck with a sledge-hammer at one of its extremities, underwent at every blow a rise of temperature to the extent of about 30°, returning immediately to its former heat. He considers that, in certain particular conditions, sonorous vibrations, shaking the nerves of sensation, may determine at the periphery of the human body a sensation of heat, just as a pressure upon the eyes produces in them a sensation of light.

**Observations on the Subject of the Note by M. Bouillaud inserted in the "Comptes Rendus" of the Session of September 30th.**—M. Th. du Moncel.—The author, having produced an experimental refutation of the views of M. Bouillaud, remarks—"I cannot help feeling astonished that M. Bouillaud has been so late in expressing his doubts now the phonograph, the telephone, and the microphone are in the hands of everyone. I shall not insist upon the theory of the effects produced in these experiments. I have even shown that the experiment of the singing condenser, along with many others, proves that the effects of electro-magnetism are not necessary for the reproduction of speech. These results are doubtless difficult to explain in the present state of acoustics, yet if I consider the sum total of the experiments which have been transmitted to me from all sides, and of those which I have performed myself, it seems that sonorous vibrations may result from every reaction of two bodies having the effect of producing abruptly and at near intervals modifications in the state of their magnetic or electric equilibrium."

[The discussion on the telephone and the phonograph raised in the Academy of Sciences by M. Bouillaud has created a feeling of painful surprise. At the meeting on Sept. 30 M. Bouillaud, by implication at least, pronounced M. Th. du Moncel a "skilful ventriloquist." This is justly considered dishonouring to the Academy, and M. Fizeau, the president, is declared to have "forgotten the duties imposed upon him by his official position. A writer in *La Correspondance Scientifique* says that in the interest

of the reputation, even of M. Bouillaud himself, who has been an eminent physician, he should have been prevented from making himself the laughing-stock of the learned world." With reference to M. Bouillaud's demand for a *phonograph which can think*, the writer adds:—"Since age has weakened an intellect which was once the luminary of French medical science, why exhibit the softening, the decay, of a brain so admirably organised."]

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*  
No. 10, 1878.

**Contributions to the Steric Law.**—H. Schröder.—The author exemplifies this law as regards the sulphides and arsenides of iron, cobalt, nickel, copper, zinc, and lead. He remarks that the modifications of arsenic and of its acids, which he describes along with the sulphides and arsenides, form so brilliant a confirmation both of the law of condensation and of the steric law that the validity of both may be assumed with the greatest probability.

**Variation of the Absorption Spectra of certain Colouring-Matters in Different Solvents.**—F. v. Lepel.—The author states that, when observing the reactions of purpurin-alumina and purpurin-magnesia, he had the opportunity to convince himself of the heterogeneous character of the purpurin spectra, according as one of the above-named compounds or an alkali was present, or according to the nature of the solvent. His attention was first excited by the appearance of a new absorption-band after the addition of a very little alkali to the pure alcoholic solution. The strange behaviour of purpurin induced him to examine the optical behaviour of a series of dyes in different solvents. Kundt proposed the law (*Pog. Ann. Jubelband*, p. 615) that an absorption-band of a colouring-matter moves so much farther towards the red the greater the refractive index of the solvent employed. A large number of dye-wares confirm the correctness of this law most distinctly. But it cannot be denied that the spectra of certain colouring-matters undergo no change, whilst the index of refraction increases, and in other cases the band is removed towards the violet, and in others again the character of the spectrum is completely altered. Hence, as Vogel recently declared, we cannot expect to observe the characteristic absorption-bands of a colour under all circumstances. The author in his experiments employed acid, neutral and alkaline, the neutral solvents being water, ether, alcohol, chloroform, and bisulphide of carbon—a series in which each member has a greater refractive power than the foregoing. The authors' results cannot be given without the accompanying diagram.

**On Didymium and Lanthanum.**—F. Frerichs.—A reply to the criticism of Cleve on the author's paper on didymium and lanthanum.

**Oxidation Products of Hexylen obtained from Mannite.**—Otto Hecht.—The author, repeating the experiment of Chapman and Thorp on the action of chromic acid upon  $\beta$ -hexylen, obtained not as they state, carbonic, acetic, and propionic acids, but, in place of the last-mentioned, normal butyric acid. He has further examined the behaviour of hexylen with dilute sulphuric acid.

**Oxidation Products of the Hexylen-glycol obtained from Mannite.**—O. Hecht and J. Munier.—The acid recognised were the normal butyric and the acetic.

**On Ortho-dinitro Compounds.**—A. Laubenheimer.—The author examines the behaviour of ortho-dinitro-benzol with ammonia, that of dinitro-chlor-benzol with amido-derivatives, and that of dinitro-brom-benzol with soda.

**On Metachlor-phenol.**—E. Uhlemann.—This compound boils at  $211^{\circ}$  to  $212^{\circ}$ , and congeals on cooling to a white crystalline mass, which, after being drained by pressure, melts at  $28.5^{\circ}$ .

**On Conchinin Sulphate.**—O. Hesse.—As conchinin sulphate is not capable of transformation into quiniferous cinchonidin sulphate, it follows that Shaer's experiments

refer to Winkler's quinidin sulphate, and not, as he maintained, to that of Pasteur.

**Action of Melting Potassa upon Glycerin.**—Erwin Herter.—The author obtained by this reaction acetic, formic, and butyric acids, and the lactic acid of fermentation.

**Action of the Halogen-Sulphur Compounds upon Aniline, and of Sulphur Chloride upon Acetanilid and Benzol.**—E. B. Schmidt.—With the object of discovering a convenient process for the preparation of the mono-sulpho-bases of the aromatic series, the author has examined the behaviour of aniline with sulphur iodide, bromide, and chloride; that of acetanilide with sulphur chloride; that of benzol with the same compound, and of sulphur chloride and benzol in presence of zinc. As the result of his researches, he finds that halogen-sulpho-compounds act upon aniline in such a manner that the whole of the sulphur is fixed, with the formation of di- and probably of tri-sulpho compounds, the yield of monothio-anilin being small.

**Formation of Crude Corallin.**—P. Gukassianz.—The author considers that neither carbonic oxide nor carbonic acid is the agent of the reactions, but that the oxalic acid, as such, enters into reciprocal action with 2 mols. phenol, 2 mols. of water being eliminated, and  $C_{14}H_{10}O_4$  being first formed.

**Action of Oxalic Acid upon Resorcin.**—P. Gukassianz.—The author obtains two colouring-matters, both of the composition  $C_{14}H_{10}O_6$ .

**A New Method for the Quantitative Determination of Sulphur.**—O. Fahlberg and M. W. Iles.—If sulphur is fused with a sufficient excess of alkali it is converted entirely into sulphite, and not into a mixture of hyposulphite and sulphide, and if still more alkali is present the result is a mixture of sulphite and sulphate. To oxidise the sulphite to sulphate the authors apply bromine. They have successfully applied this analytical principle to organic sulphur compounds, to free sulphur, and metallic sulphides. The fusion of sulphur or a metallic sulphide with potassa yields a sulphite without any loss, which is then oxidised by means of bromine and hydrochloric acid, forming sulphuric acid, which is then determined in the ordinary manner. Where metallic oxides are separated after the fusion in an insoluble state, they are removed by filtration before the bromine and hydrochloric acid are added. Sulphides of arsenic, antimony, zinc, &c., all yield, after melting, a fusible mass, whilst in case of sulphides of iron and copper these metals are left behind in the state of oxides. Even in pyritic silicates the sulphur can be accurately determined in this manner. Care must be taken that not less than 25 grms. pure caustic potassa is taken to every 0.1 gm. of sulphur supposed to be present. The operation is performed in a silver crucible, and the fusion is continued till the mixture becomes tranquil—say from fifteen to twenty minutes—or till vapours of alkali begin to condense along the upper part of the crucible, which after use shows a clean surface if sufficient alkali has been used. When cold the mass is dissolved in cold water, freed from oxides, &c., by filtration, mixed with from 75 to 100 c.c. bromine water and hydrochloric acid, added till a distinctly acid reaction is obtained. Heat is then applied till the liquid is colourless.

**Neutral Ethylic Ether of ordinary Nitrophthalic Acid, and of the Oxyphthalic Acid of A. Baeyer.**—O. Miller.—The pure neutral ethylic ether of ordinary nitrophthalic acid is easily obtained from the silver salt of this acid by the action of ethyl iodide in the water-bath, and appears as a colourless crystalline body, which melts at  $43^{\circ}$ .

**Action of Ammonia upon Acet-acetic Ether.**—H. Precht.—This compound was discovered by Geuther, who regarded it as an acid, and named it ethyl-diacetic acid.

By the action of ammonia the author obtained an amide of the composition  $C_6NH_{11}O_2$ , water being eliminated.

**Specific Gravity of the Vapours of the Chlorides of Thallium and Lead.**—H. E. Roscoe.—Seven experiments with chloride of thallium gave 8.15, 8.28, 8.06, 7.43, 8.75, 8.60, 7.84; the calculated sp. gr. being 8.49. With chloride of lead the experimental results were 9.12, 9.72, 9.51, 9.64; calculation showing 9.62.

**On Isodulcite.**—R. S. Dale and C. Schorlemmer.—The authors having treated quercitrin with hydriodic acid found it converted into a tarry mass, while a heavy iodiferous liquid distilled over, from which they did not succeed in separating any definite body.

**On Ethylidenimid Silver Nitrate.**—A. Goldschmidt.—If to the alcoholic solution of 1 vol. aldehyd there is added  $\frac{1}{2}$  vol. ammonia, and the solution of nitrate of silver is added without shaking the vessel, this compound is slowly deposited in beautiful nacreous leaflets. The properties of this body agree with those of ethylidenimid silver; it is sparingly soluble in water, alcohol, and ether, but readily in ammonia. If boiled with water it deposits silver in a specular layer.

**On Chlornaphthylamin.**—P. Seidler.—If naphthylamin, prepared according to Roussin's method, is exposed to the air for some weeks along with the mixture of stannous chloride and hydrochloric acid, it is partially converted into chlornaphthylamin. If heat is applied to the mixture the amide group is attacked, and colouring-matters are formed.

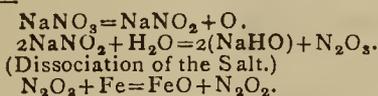
**Oxidation of certain Nitrogenous Compounds by means of Permanganate of Potassa.**—S. Hoogewerff and W. A. Van Dorp.—Aniline yields oxalic acid, almost a fourth of its carbon being oxidised. Azo-benzol is also produced. Ortho-toluydin treated in the same manner yields also oxalic acid and azo-toluol, a beautiful red compound which crystallises from ether in well-formed prisms, and melts at 55°. About 50 per cent of the nitrogen present in the ortho-toluydin reappears as ammonia. In para-toluydin only about 40 per cent of the nitrogen is obtained as ammonia. Para-azo-toluol was also obtained, as a body insoluble in the oxidising liquid. The yield of oxalic acid is relatively smaller than in the former cases.

**Lemon-yellow Nitro-benzoic Acids.**—F. Fittica.—The author has obtained and examined the sulphated diazo-benzoic acids corresponding to the above acids.

**Decomposition of Petroleum and Lignite Tar by Superheating.**—A. Letny.—The author claims priority as against Liebermann, Burg, Salzmänn, and Wickelhaus. He passed residues from Baku petroleum (sp. gr. 0.87; boiling-point, 270°) through an ignited horizontal retort, 7 feet in length by 1 foot in diameter, and filled with wood-charcoal. The products submitted to dry distillation began to boil at 80°, yielding up to 90° benzol (4.6 per cent); up to 145° toluol and its homologues (5.2 per cent); up to 340° naphthalin and unchanged petroleum (35.5 per cent). The portion boiling above 340° was received in three parts: *a*, phenanthren 2.7 and petroleum 9.3 per cent; *b*, anthracen 2.4 and petroleum 5.2 per cent; *c*, anthracen 1.94 and petroleum 6.04 per cent. Besides petroleum and lignite tar the products of the dry distillation of natural asphalte, of resinous shales, and the last residues from the refining of petroleum can be decomposed into aromatic hydrocarbons.

## TO CORRESPONDENTS.

**ERRATA.**—In the CHEMICAL NEWS of October 18, p. 191, bottom of col. 1, read—



*J. Taylor.*—Thanks for your letter. In the passage to which you take exception the writer evidently referred to a special case. No practical result would follow from further discussion, especially as the circumstances probably vary in the several districts.

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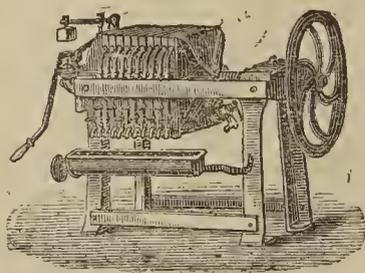
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# THE CHEMICAL NEWS.

VOL. XXXVIII. No. 988.

## ON YTTERBIA, A NEW EARTH CONTAINED IN GADOLINITE.

By M. C. MARIGNAC.

At the close of the researches on the gadolinite earths—which I had undertaken for the purpose of confirming M. Delafontaine's observations on the existence of terbia and of a new base belonging to the same group, and to which he has given the name of philippia—I obtained a few grammes of an earth presenting all the characteristics of erbia, as set forth by MM. Bahr and Bunsen and MM. Cleve and Hoglund. I ought, however, to mention that the method by which I separated it from the other gadolinite earths was not in all respects identical with that which those *savants* employed. Bunsen's method consists in heating the combined nitrates till red vapours appear, when they are re-dissolved in boiling water, and on cooling the nitrite separated. This nitrite is rich in erbia, which is deposited in little acicular crystals. I myself continued the decomposition of the nitrates until the mass assumed a pasty condition. On treating this mass with boiling water an insoluble residue remains, in which the erbia is concentrated. By repeating one or other of these methods many times an earth of a pure rose colour is obtained, which constitutes erbia.

In my first experiments I discontinued this treatment as soon as I had succeeded in obtaining a rose-coloured earth, the equivalent of which, between 128 and 129,\* corresponded to that assigned to erbia.†

More recently I have collected the products thus obtained with the object of ascertaining whether by continuing the same operations I should obtain an increase of the equivalent. In doing this I observed a fact which surprised me much.

During the first part of my work, the gradual increase of the equivalent corresponded to an increased intensity of the rose colouration and of the absorption-bands characteristic of erbium. After a certain point had been reached the equivalent still continued to rise slowly, but the rose colouration and the absorption-bands diminish rapidly, so much so that the last product obtained gave no absorption-rays; it was perfectly white, and its salts were colourless.

The equivalents of the last three products obtained were 130.4, 130.6, and 130.8. The first two still showed a distinct rose colouration, especially in the case of the crystallised oxalates and sulphates. If a sufficient quantity of material were operated upon to admit of this method of purification being extended still further 131 might be taken approximately as the extreme limit of the equivalent.

It evidently follows that the earth which I had extracted from gadolinite, and which I had considered as erbia, was in reality a mixture of two distinct oxides. The one, which was of a pure rose colour, and which gave a very characteristic absorption-spectrum, should retain the name of erbia, as it contains the most distinctive characteristics of that earth. The other is a new earth belonging to the same group, for which I propose the name of ytterbia, not only by way of alluding to its presence in the mineral of Ytterby, but on account of its resemblance to yttria by its whiteness, on the one hand, and to erbia by the elevation of its equivalent on the other, as well as by the resemblance to the latter earths in most of its properties.

\* Equivalent calculated for the formula  $EaO$ , or, more probably,  $Ea_2O_3$ , and for  $O=16$ .

† 128.5 according to Bahr and Bunsen, 129.7 according to MM. Cleve and Hoglund.

The small quantity of material I have had at my disposal has not admitted of my making a complete study of its properties. The following are, however, a few indications which establish its individuality.

I have already referred to its perfectly white colour: its salts are colourless, and the nitrate is decomposed by the aid of heat without being coloured.

The solutions of ytterbia give no absorption-rays neither in the ordinary spectrum nor in the ultra-violet, according to the observations which M. L. Soret has made. In the purest sample that I have been able to obtain, hardly a trace of the strongest erbia ray could be discerned in the yellow green.

Ytterbia is less easily acted upon by acids than the other earths of this group. It dissolves slowly in dilute acids either cold or moderately heated. It always dissolves easily in boiling dilute acids, even in acetic and formic acids.

Its sulphate exactly resembles those of yttria and erbia. It is most probably isomorphous with them, for the solutions containing ytterbia and erbia give to the last only one kind of crystal always presenting the same appearance, their colour varying only as they contain more or less erbia.

The sulphate is easily re-dissolved without deposit in a saturated solution of potassic sulphate. No precipitate is formed even when the solution is boiled.

A neutral solution of ytterbic chloride, if it is not too concentrated, is not precipitated by boiling with sodic hyposulphite. If the solution is very concentrated, and contains both erbium and ytterbium, a precipitate is obtained which is richer in erbium than the earths remaining in solution.

Ytterbium precipitated from its salts by potash, and submitted to a current of chlorine in presence of an excess of potash, is completely re-dissolved.

The formiate dissolves in less than its weight of water; it crystallises in the mamillary form like the formiates of yttria and erbia. Like them it is decomposed and tumefied by heat; it presents the same composition corresponding to the formula  $Yb_2O_3 \cdot 3C_2H_2O_3 + 4H_2O$ . It also loses its water of crystallisation at 100°.

All these characteristics sufficiently establish the fact that this earth contains no thoria, the only earth amongst those known, or which may be supposed to exist, whose equivalent would be sufficiently elevated for its presence to account for the increase in that of erbia.

The fact of this new earth being so difficult to separate from erbia may give rise to many doubts as to the exactness of the equivalent attributed to this latter earth. If I trusted to observations made on too small quantities of material to be conclusive, I should be led to believe that that equivalent is much too high. It seemed to me, indeed, that the maximum of rose colouration and of the intensity of the absorption-spectrum corresponded to products whose equivalent was comprised between 122 and 126, but which were, however, only mixtures of erbia and ytterbia.

Can it be admitted that Bunsen's method for the purification of erbia by the crystallisation of the nitrite led to the elimination of ytterbia, so that the erbia experimented upon by the German and Swedish *savants* was exempt from it.

The difficulty of procuring gadolinite in sufficient quantity, and the great length of time necessary to extract the erbia from it, and which after all is found in it only in very small quantity, leave me scarcely any hope of being able to solve these questions and to establish in a more complete manner the properties of ytterbia. It is on this account that I was desirous of calling the attention of chemists to these facts, and especially of those who have experimented upon a sufficiently large quantity of erbia, and who may possess some still, hoping that they will prosecute researches on this subject, and assure themselves of the existence of the new earth, which to my mind is thoroughly established.

Adopting provisionally for ytterbia the equivalent 131 we deduce for the atomic weight of ytterbium the value 115, or 172.5, according as the formula  $\text{YbO}$  or  $\text{Yb}_2\text{O}_3$  is attributed to its oxide.—*Comptes Rendus*.

### LABORATORY NOTES FROM THE UNIVERSITY OF CINCINNATI.

By F. W. CLARKE, S.B., Professor of Chemistry.

#### SOME SPECIFIC GRAVITY DETERMINATIONS.

The following specific gravity determinations represent work done by my students and myself during the school year 1877-78. Those portions of the work which were entrusted to students were carried out under my immediate supervision, and every precaution was taken to ensure a fair degree of accuracy. The salts were all weighed in benzol, and the figures refer to water at its temperature of maximum density as unity.

To Mr. W. H. Creighton and Mr. E. F. Wittmann I assigned mercuric cyanide and some of its double compounds. For the cyanide itself,  $\text{HgCy}_2$ , we found a sp. gr. of 4.0262 at 12°, Creighton; 4.0026 at 22.2°, Wittmann; and 4.0036, 14.2°, F. W. Clarke.\*

For the oxy-cyanide,  $\text{HgCy}_2\text{HgO}$ , Mr. Creighton found 4.437 at 19.2°, and I myself in two determinations, 4.428 and 4.419 at 23.2°.

For the double salt,  $\text{HgCy}_2\text{HgCl}_2$ , Mr. Wittmann obtained the values 4.531, 21.7°, and 4.514, 26°.

For the double cyanide of mercury and potassium we have, from experiments made by Mr. Creighton, 2.4470, 21.2°; 2.4620, 21.5°; and 2.4551, 24°. This salt is the well known  $2\text{KCy.HgCy}_2$ .

Mercuric bromide, prepared by Mr. Miles Beamer, gave 5.7461, 18°, and 5.7298, 16°.†

The double bromide of mercury and potassium was also prepared and examined by Mr. Beamer, both in the hydrated and the anhydrous state. For the salt  $\text{HgBr}_2\text{KBr}$ , he found 4.412, 17.2°; 4.419, 24.5°; 4.3996, 20.5°. For the hydrated salt,  $\text{HgBr}_2\text{KBr.H}_2\text{O}$ , as a mean of six concordant determinations taken between 20° and 24°, he found a sp. gr. of 3.867. The potassium bromide used in these preparations gave a sp. gr. of 2.712, 12.7°.‡

Mr. Beamer also re-determined the sp. gr. of the curious double salt  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7.\text{HgCl}_2.\text{H}_2\text{O}$ , finding it to be 3.329, 21°.

Mercuric iodide and a couple of double salts were determined by Miss Mary E. Owens. For  $\text{HgI}_2$ , the mean of seven experiments between 10° and 19°, is 6.231.||

For the double iodide,  $2(\text{KI.HgI}_2).3\text{H}_2\text{O}$ , the sp. gr. is 4.289, 23.5°; and 4.254, 22°.

For the iodide of mercury and tetramethyl-ammonium,  $\text{N}(\text{CH}_3)_4.\text{HgI}_2$ , were found the values 3.968, 24°; 3.976, 23.5°; 3.971, 24°; 4.003, 23.2°. The iodide of tetramethyl-ammonium itself, well crystallised, was found by Miss Owens to have a sp. gr. of 1.827, 17°; and 1.831, 19.5°.

Cadmium chloride and some of its double compounds were examined by Mr. Walter Knight.

The anhydrous chloride,  $\text{CdCl}_2$ , gave as a mean of three determinations the value 3.938, 23°.§ The hydrated salt,  $\text{CdCl}_2.2\text{H}_2\text{O}$ , gave a sp. gr. of 3.339, 18.2°; 3.320, 23.2°; 3.314, 23.6°.

The double chloride of cadmium and strontium,—  
 $2\text{CdCl}_2.\text{SrCl}_2.7\text{H}_2\text{O}$ ,  
in fine crystals, as a mean of three experiments, was found to have a sp. gr. of 2.718 at 24°.

And the barium salt,  $\text{CdCl}_2.\text{BaCl}_2.4\text{H}_2\text{O}$ , gave the values 2.952, 24.5°; and 2.966, 25.2°.¶

Several salts of acids belonging to the xanthic acid series were prepared by students under the direction of Professor R. E. Warder, and of these, three well-crystallised examples had their sp. gr. determined.

Potassium methyl-disulphocarbonate,  $\text{K.CH}_3.\text{COS}_2$ , prepared by Mr. E. P. Bishop, has a sp. gr. of 1.7002 and 1.6754 at 15.2°.

Potassium ethyl-disulphocarbonate was determined by Miss Helena Stallo and by Dr. J. P. Geppert. Miss Stallo found the sp. gr. to be 1.5564, 18.2°; and 1.5576, 21.5°. Dr. Geppert's determination gave 1.558, 21°.

Potassium isobutyl-disulphocarbonate, also determined by Miss Stallo, has a sp. gr. of 1.3713, 15°; and 1.3832, 14.5°.

A particularly interesting series of observations was made by Miss Stallo upon the formates and acetates of cobalt and nickel. I am unable to find any adequate account of these salts beyond the mere fact that they form crystalline crusts. Even the water of crystallisation in them seems hitherto not to have been determined. Miss Stallo prepared these compounds by dissolving the carbonates of the metals in the respective acids, estimated the water contained in them, and determined the density. The formates of cobalt and nickel crystallise with two molecules, and the acetates with four molecules of water. The sp. grs. are as follows:—

Cobalt formate	..	2.1286, 22.0°; 2.1080, 20.2°.
Nickel	..	2.1547, 20.2°.
Cobalt acetate	..	1.7031, 15.7°; 1.7043, 18.7°.
Nickel	..	1.7443, 15.7°; 1.7346, 17.2°.

Miss Stallo also prepared, with a view to future description, the cobalt and nickel salts of monochloroacetic and trichloroacetic acids. These salts are readily crystallisable, and seem likely to be interesting. Cobalt valerate, which Mr. J. L. Davis attempted to prepare, was obtained by him only as a red, gummy mass, of a very unsatisfactory character.

Another series of experiments having a certain theoretical interest, relates to some salts analogous to the sulphovinates. The data obtained are as follows:—

Barium methyl-sulphate,  $\text{Ba}(\text{CH}_3)_2(\text{SO}_4).2\text{H}_2\text{O}$ , 2.273, 19.2°; and 2.279, 21.2°, determined by Dr. Geppert.

Barium ethyl-sulphate, 2.080, 21.7°; 2.0714, 22.6°; Dr. Geppert.

Barium propyl-sulphate, 1.839, 20.5°; 1.844, 20.5°; Dr. Geppert.

Barium isobutyl-sulphate, 1.778, 21.2°; 1.743, 24.2°; Mr. W. H. Schuermann.

Barium amyl-sulphate; 1.623, 21.2°; 1.632, 22°; Mr. John Whetstone.

If, now, we calculate the molecular volumes of these salts, we shall find them separately by approximately equal differences. If we assume these differences to be really equal, and distribute the experimental error among the several salts, we can get the following interesting series of theoretical values.

Methyl-sulphate, molec. vol.	176, calc. sp. gr.	2.244
Ethyl-sulphate	209, " "	2.024
Propyl-sulphate	242, " "	1.863
Isobutyl-sulphate	275, " "	1.780
Amyl-sulphate	308, " "	1.646

These calculated values correspond to a supposed constant difference in the molecular volume, of 16.5 for each  $\text{CH}_2$  group; a difference which holds in a great many series of compounds. This difference may also be made out, within narrow limits of approximation, in the series of sulphocarbonates previously given. Here, for example, we have, very nearly,—

Methyl salt, molec. vol.	88, calc. sp. gr.	1.658
Ethyl	104.5, " "	1.531
Isobutyl	137.5, " "	1.367

It will be seen that all these calculated specific gravities agree closely with those actually found; and that, curiously enough, the molecular volumes thus assumed are exact multiples by whole numbers of Kopp's well known value

\* Bödeker, *Jahresberichte*, 1860, gives for  $\text{HgCy}_2$  the value 3.77, 13°.

† Karsten, *Schweigg. Journ.*, v., 65, gives 5.9202.

‡ Schröder's mean value for this salt is 2.690. *Pogg. Ann.*, 1859.

§ Filhol, *Ann. d. Chim. et Phys.* III., xxi., 1847, gives 6.250.

§ Bödeker gives a sp. gr. of 3.6254, 12°. *Jahresberichte*, 1860.

¶ Topsøe, *Chem. Centralblatt*, iv., 76, found 2.968

for hydrogen, 5.5. Are these regularities mere coincidences, or do they indicate the existence of some general law?

I may give, in conclusion, a few determinations of specific gravity made by myself.

Potassium chloroplatinite,  $\text{PtCl}_2 \cdot 2\text{KCl}$ , 3.2909, 21°; and 3.3056, 20.3.

Telluric acid, crystallised,  $\text{H}_2\text{TeO}_4 \cdot 2\text{H}_2\text{O}$ , 2.9999, 25.5°; and 2.9649, 26.5°.\*

Telluric acid,  $\text{H}_2\text{TeO}_4$ , 3.425, 18.8°; 3.458, 19.1°; 3.440, 19.2°.

Ammonium tellurate,  $(\text{NH}_4)_2\text{TeO}_4$ , 3.024, 24.5°; 3.012, 25°.

*Thallium Tellurate.*—For this compound, hitherto undescribed, I can give only a few preliminary facts. By a series of mishaps my material became exhausted, so that I was unable to complete the investigation of the substances obtained. Metallic thallium is not attacked even by a boiling solution of telluric acid. When, however, a solution of ammonium tellurate is added to one of thallium nitrate, a heavy white precipitate falls, somewhat resembling silver chloride. This precipitate dried at 100° has a sp. gr. of 5.687, 22°; and 5.712, 20°. Heated to about 180° it turns to a pale straw-yellow colour, and loses 1.46 per cent of water. The sp. gr. of this yellow salt is 6.742, 16°; 6.760, 17.5°. Heated to redness, the thallium tellurate fuses, and is reduced to tellurite. This, when hot, is almost black, but solidifies on cooling to a clear lemon-yellow glass. The exact composition of these salts remains to be determined, and I hope to return to them at some future time.—*American Journal of Science.*

ON THE ALBUMINOID MATTERS, ALCOHOL, AND PHOSPHATES IN THE BURTON ALES AND IN DUBLIN PORTER.†

By REGINALD LAWRENCE and C. W. REILLY,  
Associates of the Royal College of Science.

THE two kinds of malt liquor, Burton ale and Dublin porter, are so largely consumed at the present time, that it appeared to us desirable to have the three classes of Dublin porter, as manufactured by Messrs. Arthur Guinness and Son, and the Burton ales, manufactured by the two most noted brewers, Messrs. Bass and Allsopp, examined under the same conditions.

The samples of the Burton ales examined we obtained from Messrs. Falkner, of this city, and we are greatly indebted to the kindness of Messrs. Arthur Guinness and Son for supplying us with the samples of porter we required for our investigation.

We confined our examination to the estimation of the principal constituents:—The phosphoric acid existing in

the form of phosphates, the albuminoid matter and alcohol, together with the acetic acid, the total amount of solid matter, and the specific gravities of the different samples.

The phosphoric acid was determined in the ash by a standard solution of acetate of uranium; in the estimation of the albuminous matter, acetic acid, alcohol, and total solids, we followed the plans given by Messrs. Jackson and Wonfor.\*

We may add that the quantity of albuminous matter was determined by first finding the amount of nitrogen by Will and Varentrapp's method, and then taking 15.92 parts of nitrogen as equal to 100 parts of albumen.

Our investigations show that some of the principal elements of nutrition are present in larger quantities in the foreign and ordinary Dublin double stout than in the Burton ales.

This investigation was carried on in the laboratory of the College of Science, under the direction of Professor Galloway.

The quantities of the substances we estimated, expressed in grains per gallon, are given in the table below.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 15, 1878.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President, in the Chair

MR. BINNEY, F.R.S., F.G.S., said that at a meeting of the Society, held on the 14th day of November, 1876, he gave an account of a *Eucalyptus globulus* growing in his garden at Douglas, in the Isle of Man. In that year (1876) it had grown 7 feet 8 inches in height; in the following year 6 feet 8 inches, when it unfortunately lost its leading shoot by accident. Up to the 7th of this month it had grown 6 feet. Thus in the three years it had reached 20 feet 4 inches in height. The tree was planted in a sheltered situation close to the sea, and its foliage at the present time, notwithstanding the recent severe gales, presents a most luxuriant appearance and yields a pleasant odour. No manure has been supplied to the roots, which have grown in a soil formed of the *débris* of Manx schist.

"Relative Brightness of the Planets Venus and Mercury," by JAMES NASMYTH, C.E., F.R.A.S., Corresponding Member of the Society.

On many occasions, when observing Mercury and Venus in full daylight, I have always been impressed with the

	Bass's Ale.	Allsopp's Ale.	Foreign Double Stout.	Double Stout.	Guinness's Single Stout.	
Albuminoid matter	1st Estimation	333.2404	327.1731	574.0000	435.303	298.996
	2nd Estimation	340.5217	316.7365	549.6250	422.112	316.584
	Mean .. ..	336.8810	321.9548	561.8125	428.708	307.790
Acetic acid ..	1st Estimation	95.9280	168.2100	261.7860	139.300	160.580
	2nd Estimation	96.1310	167.9000	255.7058	147.000	160.090
	Mean .. ..	96.0295	167.0500	258.7409	143.150	160.335
Alcohol .. ..		4383.4000	4478.5125			
		4365.9000	4443.8625	5128.2000	4643.100	3534.300
		4374.6509	4461.1875			
P <sub>2</sub> O <sub>5</sub> .. ..	19.4250	18.3750	123.1100	111.088	85.600	
Total solids ..		4884	3110	4374	5068	3838.5
		1.0138	1.0144	1.01157	—	1.12438
						82.715

\* Oppenheim, *Fahresberichte*, x., 213, gives 2.340.  
† A Paper read before the Royal Irish Academy.

\* Messrs. Jackson and Wonfor "On the Composition of the Dublin Porter."—*Journal of the Royal Dublin Society*, vol. iii., page 163.

strikingly inferior brightness of Mercury as compared with Venus; and as such a condition is the very reverse of what might be expected by reason of Mercury being so much nearer to the sun than Venus, I awaited the rare event of a very close conjunction of these two planets that occurred on the 26th and 27th of September last. With the advantage of a perfectly clear sky I had the two planets before me for several hours, so to speak, side by side in the field of the telescope at the same time, thus affording me a most perfect opportunity for making a comparison of their relative brightness. It is difficult to convey in words an exact impression of the difference in the brightness of such objects, but I may attempt to do so by stating that Venus looked like clean silver, while Mercury looked like lead or zinc. Were I to indicate my impressions by way of number I would say that Venus was fully twice as bright as Mercury. So remarkable an inferiority in the brightness of Mercury, notwithstanding his much greater nearness to the sun, appears to me to indicate the existence of some very special and peculiar condition of his surface in respect to his capability of reflecting light—a condition that may be due to the nature of his envelope, if such exist, or of that of his surface, by which the fervid light of the sun's rays falling on him are in a great measure quenched or absorbed so as to leave but a small residue to be reflected from his surface. If this be so, it appears to me to be reasonable to suppose that the absorption of so much light must result in a vast increase in the heat of the surface of Mercury beyond what would have been the case had Mercury possessed the same surface conditions as Venus. Whether in the progress of spectroscopic investigation we shall ever be enabled to detect some evidence of metallic or other vapours or gases clinging to or closely enveloping the surface of Mercury that might in some respect account for so remarkable an absorption of the sun's light, we must be content to await the acquirement of such evidence if it ever be forthcoming. It appears to me, however, to be well to raise such a question, so that our astronomical spectroscopists may be on the outlook for some evidence of the cause of so very remarkable a defective condition in the light-reflecting power of Mercury to which I have thus endeavoured to direct attention.

"On the Water of Thirlmere," by HARRY GRIMSHAW, F.C.S., and CLIFFORD GRIMSHAW.

The samples of water of which the following details are given were taken by us on August 23rd, 1878, from what may be termed the "upper and lower lakes," meaning above and below the narrow waist of the lake, where crossed by the small bridge. The first taken was the "lower" sample, which was obtained on the west side of the lake about 20 yards below the bridge. The "upper" sample was taken about three-quarters of a mile below the head of the lake on the east side. The results of the two samples, so far as position affects them, should therefore be sufficient to show any possible divergency which could occur in the quality of the water on that account. These two positions are shown upon the sketch map accompanying the paper.

The two samples were analysed separately, except as regards the amounts of ammonia (determined August 28th), for which equal parts of each sample were taken, as there was not a sufficient quantity for separate analyses.

The following are the numbers obtained:—

Free ammonia—half a litre of water distilled took 1.5 c.c. standard  $\text{NH}_4\text{Cl}$ .

Albuminoid ammonia—half a litre of water distilled took 3 c.c. standard  $\text{NH}_4\text{Cl}$ .

Total hardness—70 c.c. water took 1 c.c. standard soap solution.

Permanent hardness—70 c.c. water boiled one hour and made up took 1 c.c. soap. (The ammonia analysis common to both samples, hardness same in each.)

Solid matter—100 c.c. lower sample gave 0.0045 grm. residue, which blackened on ignition, and lost 0.0025 grm.

Solid matter—70 c.c. upper sample gave 0.0022 grm. residue, which blackened a little on heating, not so much as lower sample, and lost on ignition 0.0007 grm.

Chlorine—25 c.c. lower sample took (1st) 0.25 c.c., (2nd) 0.25 c.c. standard  $\text{AgNO}_3$ ; 25 c.c. upper sample took (1st) 0.15 c.c., (2nd) 0.15 c.c. standard  $\text{AgNO}_3$ .

The foregoing figures give the following tabulated results:—

	Grains per Gallon.		
	Lr. Sample.	Up. Sample.	Dr. Roscoe's
Total solid matter ..	3.15	2.20	1.4500
Mineral matter .. ..	1.40	1.50	—
Loss on ignition .. ..	1.75	0.70	—
Total hardness .. ..	1.00	1.00	0.5000
Permanent hardness ..	1.00	1.00	0.5000
Chlorine .. .. .	0.70	0.42	0.4200
Nitrogen as nitrates and nitrites .. .. .	—	—	0.0247
Free ammonia .. .. .	0.0021	—	—
Albuminoid ammonia ..	0.0042	—	0.0049

The "ammonias" expressed in parts per million are 0.03 and 0.06 respectively; the chlorine equals 0.7 and 1.16 grains per gallon of salt.

The water was very clear and sparkling, practically free from sediment, and its reaction perfectly neutral to litmus. There was no reaction for heavy metals, copper, lead, iron, &c., although we observed that there ran in close to the top of the lake a small stream of a very turbid milky appearance, upon which is situated, on the side of the hill towards Helvellyn, a lead mine; which stream could be traced by its colour for at least 20 yards into the clear water of the mere. These mining operations, we understand, will of course be completely done away with on proceeding with the water scheme.

We may offer the following brief remarks upon the above analysis of the water of Thirlmere. In the first place it is evident that the water is one of the very purest description found in nature, not being surpassed by that of any locality in Great Britain of which analyses have been published.

As regards its use for manufacturing purposes it practically could not be improved. For drinking purposes, also, it is perfectly free from anything which could be considered objectionable, of either an organic or mineral nature, though we are not prepared to assert that a water, considered "solely" as to its suitability for this purpose, attains any particular advantage from having its amount of lime salts lower than some ten or so grains per gallon, though doubtless it is better that this should be very small than that it should be excessive. To give a fuller indication of the quality of the water of Thirlmere, we have taken the liberty of appending to our results those obtained by Dr. Roscoe from a sample of the same taken in February of this year. Now it will be seen that there is a certain difference between the results of these samples, more especially with regard to our "lower" one. On examination, however, the difference will be seen to be one of "degree" only, and not of "kind," and entirely confined to the mineral, and in this case the least important items. It is explained by the fact that the rainfall some little while before the taking of the respective samples had been very different, the longest period of dryness perhaps which we have had this year having occurred just before the taking of those of the present paper. We should therefore expect that the solid matters would be higher, and find them to be so by about  $1\frac{1}{2}$  grains per gallon, the total in either case being insignificant. It would perhaps not be wide of the mark if we said that the analyses of Dr. Roscoe and ourselves show the water at its best and its worst as regards ordinary variation. This variation, it will be seen, is not greater than may occur at the same time in different parts of the lake, as shown by our upper and lower samples, these analyses also indicating a slight gradual increase of dissolved ma-

terial as we approach the foot of the lake, where the solvent action of the water upon its bed will have accumulated and the fresh water received from the tributaries is lowest in amount. This gradation of quality will, of course, only be true of the lake under its present natural conditions.

The variation of the organic constituents of the water at the different dates is not so marked. From the behaviour of the solid matter during ignition we should say that the carbonaceous matter, of which there is a perceptible amount, is almost entirely of a vegetable nature.

#### NEWCASTLE CHEMICAL SOCIETY.

October 24, 1878.

##### INAUGURAL ADDRESS, by R. C. CLAPHAM, F.C.S.

IN the first place it is my duty to thank the members for the honour they have conferred upon me by electing me to be their President. This post has been filled in past years by former Presidents who have conducted the business of the Society with great ability and skill. I must therefore ask the indulgence of the members for any deficiencies on my part whilst continuing to discharge the duties they have called upon me to undertake. Let us, at the outset, glance backwards for a moment to the beginning of the Newcastle Chemical Society in 1868. At that time there was no recognised means of communication between chemists in their immediate districts; purely scientific chemists, manufacturing chemists, and the large number of young chemists in laboratories on the Tyne, were each pursuing their daily investigations without the frequent exchange of ideas which is not only necessary to success, but which forms a pleasant social bond of union between all scientific men. This Society's importance as a source of instruction and information to chemists cannot be exaggerated; it has at present every prospect of a great and useful future before it; and as time goes on its members will increase, and its influence as a scientific Society will be proportionably extended.

I do not wish to forget that we have also in this locality a junior Chemical Society which I have pleasure in acknowledging has shown for several years much youthful vigour and ability both in the papers read and in its general administration. I am sanguine enough to think, as I have before expressed, that the time will soon come when it will be to the interest of both Societies to amalgamate, and so form one united and strong body.

##### *Mr. Gossage.*

In the Committee's Reports which have been hitherto issued I believe that no reference has been made to the deaths of members. A record of the deaths, and in some cases a short account of the lives, is now prepared by most scientific bodies. Although reference was made in last year's Address (but which was not published) to the death of one of our most eminent members,—Mr. Wm. Gossage,—I may be excused for adding a few remarks on Mr. Gossage's career as a chemist from personal knowledge of my lamented friend's life. Mr. Gossage was born in 1799, and the earlier part of his life was spent at a time when many of the great discoveries in reference to the metals and gases were being made by the fathers of our present chemistry—discoveries which made this science at the time peculiarly attractive to young men of genius. Occupied for a time in a small druggist's shop in Chesterfield, with none of the means that are now to be found at the disposal of chemists, he may be said to have mastered the principles of chemistry which he was able practically to apply shortly afterwards as manager of alkali works at Stoke Prior, in Worcestershire. Up to that time no practical method was known, although many attempts had been made, to condense hydrochloric acid gas, and Mr. Gossage here first tried and then patented a system of condensation by means of his now well-known stone

towers, or condensers, which have proved so successful for the last fifty years. He was one of the first to set about the recovery of the waste manganese in making bleaching-powder, for which several patents were taken out, one of which closely foreshadows Mr. Weldon's now successful process. In various extensive experiments for the recovery of sulphur from soda waste much time and money were expended. With the extraction of the small percentages of copper in burnt ores of Irish and Cornish pyrites, with the manufacture on a large scale of the new silicate soap, and with a long series of experiments for improved methods of producing pure soda, free from sulphides and cyanides, his memory and name will always be associated. Mr. Gossage was a hard and earnest worker, and to those who visited at his house at Widnes a genial and sincere friend. The young student of the present day, who has the easy means at his disposal for acquiring chemical knowledge at our local schools, colleges, and laboratories, must not forget the great difficulties and discouragements with which the old pioneers of chemistry had to contend.

##### *Electric Light.*

In recent years most important investigations have been made by Prof. Graham Bell and Mr. Edison, which have led to the construction of the telephone, microphone, and other instruments for conveying the human voice and other sounds to great distances, and which may hereafter prove of the greatest importance. Although these inventions are still in their infancy, and may require time before they come to much practical utility, they in the meantime mark a great advance in electrical knowledge. The further discoveries of Gramme in France, and Siemens in England, of means for the easy and continuous production (or, as we might say, the manufacture) of electricity, and its application to lighting and other purposes, have caused the electric light to occupy at the present time a very prominent position among the subjects of interest to scientific men; and should the very recent alleged discoveries of Mr. Edison prove correct, by which the supply of electricity can be split up into a thousand or ten thousand different lights, and in this way be conveyed to our dwellings to take the place of gas, it may create a change the end of which we can hardly contemplate. For, in addition to the proposed extinction of gas, electricity so easily and successfully produced by the Gramme or Siemens machine may come to be applied in the arts and manufactures in various ways hitherto not known. It may in many cases supersede coal as a motive power, or be applied in metallurgy, and thus affect large commercial interests. It must, however, be borne in mind that up to the present time it has not been possible to give any reliable information as to the cost of supplying electricity on the large scale from a dynamo-electric machine, keeping up a continuous daily and nightly supply, whereas it is well known that gas can be supplied in this country at a very low price, owing to the fact of the by-products—consisting of tar, coke, and ammoniacal salts—finding a ready market at prices which, as a rule, may be said to nearly recoup the first cost of the coals used. In the meantime, while waiting for further information, these discoveries are well worthy of our thoughtful attention, and I trust that some of our members may favour the Society with papers on these subjects.

##### *Noxious Gases.*

The Acts of Parliament in reference to noxious gases and smoke have already proved beneficial to both manufacturers themselves and to the general public, and have become a recognised part of social legislation.

The recent report of the Royal Commission recommends that the escape from sulphuric acid works shall not exceed one grain of sulphur or half a grain of nitrogen per cubic foot of gas at 60° F.; and that in case of hydrochloric acid gas the escape shall not exceed 0.2 grain per cubic foot as heretofore, and that the inspection shall be ex-

tended to include manure works, copper works, coke ovens, and other industries not hitherto included under any Act. The deposits of soda waste, which in some localities have become a nuisance, especially old heaps, are also to come under the proposed new Act.

For information in reference to the escaping gases of chemical works, and the means for their prevention and examination, we are greatly indebted to Dr. Angus Smith, who has for many years conducted important experiments on the impurities in the air, especially in reference to hydrochloric acid, sulphurous acid, and ammonia, in the neighbourhood of large towns. The large amount of sulphurous acid in the atmosphere from the ordinary combustion of coal has received much attention of late years, and the recent paper by Mr. J. Pattinson on the impurities in small coals will further elucidate the question. I have myself at various times examined the air for sulphurous acid, and found it to exist at considerably further distances from large towns than might have been expected. At 5 miles it can be distinctly traced, and with certain winds it is found in the country even 10 miles from the Tyne. Some of these experiments, however, from local causes, require correction; but after making all allowances for small errors, it is now admitted that sulphurous acid from coal is in far greater quantity in the air than either hydrochloric acid or sulphuric acid passing off from alkali works, and that it must necessarily affect to a serious extent the growth of all vegetation within its reach. Mr. J. Maclear has stated that in well-constructed furnaces, where there is consequently no leakage of air into the flues, there is nearly 400 cubic feet of air passing for 1 lb. coal consumed; and taking an average of 1.5 per cent of sulphur in the coal, there is, therefore, equal to 0.655 grain of sulphuric acid per cubic foot of escaping gases, as compared to 0.2 grain of hydrochloric acid from condensers. He takes the coal consumed annually in Great Britain at 114,043,940 tons, and which at 1 per cent sulphur will give 3,500,000 tons of oil of vitriol escaping into the atmosphere, as compared to 44,716 tons from sulphuric acid works. It must, however, be admitted that it is difficult to lay down exact data from the percentage of sulphur in coal, for the estimation of sulphurous acid generated in combustion, owing to some kinds of coal containing more lime than others, which necessarily retains part of the sulphur in the ash. The only reliable or satisfactory plan would appear to be the testing of the atmosphere in different localities.

(To be continued.)

## NOTICES OF BOOKS.

*Sanitary Examinations of Water, Air, and Food: a Handbook for the Medical Officer of Health.* By CORNELIUS B. FOX, M.D., &c. London: J. and A. Churchill.

GREAT as has been the attention paid to the sanitary applications of chemistry, it must not be supposed that the last useful word has already been said. New methods have been devised for the analysis of sundry articles of food, of air, and especially of water, but it is still doubtful whether any of these is so satisfactory as to be incapable of improvement. Dr. Fox undertakes not so much to point out any novel process as to show how existing analytical methods may be made to throw the fullest light upon the wholesomeness or unwholesomeness of a water. His object has been "to avoid a consideration of these three subjects (water, air, and food), solely after the manner of an analyst, who mechanically deals with chemical operations and arithmetical calculations, but to treat them as a physician who studies them in connection with health and disease." This is the common sense view of the matter; what the medical practitioner, and, indeed, the intelligent man of the world require to know,

is not so much what quantity of "albuminoid ammonia" or "organic nitrogen" is contained in a million parts, but rather whether it can be consumed with safety? This question the author undertakes to answer, and we are bound to say his endeavours are far from unsuccessful. He gives a full and critical account of the various processes for the determination of the amount and nature of the organic matter in water. He shows, from actual experience, that permanganate of potash sometimes fails to afford any indication of the presence of organic matter in water that contains a large quantity of it. The water of a well which received the drainage of a cesspool, which was occasioning enteric fever, and which contained 1.08 milligrms. of albuminoid ammonia per litre, still occasioned no discolouration with Condry's fluid. The author, however, considers that the indications of the permanganate process, when controlled by other evidence, "exhibit a remarkable agreement with the Frankland and Armstrong process, and with the Wanklyn, Chapman, and Smith process, when the latter is associated with a determination of the nitrates and nitrites." Concerning the latter analytical method, he makes the following very judicious remarks:—"If you rely solely on the indications of this process, you will sometimes come to a correct conclusion as to the quality of a water, but very often a mistake will be made. Couple the evidence afforded by it with other evidence of a chemical and microscopical character, and an error will never be committed. I regard this process as a most valuable aid to the formation of an opinion by the medical officer of health as to the nature of a water, as indispensable, indeed, as is auscultation to the physician in the diagnosis of lung and heart diseases." He rebuts the objections urged by Mr. Wigner, Dr. Hill, and others, against the Wanklyn process. Still it will be already apparent that he is no indiscriminating follower of Mr. Wanklyn, from whom, indeed, he differs in laying considerable weight upon the determination of the nitrates and nitrites, in insisting upon a microscopic examination of waters and their sediments, and in the greater importance which he seems to attach to the determination of phosphoric acid. On the other hand, he remarks that "the certificate of an analysis, made by Dr. Frankland's elaborate process, is about as incomprehensible as the process itself to all who are not chemical experts. Members of Sanitary Authorities and their medical officers often find these certificates perfectly unintelligible." It is interesting to find that the discrepancies between the Frankland and the Wanklyn processes, when fairly considered, are much less important than has been supposed. Dr. Fox has obtained upwards of 90 analyses of waters, executed at or near the same time by both processes, and, on careful comparison, he finds that in only one instance is there "a distinct conflict of opinion, and in this exceptional instance the divergence in the results is easily explained." When the results of analysis made by the two processes at or about the same time do not at all agree, the author traces the discrepancy to the neglect on the part of chemists employing the Wanklyn process to estimate the nitrates and nitrites, and to take the evidence thus afforded into due consideration. If the oxides of nitrogen are estimated, a really bad water is not likely to pass undetected by either process. In his appended table of the results of ten samples examined by both processes we find a very close coincidence between the opinions formed. It would have much facilitated comparison if all the results had been calculated to the same standard. Dr. Frankland expresses all the impurities of a water as parts per 100,000. Mr. Wanklyn, and many other chemists, give the organic impurities in milligrms. per litre (parts per million), but the nitrogen present in nitrate and the chlorine as grains per gallon. We have known municipal and sanitary authorities puzzled by these varying standards, and led to believe a discrepancy where none existed,—to the discredit of chemists and of chemistry in general.

Dr. Fox makes no mention of the tannic acid process for the qualitative examination of waters—a very pardonable omission, as its results are not sufficiently characteristic. Nor does he appear to have tried the “hydrosulphite” process of Girardin. We think also that, for the benefit of medical officers of health, he might have advantageously drawn attention to the light thrown upon the character of streams by the nature of the animal and vegetable organisms by which they are peopled. In this direction there is still much to be done. We read, *e.g.*, that water-cress is a test of the purity of water, growing only in unpolluted streams. Yet in a recent series of experiments we have found it to flourish exactly in proportion to the contamination of the water, thriving best in undiluted sewage!

The chapter headed “Mistakes of Water-Analysts, and How to Avoid Them” should be taken to heart by all sanitary chemists. It is unpleasant to think how much the reputation of a professional man is at the mercy of persons who may carelessly or maliciously send him a sample of water in a dirty bottle.

Space will not allow us to enter into a survey of the remaining sections of the work,—those devoted to the sanitary examination of air and of food. Under the latter head are comprised, not merely a notice of the ordinary adulterations of food and of their detection, but valuable instructions for the examination of questionable butcher’s meat, poultry, fish, vegetables, &c.

The main characteristic of this book is sound, practical common sense. The author has succeeded in his attempt to free sanitary chemistry from “cloudy and chaotic surroundings,” and has thus conferred a boon, not merely upon officers of health, but upon the medical profession at large, and upon the general public. Had the works of sanitary reformers been always as free from extravagances and crotchets, the day of pure water, pure air, and sound food would be much nearer.

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## CORRESPONDENCE.

### “INSOLUBLE SILICIOUS RESIDUE.”

*To the Editor of the Chemical News.*

SIR,—In a great many analyses of ores and technical products, the term “insoluble silicious residue” is used in the statement of results, to designate the portion of the substance which is left undissolved by the action of hydrochloric acid. This is certainly an improvement upon the custom of calling the insoluble residue “silica,” as we have neither analysed nor heard of ores (excepting, perhaps, the new Caledonia nickel ores) of which cargo samples gave an insoluble residue of pure silica. We know of cases in which large percentages of baryta sulphate have borne the empirical formula  $\text{SiO}_2$ , in samples in which a trace of sulphur was pronounced to be present, and such things will happen so long as the commercial assays are made under the present strictures regarding time.

Now, unless some agreement is arrived at among chemists, as to how the insoluble silicious residue shall be obtained, it is still open so grave objection as an item in an analysis certificate, because it brings chemistry into disrepute, or (what is more unfortunate for the individual operator) throws the blame of incompetence upon some unoffending analyst. It is well known that iron and maniferous iron ores occur associated with silicates soluble in hydrochloric acid, such as olivine and ilvaite among the peridotes, some pyroxenes and amphiboles, the zeolites, &c. Now, iron and manganiferous iron ores nearly always give more lime and magnesia to hydrochloric acid than is sufficient to combine with the carbonic acid found, and ores entirely free from carbonic acid

usually yield at least one or two per cent of these bases to that solvent. These are the alkaline earths of the soluble silicates above mentioned, and the silica combined with those bases is not included in the “insoluble silicious residue” of those analysts that filter off their hydrochloric acid solution without evaporating it to dryness.

We are aware that occasionally they recover this soluble silica from the precipitated oxide of iron afterwards, but this oxide of iron has been precipitated two or three times, and has taken up some silica from the glass vessel in which the precipitations are made. When the solution of the ore in hydrochloric acid is boiled, some silica is precipitated, the amount which remains in solution depending upon the amount of acid present, state of dilution, time of boiling, and rapidity of evaporation. Those that filter off and weigh the residue here obtained find results varying from 0.5 to 2 per cent below results found by evaporating the solution to dryness, which latter do not exhibit variance from each other.

While “insoluble silicious residue” is understood by most chemists to be the least suggestive item in an analysis, it is frequently a guaranteed percentage in ore contracts, as if it were a definite body like oxide of iron or magnesia. While any chemist can make a figure “high” or “low” at pleasure, we think that there is some cause for complaint amongst ore merchants, although it may sometimes fall upon the heads of those who stick to one method. On our part we prefer the “high” process, and shall continue to do so until we see a reason to adopt the other, and this because it gives the same results in duplicate assays, and includes the whole and not a fraction of the silica present. Perhaps some day the Institute of Chemistry may make regulations in such cases which no individual voice will effect.—I am, &c.,

A. E. A.

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## AMMONIACAL MANUFACTURE OF SODA.

*To the Editor of the Chemical News.*

SIR,—In your notice this week of “The Metallurgical Uses of Tungsten,” it is stated that it exists in abundance in Cornwall. There is a general impression that such is the case, but the recurrence of much disappointment may be prevented by the statement that the ores of tungsten are by no means abundant. I am well acquainted with the principal sources of supply, and have found it difficult, if not impossible, to secure for any length of time even as small a quantity as twenty tons per month.

I have been much interested in the details of “The Ammoniacal Manufacture of Soda,” but they are of little or no service from the expression “1 ton of  $\frac{9}{10}$  per cent of soda or  $1\frac{1}{2}$  tons of pure bicarbonate of soda.” Does “or” mean equivalent to? If so, taking the ton at 95 per cent, should not the equivalent be 46 cwt. of pure bicarbonate of soda? Information on this point may enable an estimate to be made of the cost of manufacture, especially if to the particulars of expenditure of materials this cost of labour be considered.

I trouble you with this, as an explanation may be of service to others as well as to myself.—I am, &c.,

ROBERT OXLAND, F.C.S.,  
Public Analyst for Devonport.

October 26, 1878.

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The Faraday Lecture.—We would remind the Fellows of the Chemical Society that the Faraday Lecture will be delivered on Tuesday, November 12, in the theatre of the Royal Institution, by Prof. Ad. Wurtz. On the day following the lecture the Fellows of the Society will entertain Prof. Wurtz at a Dinner at Willis’s Rooms. The Dinner tickets are one guinea each.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 16, October 14, 1878.

**Action of the Juice of Beet-Leaves upon Ferric Chloride under the Influence of Light.**—H. Pellet.—The juice of these leaves, in the absence of chlorophyll, has the power of easily reducing salts of iron under the influence of light. This reduction may be effected in the dry state, or with solutions having no longer any vitality. This reductive action is due to the oxidation of one or of more of the organic substances contained in the leaves, such as the sugars, tannin, nitrogenised matters, &c.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.* No. 10, 1878.

**On Diphenylen-keton from Anthraquinon, and on Pyro-condensation.**—R. Anschütz.—If anthraquinon is heated, mixed with 20 parts of quick-lime, the main product is diphenylen-keton, along with smaller quantities of diphenyl, anthracen, and fluoren. The author proposes the following law of pyro-condensation:—"Pyro-condensations of phenyl-phenyl derivatives to phenylen-phenylen derivatives take place always in such a manner that the atoms or groups which link the phenylen-residues together take up the diortho position with reference to such residues."

**Detection of Small Quantities of Fluoren along with Phenanthren or Anthracen.**—R. Anschütz.—Fifteen grms. of the mixture to be tested for fluoren are oxidised with potassium bichromate and sulphuric acid, Fittig and Ostermeyer's principle. After boiling for six hours with a cohobator the filtered product is distilled with watery vapour, and the distillate is slowly crystallised from alcohol. If fluoren was present, compact crystals of diphenylen-keton separate out.

**On Monobrom-phenanthren and Phenanthren-bibromide.**—R. Anschütz.—This paper deals chiefly with hypothetical considerations.

**Preliminary Notice on an attempt to prepare Phenyl-glyceric Acid.**—R. Anschütz and L. Kinnicutt.—The authors take as their point of departure dibromocinnamic acid and its ether. They have also examined cinnamic-methyl, ethyl, and propyl ethers, and certain brom-addition products of the methyl and ethyl ethers.

**Addition of Bromic Hydride by means of its Solution in Glacial Acetic Acid.**—R. Anschütz and L. Kinnicutt.—The authors combine cinnamic acid with bromic hydride by means of the above solution.

**Decomposition of Wood Tar at a Red-heat.**—A. Atterberg.—The author mentions that the results obtained by Liebermann, Burg, Salzmann, and Wichelhaus agree with his own observations on the tar of pine-wood. By passing the tar and the less volatile tar-oil of the Swedish "wood-oil" works through iron tubes filled with coke at bright redness, he obtained a tar containing all the important constituents of coal tar. It yielded 7 per cent benzol and toluol; it was rich in naphthalin; it contained a tolerable quantity of anthracen, but little phenol. At incipient redness were obtained 10 per cent toluol, containing a little benzol; phenols boiling between 190° and 220°, but little phenylic acid, 0.3 per cent of anthracen, but no naphthalin.

**Naphthalin Chlorides.**—A. Atterberg.—The author is dubious about the existence of the  $\beta$ -naphthalin tetrachloride of E. Fischer.

**On Fluoranthren.**—A. Atterberg.—A tabulation of a series of aromatic hydrocarbons.

**New Formation of Nitro-ethan.**—P. Lauterbach.—If equivalent quantities of potassic sulph-ethylate and sodium nitrite are submitted to dry distillation, an oily matter, from which pure nitro-ethan is easily obtained by fractionated distillation.

**On a Dichlor-salicylic Acid and certain Derivatives of the Monochlor-salicylic Acid melting at 172°.**—E. J. Smith.—The author describes certain salts of the first-mentioned acid discovered by Rogers (1875), and a different acid which he obtained, and which melts at 214°. The monochloric acid and its salts and derivatives are also described.

**Synthesis of Isatin and Indigo-Blue.**—A. Baeyer.—If amido-oxindol (obtained from nitroso-oxindol) is oxidised with ferric or cupric chloride, or nitrous acid, isatin is readily obtained. The conversion of isatin into indigo-blue had been previously effected by the author and Emmerling. Indigo-blue can likewise be obtained from hydrindic acid and amido-oxindol, with the aid of phosphor-oxychloride and phosphor-pentachloride.

**Preliminary Communication.**—Th. Diehl and V. Merz.—If amido-diimido-resorcin is heated to about 170° with dilute hydrochloric acid, there is formed along with sal-ammoniac a crystalline body of great tinctorial power, and having the composition of trioxyquinon,  $C_6H_4O_5$ .

**Nitrous Gases obtained from Nitric Acid and Starch, and those of the Vitriol Chambers.**—G. Lunge.—In opposition to O. N. Witt (*Berichte*, xi., 756) the author maintains that the nitrous fumes obtained by the action of nitric acid upon starch, &c., consist not of  $N_2O_4$ , but of  $N_2O_3$ . In the lead chambers, when in normal action, little but  $N_2O_3$  is present, and no  $N_2O_4$ .

**Leucin from the Sprouts of Pumpkins.**—E. Schulze and J. Barbieri.—The authors have demonstrated the presence of this compound and of tyrosin in the sprouts of pumpkins.

**Formation of Sulphates during the Decomposition of Albumen in Germinating Plants.**—E. Schulze.—The sulphuric acid is formed from and in proportion to the sulphur of the decomposed albumen.

**Formation of Colouring-Matters by the Action of Benzo-trichloride upon Phenols and Tertiary Aromatic Bases.**—Oscar Dæbner.—Among the colouring-matters of this group the author has specially examined the one produced by the reaction of dimethyl-anilin and benzo-trichloride, and known in commerce as "malachite green." The most suitable proportions for its preparation are as follows:—To 2 mols. dimethyl-anilin, mixed with about half its weight of chloride of zinc, is gradually added, at a gentle heat, 1 mol. benzo-trichloride. After completion of the reaction the deep green mass is freed from extraneous products by the action of steam. The colouring-matter thus obtained, a zinc double salt of the coloured base, is soluble in water—especially hot—and more readily in alcohol, with a deep green colour, and possesses all the attributes of a good dye. The base may be isolated by treatment with soda-lye and agitation with ether, on the evaporation of which it remains as a red-brown oil, which on drying up shows no tendency to crystallise.

*Les Mondes, Revue Hebdomadaire des Sciences.* No. 1, September, 1878.

**Perishable Character of Paper.**—Prof. Renleaux calls attention to the nature of the paper used in the Administrative Departments. It is composed almost entirely of wood, and documents written upon it will be lost in ten to fifteen years.

**The Manures of M. G. Ville, at the Exhibition.**—M. Moigno writes—"Every year on the High Alps enormous quantities of nitrogen are collected in the shape of

cheese, and no manure is ever applied; even the excreta of the cows are kept off. Whence comes this nitrogen if not from the atmosphere, and how is it rendered assimilable if not by the electric effluve?"

*Reimann's Färber Zeitung,*  
No. 38, 1878.

**Methylen Blue.**—The Baden Aniline and Soda Company, of Mannheim, have patented a process for the preparation of blue colouring matters from dimethyl-anilin and other tertiary aromatic monamins. C. Lauth obtained violet dyes from para-phenylen-diamin, which, on the introduction of methyl, &c., yield blue and green compounds. The difficult preparation of phenylen-diamin prevented the practical utilisation of Lauth's process. The Baden Aniline Company propose instead to use dimethyl-anilin. By the action of the hydrochlorate with the nitrite of soda nitroso-dimethyl-anilin is prepared and reduced to amido-dimethyl-anilin by means of sulphuretted hydrogen. The solution is oxidised with ferric chloride. Or amido-dimethyl-anilin may be oxidised and the blue colouring matter produced by sulphuretted hydrogen. The mixture is saturated with common salt, precipitated with chloride of zinc, and filtered. On treating the precipitate with water the soluble colouring matter is extracted, the solution saturated again with salt and re-precipitated with zinc, the precipitate filtered, pressed, and dried, when it is ready for use.

**Patent Congress.**—The International Congress on Patent-right, sitting at Paris, discussed the respective advantages of a preliminary examination (German and American system), and of patents granted as a matter of course unless opposed by some party interested (French, Belgian, Austrian, &c., system). To Prof. Reuleux, who advocated the previous examination, it was replied that the German patent office might some day fall into the hands of officials like those who managed the old Prussian patent office, and who rejected almost every application. The exclusion of chemicals from the German patent system was also discussed. Switzerland was justly stigmatised as the paradise of pirates. From the various reports of this congress it appears that England has not been there represented, or if any English delegates were present they took no prominent part in the proceedings.

*Chemiker Zeitung.*

No. 40, October 3, 1878.

**Volumetric Determination of Potassium.**—Carnot proposed to precipitate potassa as a double hyposulphite of potassium and bismuth. This process has been made capable of more general application by dissolving the double salt in water and determining the hyposulphurous acid by means of a standard solution of iodine.

**New Process for the Manufacture of Caustic Soda.**—Bazin first converts the sulphate into sulphide by ignition with wood-charcoal, dissolves this in boiling water, and treats the boiling solution with cupric or ferric oxide. The metal combines with sulphur and remains undissolved, whilst the sodium takes in exchange oxygen, and becomes converted into a strong solution of caustic soda. Whether the reaction of the metallic oxide and the alkaline sulphide is complete is scarcely certain.

*Bulletin de la Societe Chimique de Paris,*  
Tome 30, Nos. 6 and 7, Oct. 5, 1878.

This issue is entirely made up of articles taken from *Liebig's Annalen*, the *Berichte Deutsch. Chem. Gesellschaft*, and the *CHEMICAL NEWS*.

## NOTES AND QUERIES.

**Testing and Valuation of Gas Liquors.**—The valuable paper by Mr. T. H. Davis in the *CHEMICAL NEWS*, vol. xxxviii., p. 193, would be complete if he explains what is meant by "normal sulphuric acid" and "normal soda."—SUL. AMM.

## MEETINGS FOR THE WEEK.

THURSDAY, Nov. 7th.—Chemical, 8. "On the Red Colouring Matter of the *Lithospermum Erythrorhizon*," by M. Kuhara. "On the Occurrence of Certain Nitrogen Acids amongst the Products of Combustion of Coal-gas and Hydrogen Flames," by L. T. Wright. "Second Report on Researches on some Points in Chemical Dynamics," by C. R. A. Wright, D.Sc., and A. P. Luff. "On the Constitution of the Olefine Produced by the Action of Zinc on Ethylic Iodide," by Dr. E. Frankland, F.R.S.

## COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

SEPTEMBER, 1878.

The following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Ni- trates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine	Sulphuric An- hydride.	Hardness on Clark's Scale.	
		Saline. Grs.	Organic. Grs.								Before Boiling. Degs.	After Boiling. Degs.
<i>Thames Water Companies.</i>												
Grand Junction .. ..	Clear	0'000	0'011	0'105	0'089	19'80	8'010	0'468	1'08	1'430	13'7	3'30
West Middlesex .. ..	Clear	0'000	0'010	0'105	0'089	19'00	8'400	0'504	1'01	1'300	13'7	3'00
Southwark and Vauxhall	Clear	0'000	0'011	0'105	0'103	18'40	7'530	0'612	0'94	1'300	13'7	3'30
Chelsea .. .. .	Clear	0'000	0'009	0'129	0'042	16'80	7'840	0'504	1'01	1'200	13'2	3'00
Lambeth .. .. .	Slightly turbid	0'000	0'010	0'126	0'096	20'80	8'840	0'612	1'08	1'440	14'3	3'70
<i>Other Companies.</i>												
Kent .. .. .	Clear	0'000	0'001	0'435	0'001	29'90	11'640	1'081	1'74	4'000	20'6	6'50
New River .. .. .	Clear	0'000	0'007	0'150	0'057	19'30	8'730	0'648	1'01	1'000	14'3	3'30
East London .. .. .	Clear	0'000	0'007	0'075	0'053	17'90	7'630	0'684	1'16	1'730	13'2	3'30

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

C. MEYMOTT TIDY, M.B.

## THE QUARTERLY JOURNAL OF SCIENCE.

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

Now ready, No. LX., October, 1878, price 5s.

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- II. The Progress of the Doctrine of Development.
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Index and Title Page to Vol. VIII.  
Notices of Scientific Works, Scientific Notes, &c.

London: 3, Horse-Shoe Court, Ludgate Hill, E.C.

## ORGANIC MATERIA MEDICA.

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Widnes, October, 1878.

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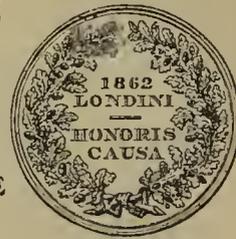
**GEOLOGY.**—In the Preface to the Student's ELEMENTS OF GEOLOGY, by Sir Charles Lyell, price 9s., he says:—"As it is impossible to enable the reader to recognise rocks and minerals at sight by aid of verbal descriptions or figures, he will do well to obtain a well-arranged collection of specimens, such as may be procured from Mr. TENNANT (149, Strand), Teacher of Mineralogy at King's College, London." These Collections are supplied on the following terms, in plain Mahogany Cabinets:—

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CHLORIDE OF SULPHUR,

ACETONE,

CHLOROFORM,

ALDEHYDE,

CHLORATE BARYTA,

ARSENIC ACIDS,

FRUIT ESSENCES FOR CON-  
FECTIONERY & LIQUEURS,

PERCHLORIDE OF IRON,

SULPHITE AND HYPOSUL-  
PHITE OF SODA,

PHOSPHATES OF SODA AND

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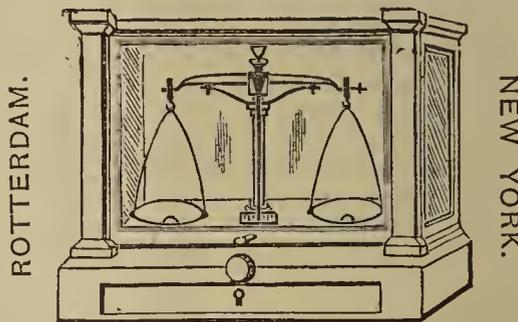
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# THE CHEMICAL NEWS.

VOL. XXXVIII. No. 989.

## ON DECIPIUM: A NEW METAL FROM SAMARSKITE.

By M. DELAFONTAINE.

WHILST prosecuting my researches on the samarskite earths of North Carolina I discovered in them a new metal which I have called Decipium (from *Decipiens*). This metal, which possesses the properties common to those of cerite and gadolinite, forms an oxide, the equivalent of which is approximately 122, its formula being  $DpO$  (or  $Dp_2O_3=366$ ).

I have not yet effected the separation of this new metal from didymia completely enough to affirm that its colour is white. Its salts are colourless; the acetate crystallises very easily, and seems to be less soluble than that of didymium, but more so than that of terbium. The decipio-potassic sulphate is only slightly soluble in a saturated solution of potassic sulphate, but dissolves easily in water.

The nitrate of decipium gives an absorption-spectrum composed of three bands at least, in the indigo and blue. In order to see them well the aid of sunlight is necessary, the best way being to direct the slit of the spectroscopie towards the disc of the sun, interposing a piece of blue glass before the eyepiece. The most refrangible ray is a little narrower than that of philippium and the *m* of didymium. It is rather dark; its middle closely corresponds to the wave-length 416, or to 195 of M. Lecoq's scale. It is nearly in the middle of the space between Fraunhofer's lines G and II, but more nearly approaches G. Neither didymium nor terbium give any ray in this region. The band which characterises terbium is hardly so broad; it is seen more to the right, and is so near to the limit of the spectrum which I obtain with my instrument that an intense solar light is necessary in order to clearly distinguish it. In exceptional conditions of light I have been able to observe the violet space beyond, and to recognise in it two well defined rays, which are probably H and H'.

The second band of decipium is narrower, more intense, and a little indistinct at the edges. It is seen in the less refrangible blue; its middle corresponds very nearly to the wave-length 478. It is nearly in the same place as a band of didymium, but its intensity is incomparably greater. More to the left, and nearer to the limit of the blue and green, there is a rather indistinct minimum of transmission, which may be the result of the overlapping of the two faintly-defined bands. I have not, however, succeeded in separating them. I intend to return to the subject shortly.

In the present state of my knowledge I recognise in the samarskite earths of North Carolina (more or less combined with other earths) the following:—

Name.	Colour.	Equivalent.	Characteristic Absorption-Band.
Ytria .. .. .	White	YO = 74.5 (Delafontaine)	None
Erbia .. .. .	Rose	ErO = 130 (Bunsen, Clève)	520 to 522
Terbia .. .. .	Orange	TbO = 114.115 (Delafont., Marignac)	About 400
Philippia .. ..	Yellow	PpO = about 90 (Delafont.)	" 449
Decipia.. .. .	White?	DpO = about 122 ( " )	416
Thoria .. .. .	White	ThO <sub>2</sub> = 267.5 ( " )	None
Oxide of didymium	Brownish	DiO = 112.114 (Marignac, Clève)	572 to 577
" of cerium..	Pale yellow		None

The equivalents\* of the metals contained in some of

\* This term is employed until the true atomic weights have been accurately determined.

these earths show rather interesting numerical relations to each other:—

Yttrium .. .. .	58
Philippium .. ..	74 or 58 + 2 × 8
Terbium .. .. .	98 or 58 + 5 × 8
Decipium .. .. .	106? or 58 + 6 × 8
Erbium .. .. .	114 or 58 + 7 × 8

If the above metals are considered as triatomic, the difference will be 12, or one of its multiples, instead of 8.—*Comptes Rendus.*

## FURTHER OBSERVATIONS ON THE CHEMICAL AND MECHANICAL TESTS OF CAST-STEELS.

By SERGIUS KERN, M.E., St. Petersburg.

THE author has already remarked in the CHEMICAL NEWS that in many cases a chemical analysis of steel does not show the quality of it as a material for manufacturing purposes. Every steel ingot, after rolling or hammering, must be tested mechanically before being used or brought into the market, for if chemical analyses only are considered very grave misapprehensions may happen. The following Table I. shows the results of testing certain samples of rolled steel plates. Table II. contains the results of the chemical analysis of the same plates. Every analysis represents the average composition, as from every sample of the plate shearings from different parts were collected. The samples which were cut off from the plates for testing them mechanically were not annealed:—

TABLE I.

No. of Specimen.	Breaking Weight; Tons per Square Inch.	Elongation Per Cent.
1	30.83	12.87
2	33.33	14.50
3	31.02	15.87
4	32.52	18.12
5	27.79	13.12
6	31.11	18.75
7	29.33	14.50
8	32.70	16.37
9	33.10	12.00
10	31.02	15.37

All these plates being prepared of mild steel they cannot be called good samples, as these plates were required to have not less than 20 per cent of elongation. The steel as shown in Table II. was of a very good quality, but the working of it was rather inferior, and the steel before rolling required hammering:—

TABLE II.

No. of Specimen.	Carbon. p.c.	Sulphur. p.c.	Phosphorus. p.c.	Silicon. p.c.
1	0.27	0.01	0.03	traces
2	0.23	0.03	0.03	—
3	0.25	0.02	0.04	0.01
4	0.24	0.01	0.02	0.02
5	0.24	0.02	0.03	0.02
6	0.23	0.02	0.05	0.01
7	0.28	0.04	0.02	traces
8	0.25	0.03	0.03	0.01
9	0.24	0.03	0.04	0.01
10	0.23	0.01	0.02	0.03

Copper was absent in all the samples. The amount of manganese was 0.10 to 0.15 per cent. Pig-irons of the best qualities were used for the preparation of the steels.

These two tables require no comment, but they may show that at present it would be rather better for buyers first to obtain information on the mechanical qualities of

steels, viz., the breaking weight and the percentage of elongation. Bad materials cannot yield a fair product, but good raw steel, if carelessly worked, may easily give a bad product, the quality of which may be seen at a glance, not by chemical analysis but by the mechanical tests.

M. Grüner, at the meeting of the Société Minérale, at St. Etienne (October 6, 1877), proposed a very good, practical, and simple method, which consists in stamping on every steel plate or forged ingot the resistance (breaking load in kilograms. per square millimetre) and the percentage of elongation. It must be remarked that several English firms have for some time past been using such a system, which certainly deserves more general employment.

## OZONE AND THE ATMOSPHERE.\*

By ALBERT R. LEEDS Ph.D.

In a paper entitled "Recent Progress in Sanitary Science,"† I endeavoured to give a short *resumé* of the labours of European physicists upon the estimation of atmospheric oxygen and ozone. I had been unable to find a published analysis of the atmosphere at any locality in the United States, all our knowledge upon the composition of the atmosphere being derived from foreign sources. Moreover, few systematic observations upon ozone had been prosecuted, or, if carried on, had rarely been published.

In making the oxygen estimations, Bunsen's methods were in most respects implicitly followed. The eudiometers employed were graduated by ourselves with great care. A gas-room was fitted up, in which the thermometric readings rarely varied more than one-half a degree during the periods of observation. The flasks employed to collect samples were of thin glass, 2½ c.m. in diameter, 20 c.m. long, drawn out at one end into a tube about 15 c.m. in length. After cleansing and drying, a pellet of pure potassic hydrate was introduced, and the tube sealed at a point about one-third from its extremity. When a sample was taken, the end of this tube was broken off with the aid of a file, the diameter of the tube near the flask narrowed down by heating in a lamp, the air in the interior completely changed by aspiration through a fine tube introduced until it nearly reached the bottom of the flask, which was then sealed with the flame. During the summer of 1876, numerous specimens of air were collected at Hoboken and vicinity, at the Centennial Exhibition, Philadelphia, and upon various mountain tops and in many valleys of the Adirondacks, New York State. The temperature, barometer, wind, &c., were noted at the same time, although these meteorological data are not of much importance, except as part of a connected and simultaneous series of observations, conducted with a view of establishing a chemical climatology of the United States. At present, what is done in this direction can be looked upon merely as the beginning of a study which will hereafter yield results of value to the agriculturist, the medical practitioner, and the physicist. Suitable equipment of our observatories, so that they may yield not merely the meteorological, but also the requisite chemical data, is essential to advance in climatology. The table in next column contains some of the most interesting of the determinations heretofore made.

### Atmospheric Ozone.

In order to obtain some knowledge of the character of the results arrived at in testing for atmospheric ozone according to customary methods, I prepared a number of ozoscopic papers, with pure materials, after the formula of Osann, and during the summers of the years 1876 and

Table of the Percentage of Oxygen contained in the Atmosphere at Various Localities in the United States, 1876.

Locality.	Date.	Per cent.
Stevens Institute of Technology .. .. .	July 4, 12 m.	20·957
Ditto ditto ditto	Aug. 2, 1.20 p.m.	20·957
Ditto ditto ditto	Aug. 11, 1 p.m.	20·821
Ditto ditto ditto	Aug. 11, (duplicate)	20·843
Ditto ditto ditto	Aug. 29	20·954
Ditto ditto ditto	Aug. 30, 9.30 a.m.	20·934
Ditto ditto ditto	Aug. 31, 5.20 p.m.	20·942
Ditto ditto ditto	Sept. 1, 10.30 a.m.	20·952
Ditto ditto ditto	Sept. 1, (duplicate)	20·957
Ditto ditto ditto	Sept. 7, 10 a.m.	20·932
Ditto ditto ditto	Sept. 7, (duplicate)	20·944
Horticultural Hall, Centennial.. .. .	Aug. 15, 3.40 p.m.	20·964
Machinery Hall, ditto ..	Aug. 21, 5.15 p.m.	20·937
Main Building, ditto ..	Aug. 18, 4 p.m.	20·868
Agricultural Hall, ditto..	Aug. 22, 3 p.m.	20·857
U.S. Building, ditto ..	Aug. 16, 4 p.m.	20·878
Centennial Grounds, do.	Aug. 15, 6 p.m.	20·962
Ditto ditto do.	Aug. 18, 6 p.m.	20·918
Stevens Institute of Technology .. .. .	Sept. 26, 10 a.m.	20·915
Keene Flats, Adirondacks	July 17	21·029
Mt. Marcy, summit of ..	July 21, 3 p.m.	20·928
Ditto ditto ..	July 21, (duplicate)	20·926

1877 in the Adirondacks, and during the rest of this period, in Hoboken, made regular observations. At Hoboken the results were negative, an ozone reaction being obtained on rare occasions only, and then in the most feeble and undecided manner. On the contrary, in Keene Flats, N.Y., the days were few in which the ozonoscopes were unaltered; usually they were decidedly affected, and sometimes to a degree most striking. The point in the Keene Flats, where the observations were conducted, was about 700 feet above sea-level, the surrounding vegetation mostly deciduous, the population and dwellings, though scanty, not inconsiderable. Even more interesting were the results during the following summer, 1877, at a point near the upper end of Upper Saranac Lake. This was located at a much higher altitude than the foregoing, entirely isolated by miles of primitive forest from any other dwellings. The woods abounded in hemlocks, pines, larches, spruces, and were often redolent with odours of the balsam. Owing to a supposed virtue in these resinous-smelling woods, large numbers of patients, especially those suffering from pulmonary diseases, are sent by the physicians of New York and other large cities to this portion of the Adirondacks. Bearing in mind that the beneficial effects are supposed to be due entirely to the atmosphere—not to any mineral waters, or peculiarities of regimen, exercise, or occupation—one of these sanitariums, like that on St. Regis Lake, would afford an opportunity of testing some disputed points concerning the effects of a varying constitution of the atmosphere on different diseases.

Certainly the intelligent selection of an appropriate sanitarium is a duty frequently devolving upon the physician, but one which at the present time he can in many cases only imperfectly perform from the lack of positive knowledge. Vague impressions or reports can never take the place of atmospheric analysis; they bear a similar relation to it with that which the ancient foretelling of the weather does to the present signal service reports. It is to be hoped that the time is not far distant when the Government may think it important to do as much for public hygiene as for commerce and agriculture.

Although in the light of subsequent experiments little value, I think, can be attached to the following ozone observations, yet as illustrative of the variations in the amount of the so-called ozonic reaction, and of the apparent lack of connection between it and other meteorological phenomena, the accompanying table may be of interest:—

\* From proof sheets of the *Annals of the N.Y. Academy of Sciences*, furnished by the Author.  
† *Annals of the Lyceum of Natural History, N.Y.*, vol. xi., November, 1876

Register of Ozone Observations made at Upper Saranac Lake, Northern New York; Altitude 1600 feet above the Sea. Times of Observation, 7 a.m. and 7 p.m. Season, Summer of 1877. Scale of 10.

Date.	Ozone.	Thermometer.	Barometer.	Weather.			Remarks.
				Wind.	Rain.	Clouds.	
July 17	5	74°	27.900	S.	Heavy		Considerable lightning
" 18	2	70	28.000	S.	—		
" 19	2	71	27.675	N.E.—S.W.	Much		Great rain at night and lightning
" 20	—	70	28.850	S.W.	—	Cirrus	Air very clear; rain at a distance
" 21	2.5	73	27.900	S.W.	—	Cum. (1)	
" 21	2	62	28.000	S.W.	—	Cum. (6)	
" 21	1	64	28.150	S.W.	—	Cum. (1)	Very pleasant day
" 22	0	67	28.275	S.W.	—	Cum. (1)	Great cumulous clouds
" 22	0	72	53.275	S.W.	—	Cum. (1)	Little air, not bracing
" 23	1	68	28.350	S.W.	—	Nimb. (7)	" " "
" 23	0	72	20.275	S.W.	—	Cum. (3)	
" 24	1	66	28.300	S.	—	Cirrus (5)	
" 24	1	—	—	—	—	Cum. (1)	
" 25	0	68	—	—	—	Cum. (1)	
" 25	1	80	28.100	—	—	Cum. (2)	
" 26	1	71	28.000	S.W.	—	Stratus (3)	
" 26	3	—	28.925	S.W.	—	" (1)	
" 27	0	72	28.125	S.W.	—	" (5)	Heavy rain at night, and lightning
" 27	1	80	28.150	S.W.	Rain	Nimb. (10)	—in morning cool and refreshing
" 28	5	72	28.100	S.W.	—	" (10)	
" 28	1	—	28.050	—	Rain	Nimb.	
" 29	1	72	28.000	—	Rain	Cum. (2)	
" 29	1	76	27.925	—	Rain	Nimb. (10)	
" 30	3	—	—	N.	—	Cum.	
" 30	3	78	28.075	N.	—	Cum.	Very bright
" 31	0	64	28.200	S.W.	—	Clear (0)	Exhilarating
" 31	6	72	28.250	N.	—	Clear (0)	
Aug. 1	5	66	28.325	Calm	—	Clear (0)	No air stirring
" 1	4	75	28.275	S.	—	Clear (0)	Exhilarating
" 2	3	68	28.250	S.W.	—	Stratus (1)	
" 2	4.5	72	28.100	S.	—	" (3)	" Mackerel-sky."
" 3	4.5	66	28.025	S.	—	" (10)	
" 3	2	72	27.925	S.W.	—	Cum. (1)	Clear and bright
" 4	4	64	28.025	N.	—	Cum. (3)	Wind-storm at night
" 4	2.3	66	28.000	N.	—	Cum. (5)	Wind-storm in afternoon
" 5	2	62	27.950	S.	—	Cum. (1)	{ Opposing air-currents producing
" 5	3	64	27.950	S.	—	Nimb. (10)	{ five storms.
" 6	2	61	27.925	N.	—	Cum. (1)	Brilliant atmosphere
" 6	1.2	66	27.900	N.	—	Stratus (9)	Bright
" 7	7	63	27.800	S.	—	Nimb. (10)	Heavy rain at night
" 7	6	72	27.800	S.	—	Stratus (7)	Shifting clouds
" 8	7	70	27.825	Calm	—	Clear (0)	{ Heavy rain and thunder during
" 8	7	70	27.825	N.E.	Much	Cum. (5)	{ day
" 9	1	72	27.825	S.W.	—	Fog (10)	Haze (smoke)
" 9	3	74	27.775	S.W.	—	Cum. (5)	Dull
" 10	3	72	27.800	S.W.	Rain	Cum. (1)	Haze. Little air
" 10	1.2	65	27.350	S.W.	—	Cum. (2)	
" 11	1	65	27.975	S.W.	—	Stratus (10)	
" 11	1	67	28.075	S.W.	—	Nimb. (4)	Thunderstorms.
" 12	0	68	28.050	S.	—	Clear (0)	Starlight night
" 12	2	65	27.950	S.W.	Much	Nimb. (10)	Opposing winds
" 13	1	68	27.950	S.W.	Much	Nimb. (10)	
" 13	2	70	28.000	N.E.	—	Nimb. (9)	
" 14	1	—	27.925	Calm	—	Mist (5)	Heavy rain at night
" 14	1	65	27.900	W.	Rain	Nimb. (10)	
" 15	1	67	27.925	S.W.	Rain	Cum. (10)	
" 15	—	67	27.900	N.E.	Rain	Nimb. (10)	
" 16	5	64	27.875	Calm	Rain	Cum. (10)	
" 16	1	66	27.850	N.E.	Rain	Nimb. (5)	

(To be continued.)

NOTES FROM THE PARIS EXHIBITION.

ENGLISH AWARDS IN THE SCIENCE SECTION.

GROUP II., CLASS 15.

Mathematical and Philosophical Instruments.

Gold Medals.—J. H. Dallmeyer; H. Grubb; A. Lége and Co.; Negretti and Zambra; T. Ross and Co.; Sir William Thomson.

Silver Medals.—H. Crouch; Horne and Thornthwaite M. Pillischer; J. Swift; S. Tisley and Co.

Bronze Medals.—E. Cetti and Co.; Dollond and Co.

Honourable Mentions.—F. Darton and Co.; A. E. Thomas.

GROUP V., CLASS 43.

Mining and Metallurgy.

Grand Prizes.—Sir J. Brown and Co.; C. Cammell and Co.; Johnson, Matthey, and Co.; Sir Joseph Whitworth and Co.

*Diploma of Honour.*—North of England Manufacturers' Association; Iron Masters' Association of Cleveland.

*Gold Medals.*—E. P. and M. Baldwin; W. Bartleet and Sons; Burys and Co.; Broughton Copper Co.; Brown, Bayley, and Dixon; Elkington and Co.; Earl Granville and Shelton Iron Co.; Hadfield Steel Foundry Co.; Harrison, Ainslie, and Co.; Hopkins Gilkes; W. Jessop and Sons; Landore-Siemens Steel Co.; Leeds Forge Co.; Lilleshall and Snedshill Iron Co.; Nettlefolds; Patent Plumbago Crucible Co.; G. H. Ramsay; Seebohm and Dieckstahl; Turton, Thomas, and Sons; West Cumberland Iron and Steel Co.; The Wigan Coal and Iron Co.

*Silver Medals.*—F. S. Barff; Barnard, Bishop, and Barnard; J. Bedford and Sons; F. Braby and Co.; J. B. Brown and Co.; Cambrian Patent Fuel Co.; G. Chambers and Co.; T. and C. Clark and Co.; Devon Great Consols Co.; Doulton and Co.; J. Dunnachie; A. Everitt and Son; W. D. Houghton; Jonas, Meyer, and Colver; A. Kenrich and Sons; Leach, Flower, and Co.; E. Morewood and Co.; R. S. Newall; E. Packard and Co.; Patent Nut and Bolt Co.; J. Russell and Co.; Ryhope Coal Co.; F. Smith and Co.; J. R. Spencer and Son; H. H. Vivian and Co.; H. Wiggin and Co.; P. Wright and Sons.

*Bronze Medals.*—J. H. Andrew and Co.; T. Bennett and Sons; Boulton and Paul; Colver Brothers; J. Corbett; Diamond Fuel Co.; T. Francis and Co.; Graigola Merthyr Co.; N. Greening and Co.; Hatton, Sons, and Co.; T. Higgin; Hill and Smith; T. Jowitt and Sons; Kirby, Beard, and Co.; London and South Wales Coal Co.; Marquis of Londonderry; H. Milward and Sons; J. Shaw; South Derwent Colliery Co.; J. R. Spencer and Son; Tayler and Co.; G. Thomas and Sons; R. W. Winfield and Co.; C. Wood.

*Honourable Mention.*—J. B. Addis and Sons; Ash and Lacy; Avery, William, and Son; Buckinsham Mining Co.; E. Burell; Burnhope Coal Co.; J. Cliff and Sons; Cooke Brothers; Cramlington Coal Co.; E. Evans; D. and H. C. Evans; Great Western Colliery Co.; E. J. Hattersley and Co.; Hayes, Crossley, and Co.; Macdonald, Field, and Co.; E. Major and Co.; J. Marston; J. C. Montgomerie; Nicholson; Palmer, Morgan, and Co.; Phosphor Bronze Co.; Read, Jefferson; W. Smith and Sons; W. Spencer and Co.; Derwent Colliery Co.; Star Manufacturing Co.; Thircutt and Bale; Tweddle, McLaren, and Co.; A. Tylor and Co.; Warrington Wire Rope Works; W. B. Wright and Co.

#### GROUP V., CLASS 47.

##### *Chemical and Pharmaceutical Products.*

(Additional names omitted from list published in the CHEMICAL NEWS, October 25.)

*Grand Prizes.*—Solway and Co.; Walter Weldon.

*Gold Medal.*—Mackintosh and Co.

*Silver Medals.*—Atkinson and Co.; G. Schweppe and Co.

*Bronze Medals.*—Bewley and Draper; J. Basisto; W. Corry and Co.; J. Green; H. and T. Kirby and Co.; G. Morse and Co.; Southall Brothers and Barclay; D. S. Sorer and Sons.

#### GROUP VI., CLASS 65.

##### *Telegraphy.*

*Grand Prize.*—A. G. Bell.

*Gold Medals.*—Siemens Brothers; M. Stroh; British Telegraph Manufactory; Telegraph Construction and Maintenance Co.

*Silver Medal.*—British Telegraph Manufactory.

*Bronze Medals.*—A. Jamieson; C. E. Zimdars.

*Honourable Mentions.*—Patent Nut and Bolt Co.; S. A. Varley.

#### GROUP II., CLASS 14.

*Silver Medals.*—G. Cheavin; J. Gray and Co.; T. Le-male and Co.; Mayer and Meltzer.

*Bronze Medals.*—Peyton and Peyton; J. H. Porter; F. C. Rein; J. Ward; R. R. Whitehead and Brothers.

*Honourable Mentions.*—T. Allen; T. Longdon and Co.; Mrs. Rein.

H. C.

### MANUFACTURE OF RESORCIN, EOSIN, AND OTHER DERIVATIVES OF RESORCIN.

By MM. BINDSCHEDLER and BUSCH.

THE authors give an account of the recent improvements in the manufacture of these colours.

1. *Resorcin.*—Into a cast-iron apparatus, fitted with an agitator and a leaden cohobator, are poured 90 kilos. of fuming sulphuric acid at 80° B., and 24 kilos. of pure benzol are allowed to flow in through the cohobator in a slender stream, stirring continually. The mass gradually becomes hot, the vapours being condensed in the cohobator falling back. In two or three hours the entire quantity of benzol will have become converted into sulpho-benzolic acid. After having removed the cohobator and connected the cover of the apparatus with a distillation-worm, the contents are gradually heated again, raising the temperature to 275°, when the sulpho-benzolic acid is converted into disulpho-benzolic, and along with water there distils a little benzol which has escaped the reaction. At this temperature the whole is maintained for about twenty minutes. It is then allowed to cool, and thrown into about 2000 litres of cold water. It is heated to boiling, and exactly neutralised with milk of lime. The whole of the matter is then passed through a filter-press which retains the sulphate of lime. The colourless effluent contains all the disulpho-benzolic acid as a salt of lime. This is then transformed into a soda-salt by adding the equivalent quantity of carbonate of soda. The resulting mass is again passed through a filter-press which retains carbonate of lime, whilst the effluent liquid is evaporated to perfect dryness. Of this product 60 kilos. are placed in a cast-iron boiler in which 150 kilos. of caustic soda, at 76°, have previously been dissolved in a little water. The whole is heated for eight or nine hours to 270°, stirring constantly, the mass in this time having become almost solid. It is let cool, dissolved in about 500 litres of boiling water, and a certain quantity of hydrochloric acid is added, keeping the liquid at a boil, so that the sulphurous acid formed may escape. The liquid, rendered slightly acid, deposits a little tarry matter. When perfectly cold it is carefully filtered and introduced into an extraction apparatus. This is composed of large copper cylinders containing 250 litres, and all fitted with agitators. These are entirely filled with the liquid to be extracted, and a current of ethylic ether is passed very slowly through them, keeping up a gentle agitation. The ether in its passage becomes saturated with resorcin, and is received in this state in stills, where it is distilled as it enters. This distilled ether is passed again and again through the liquid till entirely exhausted. In the stills the resorcin is found as a colourless liquid, which on cooling congeals to a crystalline mass. To expel the last traces of ether and of water it is heated to 215°, in vessels lined with enamel. The residue when cold forms the commercial product, containing 92 to 94 per cent of pure resorcin, a little phenol, and leaves on distillation about 5 per cent of tarry matter. In this process the water passes over first, then the phenol, and lastly resorcin almost chemically pure. On proceeding as above directed the yield obtained is almost theoretical.

2. *Fluorescein.*—Fluorescein is obtained by fusing 100 parts of resorcin with 75 parts of phthalic anhydride. The mixture is heated to 210° for an hour, let cool, and finely ground. No purification is needed.

3. *Yellowish Eosin,* soluble in water.—Tetrabrom-fluorescein-sodium.—One kilo. of fluorescein, finely pow-

dered, is stirred up in 10 litres of alcohol; 1.100 kilos. of bromine are then added very slowly, in a slender stream, stirring continuously. All the fluorescein which is already partially bromised is now in solution. A further portion of 1.100 kilos. of bromine is now very cautiously added; each drop which falls forms a crystalline precipitate of tetrabrom-fluorescein. The whole is then left to settle for some hours, and decanted. The crystalline deposit is washed first with a little alcohol to expel the mother-liquor, then with water until completely neutral. It is now stirred up in hot water and carefully saturated with caustic soda, taking care not to render the liquid alkaline. On evaporating this solution tetrabrom-fluorescein-sodium is obtained in a crystalline powder.

4. *Bluish Eosin*, soluble in water.—Tetra-iod-fluorescein-sodium.—Fluorescein is dissolved in alkaline water, and the needful quantity of iodine is added, previously dissolved in dilute soda-lye. The fluorescein and the iodine are then set at liberty by the addition of any acid, and combine instantly, forming a crystalline precipitate of tetra-iod-fluorescein, which is dissolved in dilute caustic soda and evaporated, when it forms the commercial product. An aqueous solution of tetra-iodo-fluorescein does not display the least trace of fluorescence.

5. *Safrosin*, soluble in water.—This is a compound of soda with the bromo- and nitro-derivative of fluorescein, and is manufactured as follows:—9 kilos. of tetrabrom-fluorescein are dissolved in alkaline water, adding 8 kilos. nitrate of soda. The mixture is heated to a boil, and 15 kilos. of sulphuric acid at 66° B. are added. The precipitate is gradually decolourised, and forms a flocculent mass of the colour of manganese sulphide. It is filtered, washed, dissolved in weak caustic soda, and evaporated. It dyes wool a red much more intense and more bluish than does tetrabrom-fluorescein, and if mixed with naphthal (naphthaline?) orange may form an advantageous substitute for cochineal.

6. *Eosin*, soluble in alcohol.—This eosin yields shades much more "bloomy" and more solid than the eosins soluble in water. The methylic derivative of tetrabrom-fluorescein has a tone rather more yellowish than the ethylic. We mix 5 kilos. of tetrabrom-fluorescein with 10 litres of pure methylic alcohol and 9 kilos. of sulphuric acid at 66° B. These materials are heated in a cohobator placed in the water-bath for four hours, and are then poured into a large quantity of cold water, filtered, washed, and the precipitate converted into a potassium-salt, a compound of the methyl-derivative of tetrabrom-fluorescein. This product, when dried, dissolves readily in a mixture of equal parts of water and alcohol. The solution displays a splendid fluorescence.

7. *Resorcin Blue*.—A new derivative of resorcin is a blue, finely dichroic, which gives upon silks a reddish blue shade, beautifully fluorescent.—*Abstracted from Moniteur Scientifique.*

LECTURE EXPERIMENT  
SHOWING THE  
COMBUSTION OF OXYGEN IN AMMONIA.

By N. T. LUPTON.

A MODIFICATION of the well-known experiment for showing the oxidation of ammonia by means of a coil of platinum wire, furnishes a fine lecture experiment, in which oxygen is made to burn in ammonia with a continuous flame. In the experiment as usually described, a coil of heated platinum wire is suspended in a flask containing a small quantity of a strong solution of ammonia. The wire continues to glow in consequence of the oxidation of the ammonia, nitrite of ammonia being formed. By passing a small tube delivering oxygen to the bottom of the flask

the platinum will become intensely heated and a slight explosion will ensue. Bloxam says—"By regulating the stream of oxygen, the bubbles of that gas may be made to burn as they pass through the ammonia at the bottom of the flask." The modification I have made is to allow the end of the tube delivering oxygen from a gas-holder to be about one inch above the surface of the solution of ammonia, and the oxygen as it issues will burn gently in the atmosphere of ammonia by which it is surrounded. The platinum coil must be removed from the flask as soon as the flame surrounds the end of the tube conveying oxygen. It requires some care in regulating the flow of oxygen, but when properly adjusted the flame is as distinct and continuous as that from a jet of any combustible gas.

Vanderbilt University,  
October 15, 1878.

A TABLE OF OXIDATIONS AND REDUCTIONS.

By HENRY B. PARSONS.

THE table appended shows the action of the principal inorganic acids upon each other, and requires but little explanation. (See next page.)

The reactions embraced in this table are many of them quite complicated, and difficult to remember; also there are many that are not definitely stated in English or American text-books or dictionaries of chemistry. The works most frequently referred to are Gmelin's "Handbook of Chemistry," Watts's "Dictionary of Chemistry," and Douglass and Prescott's "Qualitative Chemical Analysis," second edition. I have also been greatly assisted in this compilation by notes on "Oxidising and Reducing Agents," given to the Pharmacy Classes of 1876-7, by Otis C. Johnson, Instructor in Qualitative Analysis, in this University.

Many of the reactions have been verified by myself, and I have experimented in some cases where I have been unable to find definite authority.

To find the products of the action of one acid upon another, find the name of one of the acids in the column on the left, and follow the line through to the column designated by the name of the other acid. Then find the name of the second acid in the column on the left, and follow its line through to the column designated by the name of the first acid.

The products of the decomposition of both acids will thus be found, and the equation may be balanced in the usual way.

For example let us find the action of nitric acid on iodine. Find the word *Nitric* in the column on the left marked "Acids, &c.," and follow its line through to the column marked *Iodine*. We find that the iodine is changed to iodic acid ( $\text{HIO}_3$ ), but not rapidly, as shown by footnote.

Now, to ascertain what becomes of the nitric acid, we find the word *Iodine*, in the column on the left, and trace its line to the column marked *Nitric*. The nitric acid is changed to nitric oxide (NO). The reaction may then be written as follows:—



The table shows the action in neutral or acid solutions, unless otherwise stated.

Because of the frequent use of ferrous and stannous salts as reducing agents, and ferric salts as oxidising agents, I have placed them in the table also.

The author has devoted his spare hours, for nearly a year, to the work of compiling and revising this table, and in doing original work upon it, and now presents it with the hope that it may prove of some use to students pursuing the study of oxidising and reducing agents.

Chemical Laboratory,  
University of Michigan.

## TABLE OF OXIDATIONS

Acids, &c.	Oxalic.	Nitrous.	Nitric.	Hydrosulphuric.	Thiosulphuric.	Sulphurous.	Sulphuric.
Oxalic .. .. .	0	NO	NO	0	0	0	0
Nitrous .. .. .	H <sub>2</sub> O+CO <sub>2</sub>	0	0	S	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Nitric .. .. .	H <sub>2</sub> O+CO <sub>2</sub>	0	0	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	S+H <sub>2</sub> SO <sub>3</sub> , H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Hydrosulphuric..	0	NO or NH <sub>4</sub> NO <sub>3</sub>	NO	0	0	S+H <sub>2</sub> S <sub>5</sub> O <sub>6</sub>	S+H <sub>2</sub> SO <sub>3</sub>
Thiosulphuric ..	0	NO	NO	0	0	0	0
Sulphurous.. ..	0	NO	NO	S+H <sub>2</sub> S <sub>5</sub> O <sub>6</sub>	0	0	0
Sulphuric .. ..	H <sub>2</sub> O+CO <sub>2</sub> +CO	NO+HNO <sub>3</sub>	0	S+H <sub>2</sub> SO <sub>3</sub> †	S+H <sub>2</sub> SO <sub>3</sub>	0	0
Sulphocyanic ..	0	NO	NO	0	0	0	0
Hydroferrocyanic	0	NO	NO	0	0	0	0
Hydroferricyanic	0	H <sub>2</sub> Fe''(NO)'Cy <sub>5</sub>	H <sub>2</sub> Fe''(NO)'Cy <sub>5</sub>	S	H <sub>2</sub> SO <sub>4</sub>	II <sub>2</sub> SO <sub>4</sub>	0
Chlorine .. .. .	CO <sub>2</sub>	HNO <sub>3</sub>	0	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> S <sub>4</sub> O <sub>6</sub> , H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Hydrochloric ..	0	0	NOCl <sub>2</sub> +Cl	0	S+H <sub>2</sub> SO <sub>3</sub>	0	0
Hypochlorous ..	H <sub>2</sub> O+CO <sub>2</sub>	HNO <sub>3</sub>	0	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Chloric .. .. .	H <sub>2</sub> O+CO <sub>2</sub>	HNO <sub>3</sub>	0	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Bromine .. .. .	CO <sub>2</sub>	HNO <sub>3</sub>	0	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Hydrobromic ..	0	0	NO	0	0	0	H <sub>2</sub> SO <sub>3</sub>
Bromic .. .. .	H <sub>2</sub> O+CO <sub>2</sub>	HNO <sub>3</sub>	0	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Iodine .. .. .	CO <sub>2</sub>	0	NO	S	H <sub>2</sub> S <sub>4</sub> O <sub>6</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Hydriodic .. ..	0	NO	NO	0	0	0	H <sub>2</sub> SO <sub>3</sub>
Iodic .. .. .	H <sub>2</sub> O+CO <sub>2</sub>	HNO <sub>3</sub>	0	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Hypophosphorous	0	NO	NO	0	0	0	0
Chromic .. .. .	H <sub>2</sub> O+CO <sub>2</sub>	HNO <sub>3</sub>	0	S <sub>11</sub> H <sub>2</sub> SO <sub>3</sub> §	S+H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0
Permanganic ..	H <sub>2</sub> O+CO <sub>2</sub>	HNO <sub>3</sub>	0	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub> †	H <sub>2</sub> SO <sub>4</sub>	0
Arsenious .. ..	0	NO	NO or HNO <sub>2</sub>	0	0	0	0
Arsenic .. .. .	H <sub>2</sub> O+CO <sub>2</sub>	0	0	S	S <sub>11</sub> H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	0

Acids, &c.	Bromine.	Hydrobromic.	Bromic.	Iodine.	Hydriodic.	Iodic.	Hypophosphors
Oxalic .. .. .	HBr	0	Br <sub>11</sub> HBr	HI	0	I <sub>11</sub> HI	0
Nitrous .. .. .	HBr	0	Br <sub>11</sub>	0	I	I	II <sub>3</sub> PO <sub>4</sub>
Nitric .. .. .	0	Br	Br+O†	HIO <sub>3</sub> *	I <sub>11</sub> HIO <sub>3</sub>	0	II <sub>3</sub> PO <sub>4</sub>
Hydrosulphuric..	HBr	0	Br <sub>11</sub> HBr	HI	0	I <sub>11</sub> HI	0
Thiosulphuric ..	HBr	0	Br <sub>11</sub> HBr	HI	0	I <sub>11</sub> HI	0
Sulphurous.. ..	HBr	0	Br <sub>11</sub> HBr	HI	0	I <sub>11</sub> HI	0
Sulphuric .. ..	0	Br	Br+O†	0	I	0	H <sub>3</sub> PO <sub>4</sub> *
Sulphocyanic ..	HBr	0	Br <sub>11</sub> HBr	HI	0	I <sub>11</sub> HI	0
Hydroferrocyanic	HBr	0	Br <sub>11</sub> HBr	HI	0	I <sub>11</sub> HI	0
Hydroferricyanic	0	0	0	0	I	0	H <sub>3</sub> PO <sub>4</sub>
Chlorine .. .. .	0	Br	0	ICl <sub>3</sub> , HIO <sub>4</sub>	I <sub>11</sub> HIO <sub>4</sub>	HIO <sub>4</sub>	H <sub>3</sub> PO <sub>4</sub>
Hydrochloric ..	0	0	BrCl <sub>5</sub> ÷Br	0	0	ICl <sub>3</sub>	0
Hypochlorous ..	HBrO <sub>3</sub>	Br <sub>11</sub> HBrO <sub>3</sub>	0	HIO <sub>3</sub> , HIO <sub>4</sub>	I <sub>11</sub> HIO <sub>4</sub>	HIO <sub>4</sub>	H <sub>3</sub> PO <sub>4</sub>
Chloric .. .. .	0	Br	0	HIO <sub>3</sub>	I <sub>11</sub> HIO <sub>3</sub>	0	H <sub>3</sub> PO <sub>4</sub>
Bromine .. .. .	0	0	0	HIO <sub>3</sub> *§	I	0	H <sub>3</sub> PO <sub>4</sub>
Hydrobromic ..	0	0	Br	0	0	I	0
Bromic .. .. .	0	Br	0	HIO <sub>3</sub>	I	HIO <sub>4</sub>	H <sub>3</sub> PO <sub>4</sub>
Iodine .. .. .	HBr*§	0	Br	0	0	0	H <sub>3</sub> PO <sub>4</sub>
Hydriodic .. ..	HBr	0	HBr	0	0	I	0
Iodic .. .. .	0	Br	Br	0	I	0	H <sub>3</sub> PO <sub>4</sub>
Hypophosphorous	HFr	0	HBr	HI	0	I <sub>11</sub> HI	0
Chromic .. .. .	HBr  §	Br	0	HIO <sub>3</sub>   §	I	0	H <sub>3</sub> PO <sub>4</sub> §
Permanganic ..	HBrO <sub>3</sub> †	Br <sub>11</sub> HBrO <sub>3</sub>	0	HIO <sub>3</sub>	I <sub>11</sub> HIO <sub>3</sub>	0	H <sub>3</sub> PO <sub>4</sub>
Arsenious .. ..	HBr	0	Br <sub>11</sub> HBr	HI	0	I <sub>11</sub> HI	0
Arsenic .. .. .	0	0	0	HIO <sub>3</sub>	I <sub>11</sub> HIO <sub>3</sub>	0	H <sub>3</sub> PO <sub>4</sub>

\* Action slow and incomplete; not likely to occur in ordinary work.

† Gmelin's "Handbook of Chemistry."

‡ In alkaline solutions.

AND REDUCTIONS.

Sulphoc anic.	Hydroferrocyanic.	Hydroferricyanic.	Chlorine.	Hydrochloric.	Hypochlorous.	Chloric.
0	0	0	HCl	0	HCl	HCl
HCy + H <sub>2</sub> SO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	H <sub>2</sub> Fe''(NO)'Cy <sub>5</sub>	HCl	0	HCl	HCl
HCy <sub>3</sub> S <sub>3</sub> , HCy + H <sub>2</sub> SO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	H <sub>2</sub> Fe''(NO)'Cy <sub>5</sub>	0	NOCl <sub>2</sub> + Cl	0	HClO <sub>4</sub> + Cl + O
0	0	H <sub>4</sub> (FeCy <sub>6</sub> )	HCl	0	HCl	HCl
0	0	H <sub>4</sub> (FeCy <sub>6</sub> )	HCl	0	HCl	Cl <sub>2</sub> , HCl
0	0	H <sub>4</sub> (FeCy <sub>6</sub> )	HCl	0	HCl	Cl <sub>2</sub> , HCl
(HCy) <sub>2</sub> S <sub>3</sub>	HCy + K <sub>2</sub> Fe''(FeCy <sub>6</sub> )	0	0	0	Cl	HClO <sub>4</sub> + Cl <sub>2</sub> O <sub>4</sub>
0	0	0	HCl	0	HCl	HCl
0	0	0	HCl	0	HCl	HCl
0	0	0	HCl	0	0	0
HCy <sub>3</sub> S <sub>3</sub> , HCy + H <sub>2</sub> SO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	(Fe <sub>4</sub> '''Fe <sub>3</sub> '')(FeCy <sub>6</sub> ) <sub>6</sub> '''**	0	0	0	0
(HCy) <sub>2</sub> S <sub>3</sub>	0	0	0	0	Cl	Cl <sub>2</sub> O <sub>4</sub> + Cl
HCy + H <sub>2</sub> SO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	0	0	H <sub>2</sub> O + Cl	0	0
HCy + H <sub>2</sub> SO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	0	0	Cl or Cl <sub>2</sub> O <sub>4</sub>	0	0
HCy + H <sub>2</sub> SO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	0	0	0	Cl <sub>2</sub> , HCl	0
0	0	0	HCl	0	HCl	Cl <sub>2</sub> , HCl
HCy + H <sub>2</sub> SO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	0	0	0	0	0
HCy + H <sub>2</sub> SO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	0	HCl	0	Cl <sub>2</sub> , HCl	Cl <sub>2</sub> , HCl
0	0	H <sub>4</sub> (FeCy <sub>6</sub> )	HCl	0	HCl	HCl
HCy + H <sub>2</sub> SO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	0	0	Cl	HCl	0
0	0	H <sub>4</sub> (FeCy <sub>6</sub> )	HCl	0	HCl	HCl
HCy + H <sub>2</sub> SO <sub>4</sub> §	H <sub>3</sub> (FeCy <sub>6</sub> )	0	0	Cl or Cl <sub>2</sub> O <sub>4</sub>	0	Cl or Cl <sub>2</sub> O <sub>4</sub> §
HCy + H <sub>2</sub> CO <sub>4</sub>	H <sub>3</sub> (FeCy <sub>6</sub> )	0	0	Cl	0	0
0	0	0	HCl	0	Cl <sub>2</sub> , HCl	Cl <sub>2</sub> , HCl
HCy + H <sub>2</sub> SO <sub>4</sub>	0	0	0	Cl	0	0

Chromic.	Pernanganic.‡	Arsenious.	Arsenic.	Ferrousto Ferric.	Ferric to Ferrous.	Stannous to Stannic
Cr <sub>2</sub> O <sub>3</sub>	MnO	0	H <sub>3</sub> AsO <sub>3</sub>	0	H <sub>2</sub> O + CO <sub>2</sub>	0
Cr <sub>2</sub> O <sub>3</sub>	MnO	0	0	NO	0	NO or NH <sub>4</sub> NO <sub>3</sub>
0	0	H <sub>3</sub> AsO <sub>4</sub>	0	NO	0	NO or NH <sub>4</sub> NO <sub>3</sub>
Cr <sub>2</sub> O <sub>3</sub>	MnO	0	H <sub>3</sub> AsO <sub>3</sub>	0	S	0
Cr <sub>2</sub> O <sub>3</sub>	MnO	0	H <sub>3</sub> AsO <sub>3</sub>	0	H <sub>2</sub> S <sub>4</sub> O <sub>6</sub>	0
Cr <sub>2</sub> O <sub>3</sub>	MnO	0	H <sub>3</sub> AsO <sub>3</sub>	0	H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> S
0	MnO + O	0	0	0	0	H <sub>2</sub> SO <sub>3</sub> , H <sub>2</sub> S
Cr <sub>2</sub> O <sub>3</sub>	MnO	0	H <sub>3</sub> AsO <sub>3</sub>	0	0	0
Cr <sub>2</sub> O <sub>3</sub>	MnO	0	0	0	0	0
0	0	0	0	0	0	H <sub>4</sub> (FeCy <sub>6</sub> )
0	0	H <sub>3</sub> AsO <sub>4</sub>	0	HCl	0	HCl
Cr <sub>2</sub> O <sub>3</sub> or CrO <sub>2</sub> Cl <sub>2</sub>	MnO	0	0	0	0	0
0	0	H <sub>3</sub> AsO <sub>4</sub>	0	HCl	0	Cl <sub>2</sub> , HCl
0	0	H <sub>3</sub> AsO <sub>4</sub>	0	HCl	0	Cl <sub>2</sub> , HCl
Cr <sub>2</sub> O <sub>3</sub>	MnO‡	H <sub>3</sub> AsO <sub>4</sub>	0	HBr	0	HBr
Cr <sub>2</sub> O <sub>3</sub>	MnO, H <sub>2</sub> MnO <sub>4</sub> ‡	0	0	0	0	0
0	0	H <sub>3</sub> AsO <sub>4</sub>	0	Br <sub>2</sub> , HBr	0	Br <sub>2</sub> , HBr
Cr <sub>2</sub> O <sub>3</sub>	MnO	H <sub>3</sub> AsO <sub>4</sub>	0	HI	0	HI
Cr <sub>2</sub> O <sub>3</sub>	MnO	0	H <sub>3</sub> AsO <sub>3</sub>	0	I	0
0	0	H <sub>3</sub> AsO <sub>4</sub>	0	I <sub>2</sub> , HI	0	I <sub>2</sub> , HI
Cr <sub>2</sub> O <sub>3</sub>	MnO	0	H <sub>3</sub> AsO <sub>3</sub>	0	H <sub>3</sub> PO <sub>4</sub>	0
0	0	H <sub>3</sub> AsO <sub>4</sub>	0	Cr <sub>2</sub> O <sub>3</sub>	0	Cr <sub>2</sub> O <sub>3</sub>
0	0	H <sub>3</sub> AsO <sub>4</sub>	0	MnO	0	MnO
Cr <sub>2</sub> O <sub>3</sub>	Mn <sub>2</sub> O <sub>3</sub> + MnO	0	0	0	H <sub>3</sub> AsO <sub>4</sub>	As
0	0	0	0	H <sub>3</sub> AsO <sub>3</sub>	0	H <sub>3</sub> AsO <sub>3</sub> , As

|| In alcoholic solutions.

§ H. B. Parsons, in Douglas and Prescott's "Qualitative Analysis," 2nd ed., paragraph 166.

\*\* "Watts's Dictionary of Chemistry."

## PROCEEDINGS OF SOCIETIES.

## NEWCASTLE CHEMICAL SOCIETY.

October 24, 1878.

INAUGURAL ADDRESS, by R. C. CLAPHAM, F.C.S.

(Continued from p. 218).

*Depression in Trade.*

IN the midst of a very serious depression in trade, through which this district in connection with others is now passing, in the face of a great development in all chemical industries on the Continent, where improved methods of working have of late been steadily introduced, a competition has been created which was unknown in former times, but which has been severely felt during the last four or five years. In this state of things it may be interesting to review the progress which has been made, and is now making, to enable these important local industries in which a large amount of capital is embarked, to cope with and overcome their present difficulties, because I think we shall be compelled to admit that we must hereafter look rather to economic working and a reduction of the cost of manufacture than to the hope of high prices. To some extent we have data at our disposal to show the position of the large enterprises, and to compare results with past years. At the meeting of the British Association in this town in 1863, a paper was prepared on the Chemical Industries of the Tyne, Wear, and Tees, by the late Dr. Richardson, J. C. Stevenson, M.P., and myself, and I propose to compare the results there given with those of the present times.

*Soda Trade.*

Few of our local trades have undergone more extensive changes since 1863 than the soda manufacture with its allied branches, all of which have been greatly modified, not only from causes common to other manufactures, but from many changes and improvements carried out both in the purely chemical processes and in the erection of entirely new and costly plant. These changes have all followed in rapid succession during the last eight or ten years. The revolving Ball Furnace came into use about twenty-five years ago, but its application was limited for several years afterwards, and its construction being then confined to balling only sixty to seventy tons sulphate weekly, it was a mere pigmy as compared to the present furnace, which is constructed for something like 300 tons weekly; but comparatively speaking very few of the small furnaces were at work on the Tyne fifteen years ago, and therefore nearly all the sulphate of soda continued to be balled in the old handworked furnace, using only twenty-one tons sulphate weekly. The present large furnaces were first erected at C. Tennant and Co.'s works at Glasgow, by Mr. Macfear, and have been extensively adopted here of late years. The mixture of materials heretofore used in balling and the times of charging the batch have both been considerably altered since the introduction of the large furnaces, and the changes have resulted in a considerable saving in the chalk or limestone used, and in the turn out of a soda-ash of steady uniform quality, testing from 52 to 54 per cent. The heat of the furnace and of the batch worked have both received much attention, and means are now taken to prevent (or destroy) the formation of cyanides towards the end of the operation, from which the colour of the soda-ash is largely effected.

The Macfear Carbonating Furnace is a still more recent invention, and has come into operation during the last three years, and promises satisfactory results. A furnace of this construction will turn out from 100 to 120 tons weekly (the exact quantity depending on the quality required) as compared to an old furnace turning out 17 or 18 tons. The saving in cost to be effected by these new

appliances was at one time expected to be very large, certainly more than one-half of that formerly incurred, but it must be in fairness admitted that owing to the reduction in the price of coal to about the same as in 1871, and the much lower wages now paid, and from other changes, the difference of cost between the old and the new systems is not at present so great as was expected. The heavy outlay incurred, and the gradual liquidation of the amount expended, must also be taken into consideration. But, on the other hand, it must also be admitted that the new furnaces will show much better comparative results in times of greater prosperity than at present when a large production is important, when wages and coals are necessarily higher. The results will depend not so much upon the workmen as upon the amount of steam applied to the furnaces; under these circumstances the comparative results will be more marked. Whilst machinery is taking the place of hand furnaces, both in balling and carbonating, it is remarkable that hitherto in decomposing, the machine-worked furnace has made little progress to what was expected a few years ago. Some of the causes of both failure and success are now laid bare. Practical working has proved the necessity of far more massive machinery than was at first expected to be required, and has shown also a difficulty in keeping the working bed sufficiently level for the machinery in which at one stage an acid liquid, and at another stage a dry sulphate, have to be worked, and there yet appears ample room for improvement in these respects; on the other hand, it is found that in those works where the furnace is kept working for some time without accident, a saving, both in wages and in the consumption of sulphuric acid, is the result.

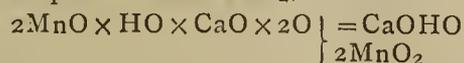
Other improvements have been made in the more general adoption of the Gay-Lussac apparatus for saving nitrate of soda, and in the erection of Glover towers for the concentration of acid from the heat of the burners, and the more perfect burning of pyrites in the kilns, all of which have brought about a considerable saving. It seems probable that investigations now being made by Davies, Affleck, and others, both for the separation of arsenic from the acid to be used in the Gay-Lussac and Glover towers, and in the loss of nitrous fumes by defective absorption, may hereafter lead to still better results. A patent taken out by Hargreaves and Robinson for the manufacture of sulphate of soda by the direct application of sulphurous acid to common salt, has been worked out in practice by our esteemed member, Mr. J. C. Stevenson, M.P., who is now producing from this process about 5950 tons annually. The chief advantages claimed by Mr. Hargreaves are—(1) The saving of capital in building by the non-erection of lead chambers; (2) That nitrate of soda is not required; and (3) That a saving in coals is effected. But to set against the above is the cost of the large metal cylinders required to hold the salt whilst the decomposition is going on, the necessary massive brick-work, and apparatus attached, all of which, I believe, have proved more expensive than was at first expected. The length of time requisite to properly finish the charge, so as to allow of a complete decomposition of the salt, has also added to the first expected cost of coals and wages. The very pure sulphate produced by this process is, however, an advantage for many operations, and must not be overlooked. But a patent which, if successful, would, to a large extent supersede the present plant in chemical works, and the present mode of manufacture, has been carried out for some time past by M. Solvay, at Nancy, in France, which consists in the decomposition of salt in the form of brine by gaseous ammonia and carbonic acid, and the production of a very pure carbonate of soda, which is now extensively used in glass works and other operations where colour is important. This process has also still more recently been established at Northwich, in Cheshire, by Messrs. Brunner and Mond, who are now producing about 12,000 tons per annum. So far as can be learned of this new process,

which may be said to be still in its infancy, it appears as if it might prove an important rival to the old method of working, and its practical application would point to the probable future of the soda trade as being near to the salt brines. If, however, the recent discoveries of Mr. Edison for the universal application of the electric light as a substitute for gas prove correct, and result in the stoppage of gas works, the necessary supply of ammonia to make up the loss in the operations might prove a difficult matter, and, at any rate, the price would be so far advanced as to make the ammonia process impossible to be established at a profit. It is to be hoped that both these interesting and important patents may form subjects or separate papers hereafter.

In the bleaching-powder trade, which is now so extensively carried out here, a great change has been effected in the last eight years, not only in the chemical operations, but also in the erection of new and costly plant. Mr. Weldon's patent for the recovery of the heretofore waste manganese has come into general use, and by this process nearly all the manganese is now being recovered. By the use of presses recently introduced, and working at a pressure of 50 lbs., the last traces of chloride of manganese liquors are separated from the settled mud (chiefly sulphate of lime), and the final loss is reduced to 5 or 7 per cent. The details by this process have so frequently been discussed by the members in past years, that I will now only add a short extract from a paper read by Mr. Weldon before the Society of Arts in 1874. He says:—"I should much like to explain to you what takes place in the fundamental operation of this process—that which is performed in the oxidiser, because it results in the formation of compositions which were not known until they were produced in this process. When I first attempted to press this process upon the attention of manufacturers, I was always met by the objection that as yet I had only performed it in the laboratory, and that many things are possible in the laboratory which on the large scale are impracticable. But, in this process, we have an instance of results being readily obtainable on the large scale, which cannot be obtained in the laboratory, and for some time we never obtained in manufacturing operation a product containing less than a full equivalent of basic oxide for equivalent of  $MnO_2$ , which is the product obtained as under:—



But each time the scale of operations was increased the chemical quality improved, until we are now able to make regularly a product containing only one equivalent of base to two equivalents of  $MnO_2$ , as under:—



The production of soda, with its allied branches, has greatly increased during the past fifteen years, as will be seen from the following figures. The importation of pyrites from abroad in 1862 was only 43,017 tons, to which must be added pyrites from Ireland and Cornwall, then extensively used, and amounting to 29,783 tons, making the consumption 72,800 tons, whereas in 1877 the importation was 186,757 tons, and after allowing for the manure trade, &c., it leaves a total consumption of 130,000 tons for alkali works, as against 72,800 tons at the former period named. And again, the consumption of salt, which, in 1862 was 90,000 tons, is now (after allowing for eight alkali works which are at present laid in) 192,500 tons, showing in these two articles, which constitute the largest raw materials used, an increase of double the former consumption.

In a paper read before the Society of Arts by Mr. Mac-tear, when speaking of the total production for Great Britain, he says that in 1862 the production of alkali was 203,000 tons, with an employed capital of £2,000,000, and in 1876 the production was 430,000 tons, with a capital of £7,000,000.

The following are the productions of manufactured articles on the Tyne:—

	1862.	1877. (Approximate.)
Alkali .. .. .	43,500	89,800
Crystals of soda .. ..	51,300	117,000
Bi-carbonate .. .. .	7,450	7,400
Caustic soda .. .. .	500	1,500
Bleaching-powder .. ..	11,200	30,000
	113,950	245,700

(To be continued)

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 17, October 22, 1878.

**Thermic Formation of the Compounds of Carbonic Oxide with the other Elements.**—M. Berthelot.—The oxide of carbon combines with the elements in the same manner as hydrogen, forming an oxide, carbonic acid, a chloride, carbonic oxychloride, and a sulphide, carbonic oxysulphide. Hence it has been sometimes regarded as an organic radical under the name of carbonyl. The author, without attaching much importance to this view, has examined the heat liberated in these combinations. On comparing the respective combinations of carbonic oxide and of hydrogen with oxygen, sulphur, and carbon, he finds that the relative order of the thermic disengagements is the same, but not their absolute magnitude, nor that of their differences. The heats liberated by the chloruretted and sulphuretted combinations of carbonic oxide are smaller than those from the corresponding compounds of hydrogen, which agrees with their lower stability.

**Various Thermic Determinations.**—M. Berthelot.—The author has examined boric acid, sodic chromate and biacetate, silicic iodide, and the alkaline-earthy phosphates.

**Vision of Colours, and especially the Influence exercised on the Vision of Coloured Objects in Circular Motion, when observed comparatively with Identical Coloured Objects in a State of Rest.**—E. Chevreul.—The author, in opposition to Young, Helmholtz, and Plateau, maintains that the primary colours are not red, green, and violet, but red, yellow, and blue, in accordance with the experience of artists and dyers.

**Determination of Butter in Milk.**—E. Marchand.—A continuation of the controversy between the author and A. Adam.

**Mosandrium of Lawrence Smith.**—Marc Delafontaine.—The author in a recent memoir on terbium (*Archives des Sciences Physiques et Naturelles*, March, 1878) disclosed facts which place the existence of this metal beyond doubt, and announced at the same time the probable discovery (since confirmed) of a new metal, which he named Philippium, and which is found in Samarskite from the United States along with yttrium. On July 22nd Mr. Lawrence Smith caused a sealed packet to be opened and read before the Academy, in which he laid claim to the priority of this discovery, and gave to the new element the name of Mosandrium. The author, however, contends that the experiments of M. Marignac, and his own, leave no doubt on the identity of terbia and of the so-called mosandric oxide. He sees nothing in Mr. Lawrence Smith's note to justify his reclamation of priority as regards the discovery of the new metal, and maintains that he has first pointed out its existence and its properties.

**Researches on the Sulphates.**—A. Etard.—The author has obtained numerous bodies of the general formula  $M_2(SO_4)_3, NSO_4, nSO_4, H_2$ ; also mixed sulphates of the formula  $2(SO_4, MSO_4, N), nSO_4, H_2$ ; and, lastly, certain peculiar simple or double sulphates, more or less hydrated.

*Moniteur Scientifique, Quesneville,*  
October, 1878.

**Contributions to the Technology of Chloride of Lime.**—Dr. J. Hurter.—The author in this extensive memoir examines the phenomenon of the absorption of chlorine in its variations with time, with the concentration of the gas, with the depth and extent of the layer of lime. Secondly, he inquires into the disturbing influences exercised by the gases mixed with the chlorine,—i.e., carbonic acid,—hydrochloric acid, and watery vapour, and the influence of the heat liberated during the absorption. As concerns the action of time and of the extent of the layer of hydrate of lime, he finds that chlorine is absorbed with a speed which rapidly increases, and that in equal times the proportions of gas absorbed are as the surfaces exposed. Hence he concludes that the depth of the stratum of lime has no influence on the absorption, the chlorine in equal times penetrating to an equal depth. The humidity of the hydrate of lime has at first little influence on the rate of absorption. He gives the following formula:—

$$s = 0.305 + 0.588 \sqrt{P} t - 0.145,$$

where  $s$  signifies the depth of the stratum, which in  $t$  hours is converted into chloride of 36 degrees by a chlorine whose degree of concentration is expressed by  $P$ . By means of this formula it is easy to calculate the yield of the chambers hitherto used. The influence of the foreign gases he finds very injurious. He holds that the chloride of lime is a peculiar compound, not containing chloride of calcium ready formed.

The chemical notes inserted under the title *Revue Etrangère* are all taken from the CHEMICAL NEWS and from Auerbach's work on Anthracen as translated by Mr. Crookes.

**Singular Use of Fluorescein.**—To determine whether the head waters of the Danube found their way through subterranean passages into the Aach, a quantity of fluorescein was placed in the former river, and three days later the splendid green colour with golden reflections was quite distinct. Ten kilos. of fluorescein had sufficed to colour, in an indisputable manner, 200 million litres of water.

**French Association for the Advancement of Science.**—At this meeting, held exceptionally at Paris, the President, M. Frémy, selected the manufactures of soda and of steel as the subject of his discourse.

**Chemical Industry at the Paris Exhibition of 1878: Anthracen and Artificial Alizarin.**—Adolphe Kopp.—A survey containing little, if anything, which is not already familiar.

*Reimann's Färber Zeitung,*  
No. 39, 1878.

**New Colouring-matters.**—According to a report presented to the Prize-Jury of the Paris Exhibition, by P. Monnet and Co., of La Plaine, near Geneva, the trade names Scarlet (écarlate) and Hortensia are applied to substitution derivatives of fluorescein into which bromine and hyponitric acid are simultaneously introduced. The Scarlet serves for wool-dyeing, whilst Hortensia can be equally well fixed upon cotton, silk, and wool. Pyrosin I is pure bi-iodo-fluorescein; pyrosin R is a mixture of -bi and tetra-iodo-fluorescein. Both give a fine ponceau colour, though tetra-iodo-fluorescein alone gives shades more approaching to violet. Rose Bengale, Phloxin, and Cyanosin

are rose-coloured dyes, which are bromo- and iodo-derivatives of fluorescein. Rose Bengale, which was discovered in 1876 by Nölting, and phloxin are not soluble in water; cyanosin is soluble in alcohol. Since 1877 the same firm offers the soda-salt of benzyl-fluorescein under the trade name of Chrysolin. It was discovered by their chemist Reverdin, by the action of phthalic acid along with sulphuric acid upon a mixture of chlor-benzyl and resorcin. The colouring-matter is soluble in water, and is easily fixed upon fibres with a fine yellow colour. For fixing the resorcin colours upon cotton, the latter is worked in an alum-bath mixed with soda and in emulsive oils. Acetate of alumina is also a good mordant.

Nos. 40 and 41, 1878.

These issues contain nothing of general interest.

*Les Mondes, Revue Hebdomadaire des Sciences.*  
No. 4, Sept. 26, 1878.

M. Wurtz has presented to the "Committee of Learned Societies" a report on the merit of M. Rosenstiehl as an investigator into the nature of artificial colours, with especial reference to his researches on the tinctorial ingredients of madder.

**Co-Chemical Nitrification.**—M. Grandeau.—The author mentions an interesting fact observed by MM. Schlœsing and Muntz, that nitrification in sewage is completely suspended by the vapour of chloroform, and hence that it is due to a living organism.

M. Odile Martin has devised an ingenious apparatus for fattening fowls mechanically.

*La Correspondance Scientifique.*  
October 15, 1878.

**Atmosphere of Planetary Bodies.**—Stanislas Meunier.—The author opposes the view upheld by Prof. Sterry Hunt, that the atmosphere is of cosmical, not terrestrial origin, and is consequently common to all the planets. His principal arguments are the absence of an atmosphere in the moon and the asteroids. He does not, however, consider that the carbonic acid now existing in a combined and solid state has ever been at one and the same time present as a gas.

**The Electric Light.**—P. Jablochhoff.—In a letter to the Editor, this eminent electrician observes: "In a previous issue of the *Correspondance Scientifique* I have replied to the different questions generally put on the use of the electric light. Others have been since brought forward, one of which is 'At what distance from the source of the electricity can a light be produced?' The answer is very simple. The distance may be as great as is desired, only a conductor of a proportionally greater diameter must be employed, so as not to augment the total resistance of the circuit. I must beg, at the same time, to be allowed a few words on an announcement which has appeared in the American papers, and has been reproduced in some European journals. Thus, in the *Times* of October 8th, we read—'The divisibility of the electric light remained still an unsolved problem; its solution was reserved for M. Edison.' But I have long ago effected the division of the electric light, as is proved by my communications to the Academy of Sciences (December 3, 1877) and to the Physical Society of France (February 1, 1878). This divisibility of the electric light has, moreover, been publicly shown, February 9th, 1878, at a lecture delivered by Prof. Jamin in the great Amphitheatre of the Sorbonne, and, what is more, the system has been at the Exhibition since May 1st, 1878, open to all visitors to the Champ de Mars. In view of this fact I do not think it needless to mention the calculations included in the same announcement, not in order to discuss them, but to make known

my opinion on such estimates. They are of two classes. The opponents of the electric light represent it as excessively costly, Partisans and promoters, on the contrary, put forward figures which cannot be called inexact, but which are merely theoretical, and consequently scarcely capable of being justified by practice, and liable to injure the cause of the light rather than to serve it. The electric light consumes hourly 5 grms. of pencil composed simply of coke and plaster. A ton of the best coke costs 45 francs, and a kilo. of plaster 0.50 centime. Taking these figures for the basis of our calculations, we find that the consumption of my electric light representing 100 gas-burners costs per hour 10.00 centime. Or an electric light equal to 10,000 gas-burners costs hourly 0.27 centime, whilst the corresponding amount of gas would occasion hourly an expense of 420 francs. No one can prove these figures inexact, yet I will not venture to put them forward as capable of realisation in practice. Wherever the electric light has been introduced a notable saving has been effected. In the great shops of the Louvre, for instance, where this light has been in action for more than a year, the proprietors have found an economy of 30 per cent, and receive a better light. At the Theatre du Chatelet the proprietor has dispensed with 30 francs worth of gas every evening, and uses instead my system of electric light, which costs him only 14."

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*  
No. 57, 1878.

Report presented by M. Cloez on Inoffensive Colours for the Decoration of Toys, as prepared by M. Turpin.—The colours in question are chiefly lakes formed by eosin in combination with the earthy or metallic bases. These colours, mixed with chromate of zinc (?) in different proportions, yield bright shades, which may be advantageously substituted for red-lead and chrome-yellows.

Limits of the Combustibility of Gases.—M. Schützenberger.—The author proposes the following law: All other circumstances being equal to every pressure from 0 up to 1 atmosphere, there corresponds a limited length of a gaseous column beyond which the combustion provoked by a spark ceases to be propagated, whilst for smaller distances it is transmitted to the whole mass.

NOTES AND QUERIES.

Extraction of Wool from Rags.—In the "Annual Record of Science and Industry for 1873," it speaks of a process for the extraction of wool from half-wool rags, devised by Dr Rudolf Wagner, but it is not published in that book. I have searched a number of works on chemical technology, but have failed to find it. I bought a copy of Dr. Wagner's "Handbook of Chemical Technology" (eighth edition), hoping to find it in that, but did not. Will you be kind enough to inform me if it is published in any of his works? or do you know of any work on that subject?—GERALD COOPER.

Thermometric Paradox.—A medical friend asks me if I can give any explanation of the following:—During last summer he placed his clinical thermometer (which registers animal heat very accurately) in the direct rays of the sun beside an ordinary thermometer, both being suspended from the top of the stem and not touching any other object. The ordinary thermometer registered about 120° F., but his clinical thermometer did not show any elevation of temperature. He tells me he has repeatedly confirmed this experiment. I was quite unable to give any explanation, never having heard of such a similar statement, nor of thermometers capable of distinguishing between animal heat and the heat of the sun. I will be glad to hear if you or any of your correspondents can confirm or otherwise such statement and explain.—THERMOMETER.

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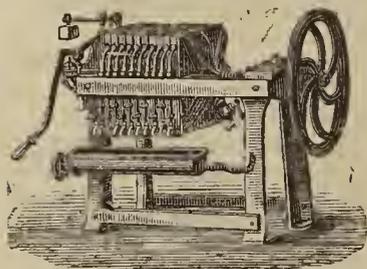
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VOL. XXXVIII. No. 990.

## PRELIMINARY NOTE ON THE COMPOUND NATURE OF THE CHEMICAL ELEMENTS.

By J. NORMAN LOCKYER, F.R.S., &c.

REASONING from analogies furnished by the behaviour of known compounds I have discovered that, independently of calcium, many other bodies hitherto considered as elements are also compound bodies.

In communicating this note to the Academy of Sciences, at the meeting which was held on October 28th last, M. Dumas observed that it was the result of three years' assiduous research, in which Mr. Norman Lockyer has, with the greatest care, compared the spectra of the chemical elements with the solar spectrum and other luminous celestial bodies. In the private letter to M. Dumas, accompanying his note to the Academy, Mr. Lockyer announces that he will shortly send the photographs and other details necessary, which will carry conviction to the minds of the Members of the Academy.

## OZONE AND THE ATMOSPHERE.\*

By ALBERT R. LEEDS Ph.D.

(Continued from p. 225.)

### Examination of Methods in Ozonometry.

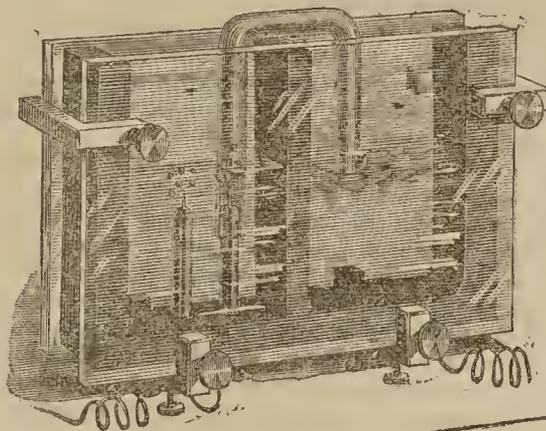
ON resuming laboratory work in autumn, an enquiry, which seemed essential before making any further observations upon atmospheric ozone, was the department of the various tests under precise and varied conditions. It was desirable to experiment upon the most convenient method of preparing ozone, upon the precautions requisite for obtaining it in as pure and concentrated a form as possible, and upon the methods of estimating its percentage in an atmosphere of ozonised air or oxygen.

*Preparation of Ozone by Electrolysis of Water containing Sulphuric Acid.*—Electrolysis was not found a convenient method of preparing ozone in considerable quantities. But it is so important to demonstrate the formation of ozone, according to the reaction which first attracted the attention of Schönbein, that the following novel experiment, which affords an impressive lecture illustration, is important.

A glass tank is made of thin sides of plate glass, and of less height and breadth than the diameter of a magic lantern condenser. These sides are held firmly against rubber walls of about 12 m.m. in thickness, cut out in such manner as to divide the tank into two cells. One is partly filled with acidulated water,† the other with a 15 per cent solution of potassium iodide.

The platinum electrodes from a battery of six Bunsen cells rise from the bottom of the first compartment of the tank, covered, except at their ends, with glass tubes, into which they have been previously sealed. A small bent glass delivery-tube is slipped over the electro-positive pole, its end just dipping beneath the surface of the potassium iodide solution. Decomposition begins as soon as the mixture of oxygen and ozone has displaced the air previously in the delivery-tube, and is made evident by the

yellow colour imparted by the liberated iodine. If, before projecting the image of the decomposition on the screen, a few drops of dilute starch have been added, the dark blue clouds, rolling away from the point of exit of the electrolytic ozone, are striking. A tincture of guaiacum, freshly prepared from the solid resin, shows the presence of ozone by a lighter blue colouration spreading across its surface in the tank, and an indigo solution is bleached. The last reaction is not so striking as the foregoing, since the bleaching is necessarily shown by a gradual instead of an abrupt change of colour.



*Preparation by Electricity.*—The methods followed to submit the oxygen, in as dry and cold and condensed a condition as possible, to the action of electricity, will be given in a subsequent paper. A large Holtz machine, manufactured by Rhumkorff, did not answer satisfactorily as a source of frictional electricity. Examination showed that the surface of the vulcanite supports was coated with a saline incrustation, which proved to be sulphates, probably formed by oxidation of the sulphur contained in the vulcanite, under the influence of ozone generated in the working of the machine. This saline matter being hygroscopic, attracted sufficient moisture to destroy insulation.\*

The insulation might have been restored by removing the coating: but in the remainder of the experiments I used the improved form of Holtz's machine, made by Messrs. Hall and Benjamin, and obtained excellent results. Various modifications of Siemens's apparatus, and the tube-ozoniser of Prof. Wright,† were employed for ozonising.

*Does the Electric Spark Decompose Potassium Iodide?*—One of the most interesting points to be determined in connection with the ozone tests, was whether the electric spark alone would decompose potassium iodide, or whether the decomposition was not due to the ozone produced whenever the electric spark is taken in the ordinary manner. To settle this question it was essential to submit the tests to the spark taken either *in vacuo*, or in an atmosphere of some gas which, under the influence of the spark, would neither suffer decomposition nor enter into combination. The first method was attended with insurmountable difficulties, for which reason the second was adopted, hydrogen being the gas selected.

The hydrogen was purified by permanganate of potash solution, as proposed by the author in an article entitled "Contributions to the Chemistry of Hydrogen" (American Association for the Advancement of Science, August 23, 1876; *American Chemist*, November, 1876).‡ It was dried in the usual manner by sulphuric acid, and then passed over a length of 20 c.m. platinum sponge, which was kept heated at the middle. The farther end of this tube was filled with phosphoric anhydride, which gradually liquefied from absorption of moisture. To make sure that all traces

\* From proof sheets of the *Annals of the N.Y. Academy of Sciences*, furnished by the Author.

† According to L. Hoffmann, a maximum liberation of ozone is obtained from a mixture of 1 part sulphuric acid and 5 parts water. (*Pogg.*, 132, 607; *Jahresb. der Chemie*, 1867, 130.) The mixture should be kept as cold as possible.

\* This difficulty had been previously noted by Prof. A. W. Wright, *Am. Journ. Sci.*, [3], vol. iv., p. 30.

† *Am. Journ. Sci.*, *Ibid.*, p. 26.

‡ Later by Shobig, *Journ. Prakt. Chem.*, II., xiv., 289, Oct., 1876.

of oxygen had been removed, by entering into combination with hydrogen under the influence of the platinum sponge in the first tube, a platinum sponge guard-tube was added, similar to the first, except that its anterior end as well as its posterior end was filled with phosphoric anhydride. In this guard-tube no change occurred. The tests were contained in an apparatus constructed as follows:—A tube 25 c.m. long and 4 c.m. wide was drawn down at its ends, and fitted very tightly with rubber corks covered with tin-foil. Through these corks glass tubes were passed, conveying platinum poles, the latter sealed to the tubes with only 5 m.m. of their free ends projecting. Two tubes were cemented on one side of the apparatus 6 c.m. from each end, and at the distance of 12 c.m., bent down at right angles. These tubes entered into small wash-bottles containing sulphuric acid, one acting as a seal at the entrance, the other at the exit of the current of hydrogen.

In the first experiment, one specimen of each of the iodised papers was introduced into the apparatus. The hydrogen was then allowed to flow until all the air in the train of purifiers and driers had been displaced. Connection was made with the platinum sponge tubes, and a slow current was allowed to flow for three hours. The object of continuing the current so long a time was not so much the view of displacing the air as of thoroughly desiccating the papers. A stream of sparks was then passed between the poles, which were separated by an interval of 5 c.m.

The papers were pierced with numerous holes, but remained colourless. On opening the apparatus there was no smell of ozone, but an odour as of something burnt. The papers on being moistened developed faint blue stains at the points where pierced by sparks. The experiment was repeated with identical results. Either, then, it appeared, the sparks alone had decomposed potassium iodide, or ozone had been formed in the course of the experiment. That the hydrogen employed still contained oxygen was negatived by the positive results obtained by the platinum sponge guard-tubes, and not less so by the absence of any smell of ozone, this last being, in fact, one of the most delicate tests we possess. But the burnt smell noticed each time the apparatus was opened rendered it extremely probable that the paper, containing as it does the elements of water, had undergone some decomposition.

To eliminate these sources of error, a tube was partially filled with pure potassium iodide, and hung upon the electrodes. After desiccation in a current of hydrogen for many hours, sparks were passed through the iodide for a very long time. The magnificent colour of the spark in hydrogen changed whenever the particles of potassium iodide were rendered incandescent. On testing the iodide afterwards, there was not the slightest indication of liberated iodine. From this it would appear that it is not the electric spark but the ozone generated under its influence which produces the chemical effects of decomposition in this and similar instances.

*Collection and Preservation of Ozone.*—A bottle with mouth partially covered may be filled with ozonised oxygen by displacement. Bottles so filled may be sealed with paraffin, and the ozone preserved indefinitely. Great difficulty was encountered in making tight joints. It has been recommended to insert the ends of tubes to be joined into a wider tube and fill in with paraffin. But the adhesion of the paraffin is so slight that such a joint easily comes apart. A better plan is to take a strip of cotton cloth about 1½ inch wide, and of suitable length, wrap it tightly round the tubes to be joined, fasten with soft flower or copper-wire, and then render it impervious by melted paraffin applied with a feather or brush. Tubes of very different diameters, and vessels of various dimensions, can be joined by suitably modifying this plan.

The action upon india-rubber is very energetic, especially when under strain. This may be illustrated as follows:—A piece of black rubber tubing is coiled tightly around a glass rod, and placed in a bottle through which

a current of ozonised oxygen is allowed to flow, the gas entering at the bottom and escaping into the partially closed top. The black colour disappears quickly, a dirty yellow following, and the surface becomes roughened. In a few minutes the edges are serrated, cracks open until the whole tube yields, and it falls into more or less ring-like fragments.

To determine more accurately the amount and kind of change produced in rubber, it was exposed to a slow current of ozonised oxygen (30 litres) for a number of hours. The gas, after passing over the rubber, was made to flow through a weighed sulphuric acid tube, then through a Liebig's bulb and sulphuric acid tube, then through another sulphuric acid tube acting as a guard, and finally through three Geissler bulbs containing solutions of potassium iodide. The time and difficulty in making so many joints tight by the aid of paraffin were great. The results were as follows:—

Porcelain boat + rubber after ozonising	= 7.2523 grs.
"    " + " before "	= 7.2415 "
Increase due to action of ozone ..	= 0.0108 "
Sulphuric acid tube after ozonising ..	= 12.745 "
"    " before "	= 12.739 "
Increase (probably water) .. ..	= 0.006 "
Potash bulbs after ozonising .. ..	= 14.620 "
"    " before "	= 14.6094 "
Increase (probably carbonic acid) ..	= 0.0106 "

The first Geissler tube was dark yellow, the second light yellow, the third colourless. The liberated iodine corresponded to 2.47 m.grm. ozone. This method of estimating ozone is fallacious, and the above experiment is preliminary to a more extended investigation into the nature of the changes occurring in rubber and other organic bodies under the action of ozone.

*Preparation by Chemical Methods.*—The most noteworthy result arrived at in an examination of these methods was the discovery of a new method of generating ozone. When potassium permanganate and crystallised oxalic acid are pulverised together in a mortar, the heat developed is so considerable as to convert into steam much of the water formed during the course of the reaction. If the salts are introduced into a test-tube, and water added, the escape of gas is at first slow, but it rapidly increases with a corresponding elevation of temperature. Iodo-starch papers held at the mouth of the tube show the presence of ozone in the escaping gases; so do those of guaiacum. Potassium iodide is little affected until the temperature is kept down by holding the test-tube in cold water, when the amount of ozone liberated is so considerable that the papers turn brown at once. Here, then, we have two solid substances which may be kept together for any length of time without change, but on the addition of water liberate ozone. The practical as well as theoretical interest of this discovery is such that a careful study of this and similar reactions is now being made.

(To be continued.)

## ON THE PYROLOGICAL EXAMINATION OF ZEOLITIC SILICATES.\*

By Lieut.-Colonel W. A. ROSS.

### No. II.

In order to examine these silicates by means of boric acid, therefore, as will be seen from the previous article, the operator has first to crush some fragments between agates to a fine powder, and, treating B.B., a trace of this powder taken up on the hot bead at the point of the blue pyrocone; to observe:—

\* These and all operations were made with one of Fletcher's admirable hand-blowers, which I purchased for 7s.

- (a.) If the fused powder forms an icy mass dissolving eventually to a clear bead.
- (b.) If the fused powder forms a milky matter, rendering the bead opaque.
- (c.) If the fused powder forms a water-gruelly matter, with balls opaque or clear.

In the case of (a) the operator may be certain that he has here an *alkaline aluminous silicate*, which may or may not contain lime or magnesia, &c.\* The only exception I know is *Harmotome*, in which baryta seems to act the part of alkali. The distinction is easily made by adding a pin's-head fragment of lime (or a lime borate ball, of which reagent a supply can be easily made and kept). In the *Harmotome* icy mass the lime ball floats uninjured, with hard well-defined edges. In the icy mass from, say, *Labradorite* the lime ball is at once decomposed into milky-white matter, which renders the bead opaque, like white enamel. There is another case of the lime ball remaining intact in the icy mass, *i.e.*, in that formed by *Lepidolite* powder, in which the lithia present seems to prevent the decomposing action of the alumina upon the lime. Examples of these three cases will shortly be given.

In the case of (b) the operator may be certain that there is a large proportion of *alumina* present with much or little lime—a matter easily determined by heating some fresh powder in a phospho-boric acid bead—*i.e.*, a boric acid bead which has been dipped hot into deliquesced phosphoric acid—when opaque white balls will shortly appear, as described in the previous paper, numerous and large in proportion to the quantity of lime present. As a saturated solution of pure alumina in a boric acid bead (made by means of a cautious addition of alkali) forms only grey or water-gruelly matter like silica, the *milky matter* of case (b) is obviously due to fine particles of milk-white lime disseminated through the bead from the decomposed lime-borate ball, so that this reaction is a proof of the presence both of alumina and lime in a mineral. In the case of a *salt*, where there is sufficient alkali to decompose the lime-borate ball, but not sufficient to re-dissolve the milky matter thus evolved, there may, of course, be no alumina present. To find if there is, crush the milk-white opaque bead in the (a) forceps (*vide* "Pyrology," page 69) and apply some small fragments B.B. to a fresh boric acid bead. If the milkiness was due to alumina, milkiness will again supervene in the fresh bead, *i.e.*, there will be no change; but if due to alkali without alumina, clear balls will immediately form, the alkali being taken up by the large proportion of fresh boric acid—an expected result.

In the case of (c), as in the result of applying the powder of such minerals as *Apophyllite*, *Wollastonite*, &c., to a boric acid bead, the operator sees at once that he has here a lime or lime-magnesian silicate *without* alumina, which may or may not contain alkali; a fact easily determined by the pyrochrome or coloured flame given by a fragment of the mineral, *per se*, except as regards the presence of soda, because nearly all silicates thus give a yellow flame, but this point again is settled by the yellowing of the normal green boric acid pyrochrome, when we may be quite certain that soda is present.

The silicic acid is diffused as a water-gruelly matter through the bead, presumably on account of a shameful desertion by its former partner, lime, who, like a fickle Lothario, prefers boric acid to it in this temperature, while alumina seems more like a rival suitor for the attractions of boric acid, with which, under great heat, it even attempts a kind of ball formation; at all events it undoubtedly exercises, even when present in the most trifling proportion, a decomposing effect upon calcium borates in a bead of boric acid, which constitute therefore a most delicate test, qualitative and quantitative, for alumina.

I now proceed to give examples from my notes:—

\* *Analcime* is a case of an icy mass, in the formation of which lime has no part.

No. 1. *Labradorite* (Sept. 1, 1878).

- (1.) A large trace L. powder to boric acid bead, B.B.
  - (a.) A siliceous mass at first, changing after O.P. to an icy mass. (*An aluminous alkaline silicate.*)
  - (b.) More O.P. Glass clear and very vitreous.
- (2.) Boiled (1 b) in Al capsule,† to eliminate the alkali.
  - (a.) Boiled to a thick, white, blanc-mangey jelly.
  - (b.) Solution (acid) extracted by slips of blotting-paper placed over the capsule, like syphons.
- (3.) Residue white, jelly-like, thrown on agate slab, dried on platinum spatula, and treated in phosphorised boric acid bead.
  - (a.) Creamy but bluish white matter; spreading.
  - (b.) More O.P. Shining particles begin to appear.
- (4.) Vesiculated (3 b). (*See "Pyrology," p. 92.*)
  - (a.) Several minute, clear, round balls: one—pretty large, but egg-shaped—extracted from the vesicle by pliers, and boiled in Al capsule.
  - (b.) An irregular double or twin roundish mass, full of transparent particles? Bead water-gruelly.
- (5.) The oval mass (4 b) in fresh boric acid.
  - (a.) Became gradually opaque white; then lost its rounded form, and became a fat-like mass with fringed edges (Al phosphate?).

[Thus we see that the effect of the alkali of *Labradorite* (which cannot be altogether removed) seems to be to cause a combination of the  $P_2O_5$  with itself and the  $Al_2O_3$ , leaving the lime free to effect a combination with the boric acid.]

No. 2. *Lepidolite* (Sept. 10, 1878).

- (1.) *Appearance*.—Scales like those of mica.
  - (a.) Obtained a fine powder by rubbing several scales on a file, and tapping gently on an agate slab.
- (2.) Trace of this powder in a B acid bead, B.B.
  - (a.) A siliceous mass, dissolving to a clear, vitreous, yellowish bead—yellow-hot. (*An alkaline, aluminous silicate, with iron.*)
  - (b.) Pyrochrome of the bead green, unchanged. (*Alkali, not soda.*)
- (3.) Vesiculated (2 a), breathed on the vesicle, and reheated in O.P.
  - (a.) An intense green fluorescent light. (*Presence of fluorine.*)
- (4.) Fragment of lime applied, B.B. to (3 a).
  - (a.) Hard-outlined clear ball, with slight water-gruelly matter round: no milky matter. (*Shows that a barium or lithium aluminous silicate is present.*)
- (5.) Fragment of baryta applied, B.B. to (4 a).
  - (a.) Bead almost immediately milk-white, opaque; clear-hot. Barium borate-ball completely decomposed. (*Considerable proportion of alumina.*)
  - (b.) Vesiculated; no balls observable.
- (6.) Fresh L. powder, dissolved B.B. in boric acid; the bead boiled; the residue washed, dried, and heated B.B. in phosphorised boric acid bead.
  - (a.) No balls; vesiculated, no balls. (*Absence of lime, magnesia, &c*)
- (7.) A scale of L. heated in Pt forceps, and touching the wick of a pyrological candle, dyed the whole pyrocone a deep crimson colour. (*Presence of lithia.*)
- (8.) L. powder dissolved in phosphoric acid, B.B., and the bead held over the base of the gas pyrocone.
  - (a.) A temporary but distinct violet tinge. (*Presence of potash.*)

N.B. This is a new test for potash, showing it even in presence of soda.

It is not necessary to give accounts here of the behaviour of *Wollastonite* or *Apophyllite* in boric acid, more especially as they will be found under the proper heads in "Pyrology."

The behaviour of *Zoisite* (case b) in boric acid will be given, with other examples, in another article.

London, November 13, 1878.

\* These little aluminium capsules, made by Messrs. Griffin for 1s. require no spirit-lamp. A bead of boric acid is boiled down without spirting in one, before the blowpipe, in fifteen seconds.

## THE FARADAY LECTURE OF THE CHEMICAL SOCIETY.

ON Tuesday evening last Prof. Adolph Wurtz delivered to a crowded audience, at the Royal Institution, a most eloquent lecture on "La Constitution de la Matière à l'état Gazeux." We hope shortly to give a full report of the lecture, which was illustrated by a series of brilliant experiments.

On Wednesday the Fellows of the Chemical Society entertained Professor Wurtz at dinner at Willis's Rooms. The guests, numbering about 400, were received by Prof. Abel. After dinner the President, who had Prof. Wurtz on his right hand and Prof. Tyndall on his left, proposed the usual loyal toasts. In proposing the health of the Prince of Wales the President paid a compliment to the memory of the "noble father of our future king," whose accomplishments in "quantitative" and "qualitative" analysis were perhaps not known to every member of the chemical brotherhood so well as they were to the speaker himself. The next toast, "The Faraday Lecturer," was greeted with an amount of cheering which is seldom heard in gatherings of scientific men. Public dining, the President said, although distinctly an English institution, is taken to kindly by our foreign visitors, and Prof. Wurtz was not ashamed to say he was partial to the situation as he found it to-day. They were glad to be able to render some small honour to such a man. In the year 1842 their guest read to them a paper on "Hypo-phosphorous Acid," and he found that up to the year 1863 he had written a total of no less than seventy-three scientific papers on subjects which had come before them. Prof. Wurtz was a great trainer of youth. He had no less than 500 young men in his chemical classes at Paris and Bordeaux, a number of them being engaged in direct original research. He was not only a worker himself in the field which had yielded such great results during the past year, and had compelled him mournfully to exclaim "There go all the gases!" but he was a great expositor as well, as those who heard his lecture the previous night, and witnessed his marvellously perfect experiments, would well know. The toast was received with enthusiasm. Speaking in English, Prof. Wurtz said he felt the spirit and temper of Faraday ought to be his example, and he hoped he received the compliment which had been paid him with due modesty. After a warm tribute to Faraday the Professor sat down, but immediately rose to propose the health of the Chemical Society and its President, Dr. Gladstone. The President having acknowledged the compliment, Prof. Frankland proposed the toast of "The Learned Societies," coupled with the names of Mr. Spottiswoode and Prof. Huxley. The President-Elect of the Royal Society on this occasion expressed his faith in the principle of devolving all work upon Secretaries, and humorously called on Professor Huxley, one of the Secretaries of the Royal Society, to reply for the double toast. Prof. Huxley congratulated Prof. Wurtz upon the admirable and brilliant address of the previous evening, and pointed out the contrast between England and the Continent in the matter of scientific information. The Continental nations were distinguished by possessing academies, whilst they very rarely form societies after the English type. In England our societies—the Linnean, the Geological, and others—had arisen by a process of budding or gemmation from the Royal Society, which, he said, was the "milky mother of the herd." He would not say whether the English or Continental system was the best; but it was plain that, in time, there would be a body of picked scientific men in England who would be to us what the academies are abroad. These would represent all the societies by a process of natural selection or election. This was the prospect we had before us, and he himself looked hopefully to the future. Professor Odling proposed the health of the visitors, which was responded to by Mr. Spottiswoode.

## PROCEEDINGS OF SOCIETIES.

## CHEMICAL SOCIETY.

Thursday, November 7, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the confirmation of the minutes of the last meeting, &c., the following certificates were read for the first time:—W. J. Noble, L. Green, H. Green, H. J. H. Fenton, H. T. Cheshire, G. H. Hatter, Kingo Takemura, D. McAlpine, Shigetake Suguira, E. Waller, H. Eccles, and A. E. Arnold.

The following papers were read:—

"Contributions from the Laboratory of the University of Tôkiô, Japan: On the Red Colouring Matter of the *Lithospermum Erythrorhizon*," by M. KUHARA. The root of the above plant occurs in commerce in thick lumps purple externally, but yellowish white inside. It was largely used for the manufacture of "Tokio purple," but from the fugitive character of its colour and the introduction of aniline dyes its use has been almost abandoned. The root contains about 10 per cent of glucose and 4 per cent inverted sugar. The purple colouring matter is extracted almost completely by alcohol, and resembles in some respects anchusin, the colouring matter of alkanet. It is prepared from the root by extraction with alcohol, acidulating the extract with hydrochloric acid, and distilling off the alcohol. The impure colouring matter thus obtained was purified by precipitation with plumbic acetate, &c., in the usual way. It was finally obtained as a dark, resinous, uncrystallisable mass with a metallic green reflection. It is soluble in alcohol, ether, benzol, oil of turpentine, methylic alcohol, and carbon disulphide, but almost insoluble in water. It has a feebly acid reaction and a peculiar odour. It softens at 95° C., and then partially volatilises in red fumes, which condense on the colder part of the tube. The alcoholic solution has an absorption-spectrum resembling that of alkanet. Stannous chloride decolourises the solution. It has the formula  $C_{20}H_{30}O_{10}$ . A barium salt was prepared and decomposed. The paper also contains an account of a bromine and a chlorine compound. Further experiments are in progress.

Dr. GLADSTONE drew attention to the activity prevailing in the laboratories in Japan, and Dr. FRANKLAND said that the Society was much indebted to its Fellows in Japan for examining substances which could not be obtained here, and such researches as the above were always very welcome.

The best thanks of the Society were then given to the author for his communication.

Dr. WRIGHT then read "A Second Report on some points in Chemical Dynamics," by C. R. A. WRIGHT and A. P. LUFF. In the former report it was shown that no practical difference exists between the temperatures of initial action of carbon dioxide, hydrogen, and carbon respectively on cuprous oxide and on cupric oxide, provided the physical state of the two metallic oxides is approximately the same. The authors find that the same rule applies to the oxides of iron. By leading a mixture of equal volumes of carbonic oxide and carbonic acid over pure  $Fe_2O_3$  at a bright red heat, an iron oxide closely approximating to  $FeO$  is formed, the composition  $Fe_{16}O_{17}$  being attained in eight hours, and remaining unchanged during a second eight hours' exposure. Samples of pure ferric oxide prepared by ignition processes, when compared with oxide and with  $Fe_3O_4$  from purified scales of boiler-plate rolling, gave the following temperatures of initial action (tested by baryta water, loss of weight during fifteen minutes exposure, and as previously described and corrected in the case of  $Fe_{16}O_{17}$  for gases occluded by the substance, such gases not being contained in the other specimens):—

Reducing Agents.	Fe <sub>2</sub> O <sub>3</sub>		Fe <sub>3</sub> O <sub>4</sub> .	Fe <sub>16</sub> O <sub>17</sub> .
	From Ignition of FeSO <sub>4</sub> .	From Ignition of precipitd Fe <sub>2</sub> O <sub>3</sub> .		
CO .. ..	202	220	205	275
H .. ..	260	245	290	305
Carbon ..	430	430	450	450

Hence, probably the "heat of formation" of all the oxides of iron is much about the same (just as with Cu<sub>2</sub>O and CuO), calculated per constant quantity of oxygen. Julius Thomsen finds the heats of formation of ferrous hydrate, FeO, H<sub>2</sub>O, and ferric hydrate, Fe<sub>2</sub>O<sub>3</sub>, 3H<sub>2</sub>O, are respectively 68280 and 191130, or 68280 and 63710 per 16 grains of oxygen. Magnetic oxide of iron that has been fused and contains titanate oxide, &c. (New Zealand iron sand), is much less readily reduced than the porous boiler-plate scales. The temperature found for CO, H, and C being respectively 360° to 420°, a few degrees higher, and about 480°. That CO will reduce at a lower temperature than H was shown by sealing up ironsand in tubes filled with the two gases and heating to 360° for several hours. CO<sub>2</sub> was formed in the first tube, but no conversion of H into H<sub>2</sub>O took place. In the case of the oxides of manganese, the instability of manganese dioxide on heating would naturally lead to the idea that the heat of formation of MnO<sub>2</sub> is considerably less than that of a lower oxide (reckoned for constant quantity of oxygen). J. Thomsen finds that the heats of formation of MnO, H<sub>2</sub>O and MnO<sub>2</sub>, H<sub>2</sub>O are respectively 94770 and 116280, or 94770 and 58140 per 16 parts of O. In accordance with the thermic rules previously deduced, reduction of MnO<sub>2</sub> should commence at a much lower temperature than that required for lower oxides. On comparing various oxides of manganese the following numbers were obtained:—

Composition by Analysis.	Litharge.	Red Lead.	Dioxide.
	PbO.	Pb <sub>2</sub> O <sub>6</sub> .	Pb <sub>11</sub> O <sub>21</sub> .
Initial temp. of CO action ..	160° to 185°	200°	80°
" " H " ..	190 to 195	230	140
" " carbon ..	415	330	260
" " evolution of O	—	above 360	260

Nickel and cobalt oxides yielded precisely similar results. The monoxides of these metals were prepared by Russell's process (strong ignition in CO<sub>2</sub>); the superoxides by precipitating with alkalis and digesting with excess of bromine. In all cases the same results follow as with manganese and lead, *i.e.*, the superoxide is first reduced at much lower temperatures than the monoxide:—

Composition by Analysis.	Cobalt.		Nickel.	
	CoO.	Co <sub>12</sub> O <sub>19</sub> .	NiO.	Ni <sub>9</sub> O <sub>11</sub> .
Initial temp. of CO action	155° below	11°	120°	30°
" " H "	165	110	220	65
" " C "	450	260	450	145
" evolution of O	—	260	—	145

In no case, out of very many examined, has any exception been found to the general rule that the temperature of the action of CO lies below that of H, which, again, is below that of carbon. This rule, as well as each of the other observations made, appears to be a special case governed by the general law that, *ceteris paribus*, the greater, algebraically speaking, is the heat-evolution taking place during a reducing action on a metallic oxide, the lower is the temperature at which the action is first noticeable during a few minutes action. Incidentally the authors have made some experiments on the absorption of CO and CO<sub>2</sub> by metallic oxides, from which they conclude that, whilst a carbonate sometimes results by the action of CO on a superoxide, the action is not one of direct combination (as

Composition by Analysis.	Essentially MnO <sub>2</sub> .		
	Mn <sub>7</sub> O <sub>13</sub> .	Mn <sub>15</sub> O <sub>28</sub> .	Mn <sub>5</sub> O <sub>7</sub> .
Physical texture .. ..	Amorphous fine powder	Crystalline, compact	Fine powder, amorphous
CO begins to act .. ..	Below 15°	87°	97°
H " " .. ..	145	190	240
C " " .. ..	260	390	410
First evolution of oxygen ..	260	390	Nearly white heat

Composition by analysis.	Mn <sub>3</sub> O <sub>4</sub> .	Manganous oxide. MnO.
Physical texture .. ..	Fine powder (amorphous)	Amorphous
Temp. of CO action ..	240°	No action at 600°
Temp. of H action ..	255	" "
Temp. of carbon action	430	" "
First evolution of oxygen	No action at white heat	" "

The oxide Mn<sub>7</sub>O<sub>13</sub> was prepared by warming potassium permanganate with nitric acid. When dried at 100° it had the composition Mn<sub>21</sub>O<sub>39</sub>, 5H<sub>2</sub>O, becoming anhydrous at 200° without loss of oxygen. Another oxide, prepared by precipitating pure MnCl<sub>2</sub> by KHO and digesting in the cold with excess of bromine, contained, when dried at 100°, Mn<sub>11</sub>O<sub>20</sub>, 4H<sub>2</sub>O. The oxide, Mn<sub>15</sub>O<sub>28</sub>, was a finely crystallised natural pyrolusite. The oxide, Mn<sub>5</sub>O<sub>7</sub>, was prepared by roasting at a red heat manganous carbonate, whilst the Mn<sub>3</sub>O<sub>4</sub> was obtained by long-continued ignition over a powerful gas blowpipe of the Mn<sub>5</sub>O<sub>7</sub> and the MnO by igniting the same in H. The authors find that the oxide formed by igniting, in a platinum capsule over an ordinary large Bunsen burner, either MnCO<sub>3</sub> or precipitated MnO<sub>2</sub> invariably contains much more oxygen than Mn<sub>3</sub>O<sub>4</sub>, which can only be obtained by long-continued heating almost to whiteness over a gas-blowpipe: accordingly, serious errors are apt to be introduced in manganese determinations by following the directions of the text-books and igniting MnCO<sub>3</sub>, &c., until they cease to gain in weight. Precisely similar results were obtained with various oxides of lead; thus—

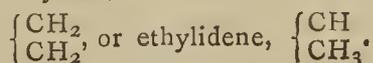
for instance, with lead), PbO<sub>2</sub> + CO = PbCO<sub>3</sub>, but takes place in two stages—



In the case of manganese, the combination of monoxide and CO<sub>2</sub> only takes place when both are nascent, which condition is not requisite with lead.

After some remarks by Messrs. NEISON, KINGZETT, and PERKIN,

Dr. FRANKLAND read a "Note on the Constitution of the Olefine Produced by the Action of Zinc upon Ethylic Iodide," by Dr. FRANKLAND and Mr. DOBBIN. This short paper contains an account of experiments made to determine the question whether the gas given off in the above reaction was ethylene,—



Many litres, after passing through alcohol and sulphuric acid, were led into a very large bulb-tube containing anti-monic chloride. The contents of the bulb-tube were finally mixed with water and distilled. The boiling-point, as determined by Chapman Jones's method, was 83° C., and was therefore that of ethylenic, and not of ethylidenic chloride, the latter substance boiling at 60°.

In answer to a question of Dr. Armstrong,

Dr. FRANKLAND said that although his expectations of obtaining ethylidene were certainly less than before, he should be very sorry to say that it did not exist, and would be still inclined to try further experiments if a reaction could be discovered to eliminate C<sub>2</sub>H<sub>4</sub> at a low temperature.

"On the Occurrence of certain Nitrogen Acids amongst the Products of Combustion of Coal-gas and Hydrogen Flames," by L. T. WRIGHT. The apparatus of the London Gas Referees for determining the sulphur in coal-gas was used by the author throughout his experiments. The combustion of 1000 litres of ammonia-free coal-gas in a Bunsen burner gave 0.00058 grm. nitrogen as  $\text{HNO}_3$  and 0.00058 as  $\text{HNO}_2$ . 1000 litres of coal-gas charged with ammonia gave 0.01071 grm. N as  $\text{HNO}_3$  and 0.00168 grm. N as  $\text{HNO}_2$ . The combustion of 1000 litres of coal-gas charged with ammonia, in a normal atmosphere, in a Bunsen burner with air-holes closed, gave 0.01595 grm. N as  $\text{HNO}_3$  and 0.00238 grm. as  $\text{HNO}_2$ . The combustion of 1000 litres of ammonia-free coal-gas, in an atmosphere charged with ammonia, in a Bunsen burner gave 0.03938 grm. N as  $\text{HNO}_3$  and 0.1115 grm. as  $\text{HNO}_2$ . When hydrogen passed over strong sulphuric acid was burned in an ordinary atmosphere, about 0.013 grm. N as  $\text{HNO}_3$  and 0.0002 grm. N as  $\text{HNO}_2$  were produced per 1000 litres. When the air was thoroughly purified by passing over strong sulphuric acid, &c., no nitric acid and less than 0.00001 grm. N as  $\text{HNO}_2$  were obtained. By a still more efficient purification of both hydrogen and air the condensed water was obtained free from nitrates and nitrites. The author, in conclusion, expresses his belief that the origin of the nitrogen acids found in the condensed water procured by burning coal-gas or hydrogen in air is ammonia either free or combined.

Dr. FRANKLAND said that the experiments just detailed raised some interesting points as regards the combustion of coal-gas. In the combustion of ammonia-free coal-gas the temperature never rose high enough to cause the oxidation of any large amount of nitrogen. An interesting experiment on the subject was the following:—If a jet of hydrogen be lighted in a glass bell-jar no red fumes are formed, but on adding oxygen to the atmosphere an increase of temperature soon produces perceptible red fumes in the bell-jar. In connection with the arc of the electric light, the temperature of which must be enormously high, it would be most important and interesting to determine whether any oxides of nitrogen were formed, and in what quantity.

"On the Action of Bromine upon Sulphur," by J. B. HANNAY. In former papers the author showed that when sulphur and bromine were distilled together distillates of any desired composition might be obtained, but that the residue was never free from bromine. The author in the present note attributes this retention of bromine to the sulphur passing into the viscous state, and finds that at 15° complete dissociation can be effected.

"Researches on Dyeing: Part I., Silk and Rosanilin," by Dr. MILLS and G. THOMSON. The authors have investigated the nature of the transaction which occurs when a vat is exhausted of its tinctorial ingredients. The experiments consisted in immersing a constant area of white silk in a solution of rosanilin acetate, &c., at a constant temperature for varying times, and determining the loss of strength of the rosanilin solution. They have arrived at the following conclusions:—(1) That when silk is dyed with rosanilin salt that salt is deposited as a whole. (2) That a boiling weak solution of rosanilin salt may undergo dissociation so as to become quite colourless; in which state, however, the dissociating force is wholly overcome by a silk. (Silk is dyed red by immersing it in a solution containing 0.0000003 grm. in 1 c.c., previously rendered colourless by boiling for half an hour.) (3) That for periods of four days, at the ordinary temperature, a magenta-vat is exhausted at compound interest. (4) That the rate of exhaustion of a magenta-vat is retarded by sodic or potassic chloride, and not improbably to an equal extent by equal weights of those chlorides.

"Comparisons of the Actions of Hypochlorates and Hypobromites on some Nitrogen Compounds," by H. J. H. FENTON. Both the above reagents act rapidly on ammonium carbamate, but as with urea, only half the nitrogen is evolved with hypochlorite, whilst hypobromite causes

the evolution of the whole of that gas. The residue from the hypochlorite does not contain nitrogen as a cyanate, but probably in the form of sodium carbamate. Guanidin yields to both reagents two-thirds of its nitrogen. The residue behaves like that from the action of hypochlorite on urea. Biuret gives one-third of its nitrogen with hypochlorite and two-thirds with hypobromite; the residues resemble those from urea. The author's results are given in the following table:—

	Urea.	Ammonium Carbamate.	Guanidin.	Biuret.	Ammonia Salts.	Cyanates.
NaClO evolves	$\frac{1}{2}$	$\frac{1}{2}$		$\frac{1}{3}$	All	None.
NaBrO	All	All	$\frac{2}{3}$	$\frac{2}{3}$	All	None.

In conclusion the author discusses the formulæ of the above bodies.

"Notes on two New Vegeto-alkaloids," by F. VON MÜLLER and L. RUMMEL. Alstonin is obtained from the alcoholic extract of the bark of *Alstonia constricta*. It forms an orange-yellow brittle mass, of a bitter taste, melts below 100° C.; is soluble in alcohol, ether, and dilute acids, sparingly soluble in water. Dilute solutions have a strong blue fluorescence, which is unaffected by acids and alkalies. It is precipitated by the usual alkaloid reagents. Duboisin is a volatile alkaloid obtained from the leaves and twigs of *Duboisia myoporoides*, by a process similar to that employed for the extraction of nicotin. Duboisin is probably identical with Staiger's piturin. Duboisin is a yellowish oily liquid, lighter than water, with a strong narcotic odour and alkaline reaction; very soluble in ether, alcohol, and water. It is not precipitated by phospho-molybdate of soda, picric acid, or platinum chloride.

"On the Determination of Lithia by Phosphate of Soda," by C. RAMMELSBERG. Berzelius detected lithia in Carlsbad water by evaporating the solution of the alkalies with phosphoric acid and sodium carbonate. On treating the whole with water an insoluble phosphate of sodium and lithium remained. This double salt the author has shown to be a variable mixture of the two phosphates. Mayer, however, contradicted these results and denied the existence of a double phosphate, and contended that the above residue was pure lithium phosphate. The author has repeated his former experiments and completely confirmed them, preparing synthetically double salts having sodium to lithium as 1 to 3 or 9 to 2, and therefore the author concludes that lithium cannot be determined by Mayer's method, which is also recommended by Fresenius. The employment of this process for the estimation of lithium in micas has led to too high a percentage of lithium. The author, in conclusion, gives analyses of micas, especially as regards lithium; the lithium and sodium chlorides being separated by treatment with ether alcohol, as suggested some time ago by the author.

The Society then adjourned to November 21st, when Dr. Tidy will read a paper on "The Processes and their Comparative Value for Determining the Quality of Organic Matter in Potable Water."

Papers announced: "A Chemical Study of Vegetable Albinism," by Prof. Church; "Researches on the Action of the Copper-Zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe; "On a New Gravimetric Method for the Estimation of Minute Quantities of Carbon," by Drs. Dupré and Hake.

#### PHYSICAL SOCIETY.

November 9, 1878.

Professor G. C. FOSTER, Vice-President, and afterwards Prof. W. G. ADAMS, President, in the Chair.

THE following candidate was elected a member of the Society:—Sir Frederick Elliot.

Prof. W. G. ADAMS explained a simple appliance made by Mr. S. C. Tisley for exhibiting the coloured bands due

to interference with thick plates. The bands due to regular reflection and refraction were produced by two thick plates nearly parallel to each other and fixed in a brass box with rectangular apertures on its flat faces, so that the light fell on the first plate at an angle of  $60^\circ$ , the whole apparatus being of a convenient size for the waistcoat pocket. On a previous occasion (June 23, 1877) Prof. Adams exhibited these bands to the Society, but not in a portable form. The elliptical interference bands, due to the scattering or diffusion of light at a point on the front surface of one of the plates, were shown by means of a precisely analogous arrangement, except that the inclination of the plates to each other was somewhat greater; in this case the interference bands formed by *regular* reflection and refraction fall in another direction, so that they are not received by the eye; the diffusion interference fringes obtained were clearly visible when thrown on the screen. They are formed by rays once diffused from points on the first surface, and afterwards regularly reflected and refracted from the front and back faces of the two plates in succession. Prof. Adams pointed out that this instrument would form a convenient means of obtaining polarised light in cases where the length of a Nicol's prism is objectionable, for instance, under the stage of a microscope; the light will be completely polarised if the plates be placed to receive the light at the polarising angle, and the field will be much brighter than when a plate of tourmaline is employed.

Prof. W. F. BARRETT exhibited and explained Edison's Micro-tasimeter and Carbon Telephone. In the course of a brief recapitulation of the history of these instruments he referred to Th. du Moncel's early observations, published in 1856, that variations in the resistance of a circuit can be produced by varying the pressure on metallic surfaces in contact, and, after referring to Clérac's plumbago rheostats, he stated that Edison was probably the first to apply the diminished resistance of carbon under pressure to a practical use, which he did early in 1877 in his carbon relay, the progenitor of the carbon rheostat, micro-tasimeter, and carbon telephone. In all he uses compressed lampblack, a bottom of which may be formed as follows:—The wick of a paraffin lamp having been cut so that it smokes, a quantity of lampblack is formed in the chimney; the lower portion, which has the more intense black colour, is collected from time to time, and all brown particles must be carefully removed, since they offer a greater resistance. The mass is compressed into a disc about the size of a sixpence, crushed, passed through a fine sieve, and again compressed; and this operation may be two or three times repeated in order to attain to perfect uniformity. The original form of tasimeter, in which the hard rubber or other substance was placed horizontally, has been modified so that the whole is vertical. The carbon button rests on a smooth metallic surface in connection with a binding screw, and a similar conducting surface rests upon it leading to a second binding screw. A strip of hard rubber, 1 inch long,  $\frac{1}{4}$  inch wide, and  $\frac{1}{16}$  inch thick is supported vertically above it, its upper end being attached to a fine screw worked by a tangent screw with graduated head. The whole is enclosed in a heavy conical brass box. Prof. Barrett suggested that it would be preferable to make this jacket cylindrical, and that the apparatus should be inverted, because the weight of the strip on the button is found to prevent the needle of the galvanometer returning at once to zero. Employing one Daniell's cell and inserting a shunt, Wheatstone's bridge and resistance coils in the circuit, it was shown that the hand at some distance caused a considerable deflection, and Prof. Barrett stated that in a still room the instrument becomes so sensitive as to be almost unmanageable. By replacing the hard rubber by a strip of gelatine varnished on one side, a very slight change in the hygrometric state of the atmosphere can be detected by the absorption of moisture causing expansion of the gelatine, and, therefore, compression of the carbon. Its action as an aneroid, baroscope was suggested by Prof. Barrett,

the button being associated with an exhausted box. He pointed out that before the tasimeter can be used as a measuring instrument, experiments must be made in order to ascertain the exact relation between the resistance of carbon and the pressure to which it is subjected. The carbon telephone, full particulars of which will be found in the current number of *Nature*, was next described; and Mr. ADAMS, Mr. Edison's assistant now in England, exhibited a complete transmitting apparatus with call, &c. A very ingenious and simple form of shunt, received from Mr. Edison with the tasimeter, deserves mention. A row of brass studs fixed on a board are united by plugs, so that if the current enters at one end it can pass out at the other without meeting with any appreciable resistance. But if a plug be removed it throws in about 4 inches of a resisting wire wound over two rows of pins underneath the board, one row of which are in metallic connection with the studs. Thus the entire length of wire is in circuit when all the plugs are removed. Finally, Prof. Barrett mentioned that a communication has just been received from Mr. Edison stating that he has succeeded in arranging an efficient receiving instrument, in which no form of magnet is employed.

Mr. LADD then showed several forms of Electric Lamp, arranged so as to render the use of clockwork unnecessary. In that known as Wallace's workshop lamp the spark passes between the edges of two plates, the lower one being fixed, while the upper one is lifted to a suitable distance by an electro-magnet, brought into action immediately on the passing of the current. A second form, in which an annular magnet was employed, acted on the same principle, the armature carrying the upper plate being specially arranged so as to give a maximum of attractive force. In the third form, the V-lamp, two rods of graphite were inclined at an angle of  $45^\circ$  to the vertical resting in contact on a piece of china. Immediately on the current passing an electro-magnet is caused to act, and after the rods have been firmly gripped they are separated and the support removed. Should the circuit be broken they will at once fall together.

#### NEWCASTLE CHEMICAL SOCIETY.

October 24, 1878.

INAUGURAL ADDRESS, by R. C. CLAPHAM, F.C.S.

(Concluded from p. 231).

#### *Sundry Trades.*

IN the Cement trade, which now forms an extensive local industry, the production in 1862 was 12,000 tons; and I now find, according to an authority on whom we can rely (Mr. John Watson), that the production for the present year is 61,000 tons. In the manure trade, which is an equally important branch of business, the production in 1862 was 15,000 tons, and for the present year 51,000 tons. I am indebted for much useful information on this head to Mr. Henry Bell and Dr. Merz. In the soap trade—a very old local manufacture, dating as far back as 1770—the production in 1862 was 6000 tons, but from information supplied by Mr. E. A. Hedley, owing to the stoppage of one or two soap works the turn out is not now more than 3200 tons. During the last few years two new and important additions have been made to our local industries. At Middlesbrough, Jones and Co. have commenced the manufacture of oxalic acid, and I believe their works are the largest in England for this purpose; and on the Tyne, Messrs. Redmayne have commenced the manufacture of acetic acid.

So far we have had to record an almost universal increase in chemical productions, but we have now to look at another side of the picture, where some trades have partially died out. The copperas trade, which was begun in this district as early as 1748, and which flourished for 120 years, and in which seven works on the Tyne were at

one time occupied, now only produce 1100 tons annually. The alum business, at one time a very extensive trade, and one of the oldest, established on the Yorkshire coast in 1460, and in which three large works were occupied on the Tyne, has disappeared altogether from the Yorkshire coast, and now only survives in one work in this locality. The prussiate of potash business, in which a considerable capital was at one time embarked, has entirely gone, its products being superseded by colours from coal tar. The Epsom salt trade has also left the Tyne, but has been extensively established at Middlesbrough, where the production is 3000 to 4000 tons annually.

The important trade in glass, established here in the fifteenth century, has fallen off to a serious extent, and the large glass works at St. Peter's and other places for crown glass have ceased to work. The large bottle trade has also decreased considerably; and of the forty-seven bottle houses in 1862, according to Mr. Alderman Ridley, only ten now remain at work, but plate-glass and pressed glass both continue to be produced to a considerable extent.

#### Copper Trade.

Turning now to the metallurgy of the district, we find that in 1862 the quantity of copper made on the Tyne was only 700 tons, and chiefly produced by the old method of smelting burnt pyrites containing only small percentages of copper (about 1·2 to 1·8 per cent), but mixed with richer imported copper ores. The "wet process" for the extraction of copper, which was only just coming into operation on the Tyne, was afterwards greatly stimulated by a yearly importation, now reaching 180,958 tons of Spanish and Portuguese pyrites, containing about  $3\frac{1}{2}$  per cent copper, 48 per cent sulphur, very little silica or other impurities, and which was peculiarly well adapted for the wet process; and these ores in time altogether superseded the non-cuprous ores which had hitherto been imported from Belgium, Ireland, and other places, and the produce of copper has gradually increased from 700 tons to 7500 tons per annum.

In all Spanish pyrites there is found small quantities of silver and gold, varying in some ores, but existing to the extent of about half-an-ounce to the ton of calcined ore. Silver is now successfully produced by M. Claudet's patent by one work on the river, and it is possible that this branch of metallurgy may hereafter be increased. Improvements have been effected of late years in the calcining and treatment of the burnt ores, in the quantity of coals used, and in the amount of wages paid, so that the cost of manufacture has been much reduced; and when the oxide of iron produced ("Blue Billy") is allowed for, I believe it may be stated, without any doubt, that the copper trade of the Tyne can hold its way, both in quality and price, against the ordinary dry smelting process of other localities, although, at the present time, the English copper trade has to contend against an unusually severe competition from Chili and Australia, which has reduced the price of copper to a point hardly before known in this country.

#### Lead Trade.

The increase in the production of manufactured lead on the Tyne since 1862 has been very considerable, and like some other local enterprises it has, in many of its branches, undergone changes to meet the times.

The separation of the silver, which had been conducted for many years in accordance with the late H. L. Pattinson's patent, in which the crystallisation of the lead in a metal pot was worked by hand labour, has been to some extent superseded by Rozan's patent, in which operation steam is applied as an agitator in the pot where the crystallisation of the pure lead takes place, in lieu of hand-labour, and in other respects it produces a chemical change, and facilitates the work. I shall not further refer to this patent, as we shall shortly be favoured with a paper on the subject by our esteemed member, Mr. Norman Cookson. The most striking change in this respect is the adoption by Mr. Leathart of the patent of

M. Flach for the separation of the silver by means of zinc, which is found to wash the melted lead entirely free of the silver contained in it, and the mixture of silver and zinc floats to the top of the pot and is skimmed off. When this process is completed, the mixture of zinc and silver is treated in accordance with M. Guillem's patent, and is placed in plumbago crucibles in a furnace, and the zinc is distilled off and collected in small metal chambers, where it cools in the form of cake-zinc, and is fit for use again. By this means about half of the original zinc used is at present obtained, but it is expected shortly that means will be taken to collect the remainder also. Both these ingenious processes are extremely simple and appear to be most effective. In the manufacture of white-lead a new method has also been worked out by Mr. Leathart, in the adoption of Milner's patent, which consists in subjecting very finely ground litharge in a mixing vessel to the action of salt brine, producing chloride of lead and caustic soda. This mass is then run into an iron vessel, into which carbonic acid is pumped, causing a further chemical change in the production of carbonate of lead and common salt once more, the latter of which is washed out from the white-lead, and may be used over again in the first operation. The patent white-lead produced in this way appears to be very white and chemically pure, but is not quite so heavy as the white-lead made by the old process. At the present time the lead trade is subject to considerable competition. America is now exporting lead, instead of, as formerly, being an importer. Steam-boat communication, with the present low freights, has really brought the shipping ports of America almost as near to the Tyne (as far as cost of carriage is concerned) as the well-known lead-mining district of Alston Moor. The lead ores that have recently been discovered in Colorado and Nevada, which are unusually rich of silver, are now being extensively worked, and it is reported that the silver alone in these ores is sufficient to realise a large profit, so that the lead can be set aside as dross, or at any rate sold at a low price for exportation.

The production of manufactured lead on the Tyne is as under:—

	1862.	1877.
White-lead .. .. .	7500	12,000
Red-lead .. .. .	4500	6000
Litharge .. .. .	800	1000
Sheet lead .. .. .	4500	11,000
Lead pipes .. .. .	1500	2500
Shot.. .. .	750	1000
	19,550	33,500

I am much indebted to Mr. J. Leathart, Mr. Warwick, and Mr. N. Cookson for valuable information concerning the lead trade.

#### Iron Trade.

In referring to the iron trade, which now forms so important a manufacture in the North of England, I shall be obliged to confine myself, from the largeness of the subject, simply to the change which is taking place in the substitution of steel for iron, as its production may fairly be claimed as a chemical operation. The Bessemer process for making steel is now being successfully carried out at Middlesbrough, where steel railway-rails are produced at a price certainly not exceeding £1 per ton above ordinary rails, and which, according to Mr. F. E. Harrison, possess a life three times that of the old rail. Steel plates for boilers and shipbuilding are made by Siemens's patent, and now supplied at prices which may ultimately supersede, for these and other purposes, the ordinary boiler plates. Hitherto, however, the steel made in England has been made from hematite iron ores, or from iron ores brought from Bilbao in Spain, or other places where ores free of phosphorus can be obtained. But important experiments have been conducted, and are now going on, with pig-iron from Cleveland, with the object of separating the phosphorus in it, which averages about 1·5 per cent. At the meeting of the Iron and Steel

Institute, held in this town in 1877, an interesting paper was read by Mr. I. L. Bell, M.P., describing a process by which Cleveland iron, mixed with a certain weight of oxide of iron, and kept at a moderate melting heat, was found to liberate a large part of the phosphorus, whereas at a high heat the phosphorus was retained. In a letter recently received from Mr. Bell, he says: "I have succeeded, by means of oxide of iron at moderate temperatures, in removing 96 per cent of the phosphorus in pig-iron, containing 1.5 per cent of this substance, while not more than 4.5 per cent of the carbon was effected, although it existed to the extent of 3.5 per cent in the pig. The silica was almost entirely carried off as  $\text{SiO}_2$ ." Whether these results will lead to their practical application is yet to be seen, but there can be no doubt of the extreme importance of Mr. Bell's experiments if they succeed in making Cleveland iron applicable to the manufacture of steel, and we may wish our eminent member success in his labours. Other processes for the separation of the phosphorus are also being worked out by manufacturers, and there therefore appears little doubt that in time we shall have steel made from north country iron.

#### Papers Read.

During the last winter session there were altogether eight papers read before the members, and amongst them I may refer first to two important papers on the action of the Glover tower, and on nitrous acid compounds generally—the one by Mr. James Maclear, and the other by Dr. George Lunge, of Zurich. Although the conclusions arrived at by the authors differed, there can be no doubt that the subjects embraced in the two papers were ably handled, and are well worthy of further investigation. Gay-Lussac has long since taught us that at least two-thirds of the nitrate of soda at one time thought necessary may be saved by the use of his well-known tower. But in the present day further reliable investigation appears necessary to account exactly for the remaining third, and to suggest remedies for its loss. It is to be hoped that the authors will give us additional papers at a future time on this subject. We had also an interesting paper by Mr. Maclear "On the New Revolving Ball Furnace," and the "New Carbonating Furnace," which bear his name, and which have already been referred to. Mr. John Pattinson read a valuable paper "On the Quality of Small Coals used on the Tyne," which will prove of use hereafter; Mr. J. W. Swan, "On a New Form of Water-jet Aspirator;" Mr. John Watson, of Seaham, "On the Purification of Rivers," a large and important subject, in a sanitary point of view; Mr. John Morrison, "On the Manure Trade;" and Mr. J. T. Dunn, "On Indicators in Alkalinity," which are all important contributions to our knowledge, and will be found in the *Transactions* of the Society for last year.

In concluding this paper I have to ask your indulgence for many omissions, and have, at the same time, to thank you for your patient attention to the few imperfect remarks which I have ventured to address to you.

## CORRESPONDENCE.

### OZONE AND THE ATMOSPHERE.

To the Editor of the *Chemical News*.

SIR,—In the *CHEMICAL NEWS* (vol. xxxviii., p. 224) there appeared a paper on the above subject, in which the author (Albert R. Leeds, Ph.D.) seems to have fallen into an error committed by many other observers, namely, that of estimating as ozone everything in the atmosphere capable of colouring so-called ozoscopic papers. I have so repeatedly pointed out this error in the publication of researches on the oxidation of terpenes and similar hydrocarbons, that scientific men, at least, might be reasonably expected to avoid it.

Curiously enough, the very facts mentioned in Mr. Leeds's paper afford evidence of the truth of my statements. He has observed that the atmosphere in the neighbourhood of pine woods is particularly rich in what he regards as ozone, but what I have shown to be peroxide of hydrogen formed during the atmospheric oxidation of the turpentine which is being constantly volatilised into the atmosphere.

One cannot deny the constant occurrence of atmospheric conditions under which ozone would presumably be formed, but, in my opinion, peroxide of hydrogen is a far more abundant and more effectual natural purifier.

Trusting, Sir, you will insert these few words, for the sake of accuracy in chemical observations, I am, &c.,

C. W. KINGZETT.

12, Auriol Road, West Kensington,  
November 11, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Fustus Liebig's Annalen der Chemie,*  
Band 194, Heft 1.

On Ultramarine.—Dr. R. Hofmann.—Theoretical investigations with the view of determining the constitution of ultramarine. The author, however, quoting some of the formulæ for natural silicates proposed by Hanshofer, admits that they "belong in the realms of fancy rather than in those of sober research."

Action of Alcoholic Potassa upon Bromoform.—H. Long.—The author's results show that ethylen and carbonic oxide, although produced by the action of potassa from two distinct bodies, namely, alcohol and bromoform, bear to each other the simple stœchiometrical relation of 1 : 3 molecular weights.

On Hypophosphorous Acid and its Salts. (Second Treatise).—Th. Salzer.—Concerning the preparation of the acid the author remarks that only about one-fifteenth of the phosphorus employed is converted into hypophosphorous acid, the bulk passing on to the state of phosphoric acid. He then gives a detailed account of the combinations of hypophosphorous acid with soda, potassa, ammonia, baryta, and lime. He adds that, as there seems to exist only one combination of hypophosphorous acid and lime, it will be possible to titrate neutral solutions of lime with neutral hypophosphite of soda, using reddened tincture of litmus as indicator, since an alkaline reaction must appear when the precipitation is complete. The process may be extended to the salts of lead and other metals.

Material for Standard Weights and Measures.—F. Mohr.—As material for weights the author proposes glass containing a large proportion of silica. He remarks that the only men of science who work with good balances and accurate weights are the chemists; and hitherto none of them has considered it necessary in his weighing operations to consult the barometer and the thermometer, except as regards the gases. In one and the same set of weights are to be found pieces of brass and of platinum, and the same weights are used in Munich, at the height of 1700 feet, and in London, Kiel, and Greifswalde, at slight elevations above the sea-level. Against the consequences of these fallacies the best weights are no protection, and we may say that this source of error has been neglected in all chemical discoveries. We must easily see that it is unjustifiable to weigh finer than to milligrammes in all cases where a platinum crucible is concerned, or the ash of a filter, or glass vessels holding a considerable volume of air, or precipitates not absolutely insoluble.

Rarely is the substance weighed which we are in search of, as silica or alumina, but it is generally calculated from some compound, and this introduces the further uncertainty of the atomic weights which are brought to a round number, as in case of phosphorus, sodium, calcium, magnesium, &c. It may be said that the whole structure of organic chemistry has been erected with a false atomic weight for carbon, which is even yet uncertain. A fall of the barometer of 10 m.m., which may occur in one day, will render a kilo. weight of rock crystal lighter by 5.3 mgrms. What is the use, therefore, of adjusting a standard kilo. to the decimal of a milligramme if the barometer and the thermometer can bring about such changes? Weights of crystal and of platinum are not commensurable unless the atmospheric pressure is taken into account. (See "Researches on the Atomic Weight of Thallium," by the Editor, as an instance of a chemical investigation where the influence of the barometric pressure was taken into account in the operation of weighing.)

On Vanillo-diacetonamin.—W. Heintz.—The author describes this base, and its oxalate, sulphate, nitrate, and hydrochlorate.

On a New Organic Base in Animal Organisms.—P. Schreiner.—The base in question, which occurs in various parts of the animal system, both in a morbid and in a normal condition, evolves ammonia on treatment with soda; with chloride of zinc it gives a white flocculent precipitate soluble in hydrochloric acid. With auric chloride it yields an immediate gold-coloured precipitate which gradually becomes crystalline. With solution of tannin there is formed a white flocculent precipitate; with silver nitrate a white flocculent precipitate, soluble in ammonia, and in the nitric, sulphuric, and acetic acids. Iodide of potassium produces no change, and plumbic acetate, whether neutral or basic, occasions no precipitation.

Action of Ammonia upon Isatin (Second Treatise).—Dr. Erwin v. Sommaruga.—The author describes the derivatives of diamido-isatin; its reduction with sodium-amalgam: the salts of dihydro-mono-amido-isatin; the reduction of diamido-isatin with tin and hydrochloric acid; the derivatives of oxydiimido-diamido-isatin, its nitroso-product and its reduction; the oxidation of diamido-hydrindinic acid; for which compounds he in conclusion proposes a set of structural formulæ.

Constituents of Corallin, and their Relations to the Colouring-matters of the Rosanilin Group.—Carl Zulkowsky.—The author describes the following process as the most advantageous for the preparation of corallin:—One part of phenol is weighed into a flask, and  $\frac{3}{4}$  part sulphuric acid added by degrees. The mixture is heated for ten hours in the water-bath, in order to complete as fully as possible the formation of sulpho-phenol. The pulverised oxalic acid is dehydrated in a pan heated by steam, and 0.7 part added at once to the above mixture. The flask is fitted with a reflux-condenser and a thermometer, placed upon an iron disk, and gradually heated to 120°, when the oxalic acid is gradually dissolved. The temperature is maintained at from 125° to 130°, till the liberation of gas becomes decidedly slight and the contents of the flask on cooling appear as a thick dark mass. It is heated again and poured into an excess of water, which is constantly stirred, when the corallin is deposited as a resinous body of metallic lustre. The liquid contains a considerable quantity of phenol, sulpho-phenol, the whole of the sulphuric acid, and a little corallin, and is therefore drawn off for future utilisation. The deposit of corallin is repeatedly boiled in water by means of steam, when all adhering phenol is dissolved or evaporated. It is finally obtained as a solid, brittle, green mass. The yield of this process is 70 per cent. From the residues it is still possible to obtain a very considerable quantity of corallin. They are mixed with an excess of cream of lime, when the mass takes a deep red colour. The sulphate of lime is removed by filtration and the liquid con-

centrated, filtering off any further deposits of gypsum. The liquid is then further concentrated until the temperature reaches 135°. Such residues yield corallin if mixed with the corresponding quantity of anhydrous oxalic acid and treated as above specified. The author resolves rosolic acid into five portions: a rosolic acid crystallising in needles of a bright green metallic lustre, accompanied by violet-blue needles; a rosolic acid in larger garnet-red crystals, also accompanied by the violet-blue substance; a compound which appears as a light red crystalline powder contaminated with a little resin. The first-mentioned rosolic acid has a chemical composition expressed by the formula  $C_{20}H_{16}O_3 + H_2O$ . Several isomeric compounds of this kind are probable. The garnet-red rosolic acid appears to have the composition  $C_{19}H_{14}O_3$ . The blue-violet acicular crystals,  $C_{21}H_{16}O_6$ , undergo a partial decomposition even at 100°. They are probably a derivative of the garnet-red acid, both yielding the same leuco-product. Leuco-rosolic acid has not been closely examined. Nor has the composition of the resinous matter (pseudo-rosolic acid) been determined. Its oxidation-product, obtained by treatment with a mixture of permanganate of potassa and caustic alkali, is a true colouring-matter, dyeing yellowish orange shades on wool closely resembling those produced with annatto. Its properties agree closely with those ascribed by Baeyer to the compounds of phthalidein with the phenols. Its elementary analysis agrees with the composition  $C_{20}H_{14}O_4$ .

## MISCELLANEOUS.

The Royal Society.—The following are the awards of medals by the Council of the Royal Society for the present year:—The Copley Medal to M. Jean Baptiste Boussingault, for his long-continued and important researches and discoveries in agricultural chemistry; a Royal Medal to Mr. John Allan Broun, F.R.S., for his investigations during thirty-five years in magnetism and meteorology, and for his improvement in methods of observation; a Royal Medal to Dr. Albert Günther, F.R.S., for his numerous and valuable contributions to zoology and anatomy of fishes and reptiles; the Rumford Medal to M. Alfred Cornu, for his various optical researches, and especially for his recent re-determination of the velocity of propagation of light; the Davy Medal to Messrs. Louis Paul Cailletet and Raoul Pictet, for their researches, conducted independently, but contemporaneously, on the condensation of the so-called permanent gases.

## NOTES AND QUERIES.

Resorcin and its Derivatives.—Can anybody give me the address of the manufacturers of the above, or of their agents in London?—CHARLES H. PIESSE.

Porion Evaporator.—Can anyone supply the date and number of the Specification of Patent, or say where will be found a description of the evaporator.—J. C.

Testing and Valuation of Gas Liquors.—(Reply to "Sul. Am.") In my paper on "Testing and Valuation of Gas Liquor," what I mean by normal sulphuric acid is sulphuric acid made of such a strength that 1 c.c. of it will exactly neutralise 0.017 gm. of  $NH_3$ . Such an acid contains 40 grms. of  $SO_2$  per litre, or 0.04 gm. per c.c. Normal soda is a solution of caustic soda of such a strength that 1 c.c. will exactly neutralise 1 c.c. of normal sulphuric acid.—T. H. D.

Chemical Bronzes.—I believe that it is an admitted fact that the various manufacturing nations of Europe, also the Americans, are daily driving us closer into a corner (commercially); and, I think, in no trade more than in the various brass manufactures. We are (employers and employed) behind the age in chemistry: in bronzing, for instance, the French stand pre-eminently over us. I have no doubt but that some of the readers of the CHEMICAL NEWS could and would help us considerably in this matter. What is wanted is this—some plainly described processes to get the different colours on brass, spelter, and iron. If such recipes were given in the CHEMICAL NEWS they would be copied in all technical and many other newspapers.—RICHARD BENTLEY.

## TO CORRESPONDENTS.

Burnard, Lack, and Alger.—This firm write to say that they were awarded two Silver Medals for their exhibits at the Paris Exhibition in addition to the "Honourable Mention" in our list of Oct. 25.

## THE CHEMICAL NEWS.

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## ON THE CONSTITUTION OF MATTER IN THE GASEOUS STATE.\*

LADIES AND GENTLEMEN,—I esteem it a great honour to address you within these walls, about which there still hovers the ever fresh memory of him whose name we celebrate to-day, while we deplore his loss. I am fully sensible both of the great value of this honour and of the danger that attends it, and I have need to shelter myself under the authority of the great name of FARADAY. I have, therefore, chosen a subject connected with his earliest discoveries. The constitution of matter is a question of the highest importance with regard both to physics and to chemistry.

The word *gas* was introduced into science by Van Helmont, who, at the beginning of the seventeenth century, first pointed out, with some degree of precision, the differences existing between certain aëriform fluids. He it was who first spoke of *Gas silvestre*, formed by the combustion of charcoal, and given off during the fermentation of beer. To him, also, we owe the distinction—which kept its ground for two centuries—between gases and vapours. He regarded gases as aëriform fluids, incapable of reduction to the liquid state by cooling, whereas vapours require the aid of heat to maintain them in the gaseous state. An important difference of constitution seemed, therefore, to exist between these two kinds of aëriform fluid. This difference, however, is not fundamental, and the distinction between gases and vapours has disappeared, in a theoretical point of view, being, in fact, reduced to a simple question of temperature and pressure.

On March 13, 1823, Faraday, then a young man engaged as chemical assistant at the Royal Institution, read before the Royal Society a note entitled "On Fluid Chlorine." He had succeeded in condensing this gas to a liquid by a process which has become classical. This process consists in heating in a closed vessel placed in a water-bath crystals of chlorine hydrate. This compound, very rich in chlorine, is resolved at a gentle heat into chlorine and liquid water, the quantity of which is not sufficient to dissolve the whole of the chlorine. The latter is therefore disengaged in great part in the state of gas, which accumulates in the small space remaining to it, and is liquefied by the pressure which it exerts upon itself.

On the same day Sir Humphry Davy read a note "On the Liquefaction of Hydrochloric Acid Gas," which he effected by decomposing sal-ammoniac with sulphuric acid in a closed vessel. These researches were completed by Faraday, who, on April 10 of the same year, described the liquefaction of a large number of gases, directing his efforts, by Davy's advice, chiefly to those which are dense, or very soluble in water, such as sulphurous acid, ammonia, sulphuretted hydrogen, carbonic acid, and protoxide of nitrogen.

To enumerate the special processes adopted in each particular case would occupy too much time. We shall therefore merely observe that the chief, if not the only, means of condensation adopted in these experiments was compression, that is to say, the reduction of the gas to a small volume, and that this compression was exerted by the gas upon itself, as it accumulated in the very strong sealed glass tubes in which it was disengaged. Sir Humphry Davy, in the note above cited, had remarked

that pressure appeared to be a more efficacious method of condensation than cooling, inasmuch as a double pressure reduces the volume of the gas to one-half, whereas a depression of temperature of 1° F. reduces the volume by only  $\frac{1}{400}$ , the lowering of temperature, moreover, soon attaining an impassable limit. It must, however, be especially observed that, even in his first experiments, Faraday made use of differences of temperature, if not to liquefy the gases, at all events to distil and isolate the liquids. Thus it was in the case of chlorine, for example, and in that of ammonia, which he liquefied by heating ammoniacal silver chloride in a bent tube sealed at both ends, the liquid ammonia then distilling over and collecting in the empty branch of the tube, which was cooled to a low temperature.

Similar phenomena will be exhibited in the experiment which I am about to show you, consisting in the liquefaction of cyanogen gas by heating cyanide of mercury in a small glass tube terminated by a long capillary tube bent in the form of the letter U. The figure of this curved portion will be projected on a screen by the electric light, and in a few seconds you will see the liquid cyanogen collect in the bend.

Before leaving this part of my subject, I would recall to your attention two of Faraday's discoveries resulting from the application of the principles just explained. Having compressed coal-gas to twenty-five atmospheres, Faraday, in 1825, discovered two important bodies, namely, butylene, a compound of great importance in a theoretical point of view—and benzene—so named by Mitscherlich several years afterwards—which in our own time has become the object of numerous and important applications, and the pivot of an entire department of chemistry.

Another instance is afforded by sulphurous acid gas (SO<sub>2</sub>), which was liquefied by Bussy in 1824, at the ordinary atmospheric pressure by the effect of a cold of 12° to 15° below zero.

Whether we condense gases by pressure or reduce them to the liquid state by diminution of temperature, the result of either method is to bring their particles closer together. It would seem then, in accordance with Davy's view, that pressure ought to be more efficacious, as a means of condensation, than cooling. Nevertheless it is not so. The mere approximation of the particles of certain gases does not suffice to effect their liquefaction, and, moreover, the distances between the particles cannot be diminished indefinitely by pressure alone. M. Natterer, of Vienna, has compressed oxygen, hydrogen, and nitrogen to 3000 atmospheres without effecting their liquefaction. These gases, hitherto called permanent, cannot be liquefied by pressure alone, and their liquefaction, which has quite recently been effected, is the joint effect of strong pressure and a great degree of cold. This is the important point, and I request your permission to offer in this place a few explanations which will serve to place it in its true light.

The impossibility of liquefying certain gases by pressure alone is in accordance with the ideas which are current at the present day respecting the nature of aëriform fluids, and likewise with a discovery made in England within the last few years, on the continuity of the gaseous and liquid states. I will explain myself briefly on these two points.

Daniel Bernouilli first enunciated the idea that gases are formed of material particles, free in space, and animated by very rapid rectilinear movements, and that the tension of elastic fluids results from the shock of their particles against the sides of the containing vessels. Such is the origin of the kinetic theory of gases, which has been revived since 1824 by Herapath, Joule, and Krönig, and developed chiefly by Clausius and Clerk-Maxwell.

The law of Boyle and of Mariotte follows as a natural consequence of this idea. Suppose a gas occupying a certain volume, and composed of a definite number of material particles—or molecules so-called—to be contained in a closed vessel, such as the cylinder of an air-pump;

\* The Faraday Lecture, delivered before the Fellows of the Chemical Society, in the Theatre of the Royal Institution, on Tuesday, November 12, 1878, by Ad. Wurtz, Membre de l'Institut; Doyen Ordinaire de la Faculté de Médecine de Paris.

the pressure on the piston will be determined by the number of shocks of the molecules diffused through the neighbouring stratum of gas. If, then, the volume of the gas be reduced, the number of particles in this layer will be increased, as well as the sum of the shocks, and the pressure will be increased in proportion thereto.

The velocities with which these molecules move are enormous. Clausius supposes that the molecules of air move with a mean velocity of 485 metres per second, and those of hydrogen with a mean velocity of 1844 metres per second. I say mean velocity, for all the particles of a gas do not move at the same rate. But can the particles traverse freely these wide spaces? By no means; their number is so immense that at every instant they enter into collision with one another, and rebound in such a manner that their motion is altered both in velocity and in direction. It follows, therefore, that the molecules of a gaseous mass are continually moving in all directions with variable velocities, their motion in the intervals of collisions being sensibly rectilinear. The distribution of the velocities has been made the subject of important researches by Clerk-Maxwell.

These movements of gaseous molecules determine a very important physical condition, namely, temperature. In fact, the energy of the rectilinear movements, that is to say, the mass of the gaseous molecules multiplied by the square of the velocity, gives the measure of the temperature, which consequently increases proportionally to the energy of the rectilinear movement, or, for the same gas—since the masses remain constant—it increases as the square of the velocity. If the velocity were reduced to nothing, the calorific motion would be annihilated, that is to say, the gas would be entirely deprived of heat. This state corresponds with the absolute zero.

The gaseous molecules moving in all directions, and coming into collision with one another in space, are very nearly emancipated from cohesion. Nevertheless this attractive force makes itself felt for the infinitely short time during which the molecules actually touch one another, or are on the point of doing so. This influence of cohesion is one of the causes of deviation from the law of Boyle or of Mariotte.

In liquids the influence of cohesion is manifest, preventing the molecules from separating, though it allows them to glide one over the other. This molecular cohesion, or attraction, is in continual strife with the force of expansion, or kinetic energy, which, if unopposed, would launch the molecules into space.

To understand the antagonism between these two forces, consider for a moment a saturated vapour in contact with the liquid from which it has been formed. When it is reduced to a smaller volume, a certain number of its molecules are brought within the sphere of action of cohesion; they are consequently aggregated together and precipitated in the liquid state, while the rest, being now diffused through a wider space, continue to move with the same velocity and to exert the same pressure as before. In this case the force of cohesion of the liquid particles exactly balances the expansive force or kinetic energy, and serves to a certain extent as a measure of its amount.

Now let the vapour be heated, after it has been withdrawn from the action of the liquid; its expansive force will then increase; it will dilate, and may then be compressed, until, by the approximation of its particles, it is again brought within the sphere of action of the cohesive force,—that is to say, to the point of saturation corresponding with the temperature to which it has been raised. With the increase of temperature, the expansive force or kinetic energy of the vapour likewise increases, whereas the cohesion of the liquid becomes less: hence the necessity of further diminishing the distances between the particles by increase of pressure. But this double effect of increased kinetic energy of the gaseous molecules, and diminished cohesion of the liquid molecules, going on progressively as the temperature rises, a point will at length be attained at which the energy of the

molecular movement will finally gain the victory over the force of cohesion, *whatever be the pressure to which the vapour is subjected*. The minimum temperature at which this effect is produced, and at which, therefore, a vapour can no longer co-exist with its liquid under any pressure whatever, has been called, by my friend Dr. Andrews, the critical point, and by M. Mendelejeff the absolute boiling-point. Above this temperature, whatever may be the pressure, the gas, whether dilated or compressed, will maintain the same physical state, characterised by freedom of molecular or calorific movement.

I can show you by experiment this peculiar phenomenon of the sudden passage of a liquid mass to the state of gas, by heating liquid carbonic acid in a closed vessel, just as Cagniard de Latour formerly heated ether. Here is a tube, half filled with liquid carbonic acid, which we are about to immerse in water at 35°: you observe that the liquid first rises quickly in the tube, its coefficient of expansion being greater than that of gases; at the same time the meniscus flattens more and more, indicating a diminution of cohesion in the liquid (Andrews), and finally disappears altogether; in fact the liquid itself has disappeared, having been entirely and suddenly transformed into gas. What now must we do to cause it to reappear? We must lower the temperature, so as to diminish the kinetic energy of the gas, and increase the cohesion of the liquid. A moment will then arrive when the cohesive force will again be able to resume the contest, and the liquid will be re-constituted.

We are now in a position to understand why certain gases, hitherto called *permanent*, cannot be liquefied except by the combined action of very strong pressure and a very great degree of cold. The critical points of these gases are situated at very low temperatures. They have quite recently been liquefied, this great discovery having been made by MM. Cailletet and Raoul Pictet.

The principle of Cailletet's apparatus is the following:—The gas to be liquefied is introduced into a cylindrical glass vessel, and transferred by means of mercury to a very strong glass tube sealed into the reservoir. This latter is firmly fixed in a cylindrical cavity hollowed out of a block of iron, and serving as a kind of closed mercurial trough. The cylindrical cavity communicates with a hydraulic press which injects water on to the surface of the mercury, driving it into the gas reservoir, which is ultimately quite filled with that liquid, the gas being thereby driven into the tube, where it is liquefied.

In this manner we shall be able by a few strokes of the piston of the hydraulic press to liquefy carbonic acid. Other gases less easily condensable may be liquefied in a similar manner, if the tube be cooled to  $-20^{\circ}$  or  $-30^{\circ}$ . But these temperatures do not suffice for the liquefaction of the so-called permanent gases. To cool these gases to lower temperatures, M. Cailletet avails himself of sudden expansion (*détente*). The gas, compressed to several hundreds of atmospheres, when allowed to expand suddenly, and drive the air before it, consumes a certain quantity of heat, and is thereby reduced to a kind of mist, which will appear on the screen, and pass away like a cloud, if we suddenly expand the strongly compressed carbonic acid gas, which we have here, in default of oxygen or hydrogen.

M. Raoul Pictet has succeeded in condensing oxygen and hydrogen in the form of liquids, properly so called, and even in obtaining the latter of these gases in the solid state. To produce this effect, he employs condensing apparatus of incomparable power, combining the action of a cold of  $120^{\circ}$ — $140^{\circ}$  below zero with that of enormous pressures amounting to 550 and even 650 atmospheres. The pressure is produced by the accumulation of the gases in a closed space consisting of a long copper tube of very thick metal. The oxygen was produced by heating potassium chlorate in a howitzer shell, having a copper tube soldered into its orifice. The hydrogen was prepared in a similar apparatus, by decom-

position of a dry mixture of potassium formate and potassium hydroxide.

To produce very low temperatures of  $120^{\circ}$  or even  $140^{\circ}$  below zero, M. Piçtet resorts to a very ingenious artifice. Over the reservoir-tube which surrounds the copper tube, and in which these low temperatures are intended to be produced, he superposes another system of concentric tubes, intended to produce a first fall of temperature amounting to  $-65^{\circ}$ , by the volatilisation of liquid sulphurous acid. By means of this first depression of temperature it has been found possible to liquefy carbonic acid gas in the inner tube of the system just mentioned, by a pressure of only a few atmospheres. The carbonic acid thus liquefied being introduced into the lower reservoir-tube of the apparatus, produces by its volatilisation, a second fall of temperature round the copper tube containing the compressed oxygen which is to be liquefied. M. Piçtet has in fact established a double circulation, one of sulphurous acid, the other of carbonic acid. I will describe the former. Sulphurous acid gas is liquefied by a pressure of three atmospheres, and collects in a strong vessel, from which it passes through a tube into the upper reservoir. The pressure is exerted by means of a force-pump. A suction-pump connected with the force-pump, and acting in concert with it, withdraws the liquid sulphurous acid from the reservoir-tube, and transfers it to the force-pump, which brings it back to the vessel, and thence to the upper reservoir-tube.

The circulation of the carbonic acid is established in the same manner, by means of two pumps, one of which condenses the gas by forcing it into tubes cooled to  $-61^{\circ}$ , while the other, which is a suction-pump, sends it back to the force-pump. The volatilisation of the carbonic acid produces round the copper tube, the low temperatures above mentioned. The copper tube is in fact surrounded by solid carbonic acid.

In this manner M. Piçtet has liquefied oxygen, and has approximately calculated its density. He has also liquefied and even solidified hydrogen, which he has seen to issue from the tube in the form of a steel-blue liquid jet, which partly solidified. The solid hydrogen, in falling on the floor, produced the shrill noise of metallic hail, thus confirming the bold and ingenious idea of Faraday, who first suggested that hydrogen is a metal.

The experiments of MM. Raoul Piçtet and Cailletet have, then, removed from science the distinction between permanent and condensable gases. Permanent gases exist no longer. All æriform fluids may be liquefied with a facility greater in proportion as their critical points are situated at higher temperatures. From a physical point of view, therefore, gases and vapours have the same constitution, being formed of molecules which move freely in space. In what, then, do they differ? They differ by the nature and constitution of these molecules; and here we enter on the domain of CHEMISTRY.

It is supposed in chemistry that the molecules of each species of gas or vapour are formed of a definite number of atoms. The simplest molecules, like those of mercury vapour, are formed of single atoms. Others include several atoms of the same or of different kinds: and these latter molecules may be very complex, that is to say, formed of a large number of atoms held together by affinity, and vibrating in concert in a system to which they are attached, viz., the molecule. In this system, which has a definite form, extent, and centre of gravity, the molecules execute their own proper movements, and are at the same time carried forward with the entire system in the molecular paths.

I cannot here dilate on the nature and chemical properties of the several gases and vapours. I wish merely to throw light on a single point, which is of great importance, inasmuch as it constitutes one of the foundations of chemical science.

The proposition which I am about to enunciate is generally adopted by chemists, resting as it does on an imposing array of facts:—*Equal volumes of gases or vapours, under*

*the same conditions of pressure and temperature, contain equal number of molecules.*

The Italian chemist, Amadeo Avogadro, in discussing the discoveries of Gay-Lussac respecting the simple relations which exist between the volumes in which gases combine, was the first to recognise that there likewise exists a simple relation between the volumes of gases and the number of molecules which they contain. The simplest hypothesis, said he, that can be made regarding this matter, consists in supposing that all gases contain in equal volumes equal numbers of "integrant molecules." By this term he denoted what we now call simply *molecules*, and he distinguished these integrant molecules from the "elementary molecules," which we call *atoms*. According to him, the integrant molecules of gases are all equally distant one from the other, and these distances are so great in proportion to the dimensions of the molecules that the mutual attraction between the latter is reduced to nothing.

These integrant molecules are composed of a greater or smaller number of elementary molecules, not only in compound, but likewise in simple bodies: the integrant molecules of chlorine, for example, are composed of four elementary molecules, and the same is the case with the integrant molecules of hydrogen. What happens, then, when chlorine and hydrogen combine together? The integrant molecules of these two bodies are then resolved into elementary molecules, which combine, two by two, to form hydrochloric acid.

Ideas analogous to those of the Italian chemist were enunciated in 1814 by Ampère, and thus there has been introduced into chemical science the notion that there exist two kinds of small particles, namely, molecules and atoms, the former being diffused in equal numbers through equal volumes of gases.

But this notion, so clearly enunciated more than sixty years ago, was afterwards destined to be obscured. Berzelius, taking up Ampère's proposition, altered it by substituting atoms for molecules, and saying that "equal volumes of gases contain equal numbers of atoms." This proposition, which has given rise to long discussions, must now be rejected, for it is inexact. It is to Gerhardt, and more recently to Cannizzaro, that is due the honour of having restored the thesis of Avogadro and Ampère, and pointed out its importance in connection with chemical theory. This I must explain in conclusion.

In the first place Gerhardt simplified the rule of Avogadro. The latter supposed that a molecule of chlorine or of hydrogen contains four atoms, whereas Gerhardt regards it as consisting of two. Avogadro's proposition thus modified, assumes a very simple form, and may be enunciated in the following terms:—Suppose that a volume, or the unit of volume, of hydrogen contains one atom, then the molecules of all gases and vapours will occupy two volumes. Thus, a molecule of hydrogen formed of two atoms will occupy two volumes, and a molecule of chlorine formed of two atoms will likewise occupy two volumes. What, now, will happen when chlorine combines with hydrogen? The molecules will be cut in two, and each of the two chlorine-atoms, uniting itself to an atom of hydrogen, two molecules of hydrochloric acid will be formed, each occupying two volumes. Thus, if an atom of hydrogen occupies one volume, a molecule of hydrochloric acid will occupy two volumes. The same is the case with the molecules of all other gases and vapours.

1 mol. water formed of 2 at. H and 1 at. O occupies 2 vols.  
 „ ammonia „ 3 at. H and 1 at. N „ „  
 „ marsh gas „ 4 at. H and 1 at. C „ „

This list might be prolonged by taking as examples a large number of gaseous or volatile bodies belonging both to mineral and to organic chemistry, and including chlorinated, brominated, and oxygenated compounds of the metalloids, and of a large number of metals. The countless volatile compounds of organic chemistry, hydrocarbons, alcohols, chlorides, bromides, organo-metallic

compounds, compound ammonias, aldehyds, ketones—all this legion of divers compounds—conform to the law of Avogadro and Ampère, their molecules occupying two volumes if an atom of hydrogen occupies one volume. Hence it follows that the relative weights of two volumes represent the relative weights of the molecules or the molecular weights. To find these latter, therefore, it is sufficient to double the numbers which express the weights of a single volume, or of the unit of volume, that is to say the densities. The densities of gases may be referred to that of hydrogen as unity, and the atomic weights to that of hydrogen. The unit being then the same, it follows that the numbers which express the double densities referred to hydrogen will also represent the molecular weights.

Chemists represent the constitution of molecules by formulæ, each of which shows the number of atoms condensed within the molecule. Now the molecular weights being known, it is very easy to deduce the formulæ from them, as these formulæ must represent the number of atoms comprised in two volumes. Such is the relation which exists between the Law of Volumes and Chemical Notation. The rule of Avogadro and Ampère has, in fact, become one of the bases of this notation. There are, however, certain exceptions to its generality, but they are probably more apparent than real. Sal-ammoniac, ammonium sulphhydrate, phosphorus pentachloride, iodine trichloride, sulphuric acid, calomel, amylen hydrobromide, and chloral hydrate, have vapour densities such that their molecules appear to occupy four volumes. Such, however, is not the case; and it may be shown that the bodies in question do not volatilise without decomposition, but that, when they are heated, their molecules split up into two, each of which occupies two volumes. Being unable to analyse all the cases above-mentioned, I will confine myself to the last, viz., chloral hydrate, which has been given rise to a long discussion.

The question to be decided is, whether this compound is or is not decomposed by conversion into vapour. If it really suffers decomposition, it should be resolved into anhydrous chloral and water. That this decomposition really takes place may be shown on a method based on the theory of dissociation developed by M. H. Ste.-Claire Deville.

Here is the case in a few words. We have here in a tube a certain volume of the vapour of chloral hydrate under a certain pressure; it is required to show that this vapour contains vapour of water. For this purpose we are about to introduce into it a body capable of emitting vapour of water, crystallised potassium oxalate, for example. If the atmosphere is dry, this salt will give off vapour of water just as it would in dry air or in vapour of chloroform at the same temperature, and it will continue to emit this vapour until the atmosphere shall have taken up a degree of humidity corresponding with that which is designated by M. H. Ste.-Claire Deville as the *dissociation tension* of the hydrated salt in question. If, on the other hand, the chloral atmosphere is moist, and exhibits exactly the degree of humidity just defined, the crystallised oxalate will not emit any water. In this first tube, then, we have the vapour of chloral hydrate; the second contains vapour of chloroform. This latter is dry, and I am about to prove to you that the former is moist. In fact, the crystallised potassium oxalate which we are introducing into the chloroform tube will rapidly depress the level of the mercury by emitting vapour of water, whereas in the atmosphere of chloral hydrates it will not emit vapour of water, and consequently will not depress the level of the mercury. This shows that chloral hydrate undergoes decomposition when converted into vapour, and this supposed exception to the rule of Avogadro and Ampère vanishes, like all the rest, when submitted to the test of experiment. This rule appears, then, like a grand law of nature, as simple in its enunciation as it is important in its consequences.

Such are the considerations which I wished to lay be-

fore you on the physical and chemical constitution of gases. Does not this exposition seem to show that, of all the states which matter can assume, the gaseous state is the most accessible to our researches, and the best known—not, indeed, that we can affirm the certainty of the theoretical considerations which I have brought before you, for they are but probable. In the physical sciences nothing is certain but well-observed facts and their immediate consequences, and, whenever we attempt to make these facts the basis of any general theory, hypothetical data are apt to mix themselves up with our deductions. In the present case the hypothesis consists in assuming that gases and matter in general are formed of molecules, and these latter of atoms. No one has ever seen these molecules and atoms, and it is certain that nobody ever will see them. Does it follow, then, that we ought to reject or disdain this hypothesis? By no means. Our theories may be verified in their consequences, and may thereby acquire a certain degree of probability. The theory under consideration has been subjected to this ordeal, and nothing has hitherto been found to contradict it. Yes, it is probable that gases are composed of small particles moving freely in space, with immense velocities, and capable of communicating their motion by collision or by friction. It is probable that these molecules are diffused in space in numbers so enormous that the most rarefied spaces still contain legions of them; and it is this circumstance which explains the possibility of the movements of the radiometer.

Be this as it may, the idea of Daniel Bernouilli has been developed into a beautiful theory—the kinetic theory of gases—a theory which has shed a sudden clearness, an unexpected light, on matters which seemed to be veiled in the deepest obscurity. The molecules, as already stated, are invisible. Nevertheless, attempts have been made to penetrate this invisible world by the force of scientific reasoning, and by an effort which does honour to the human mind, even if it be destined to remain barren. The illustrious authors of the kinetic theory of gases have sought to determine, not only the velocities of the gaseous molecules, and the prodigious number of their collisions during a unit of time, but likewise their distances, their absolute dimensions, and their number in a given volume. And here we arrive at results which bewilder the imagination, but which, in this lecture, I must not attempt to unfold.

Permit me only to add that these great labours mark a resting-place in our course, and are, perhaps, an approach towards the solution of the eternal problem of the constitution of matter—a problem which dates from the earliest ages of civilisation, and though discussed by all the great thinkers of ancient, as well as of modern, times, still remains unsolved. May we not hope that in our own time this problem has been more clearly stated and more earnestly attacked, and that the labours of the nineteenth century have advanced the human mind in these arduous paths, more than those of a Lucretius, or even of a Descartes and a Newton. From this point of view, the discoveries of modern chemistry, so well expressed and summarised by the immortal conception of Dalton, will mark an epoch in the progress of the human mind; and to one of the most important among these discoveries—that of the liquefaction of the gases—grateful posterity will for ever join the glorious name of FARADAY.

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On Isodulcite.—L. Berend.—It has been recently shown, by MM. Liebermann and Hörmann, that the glycoside of Persian berries when decomposed by acids, contrary to previous statements, yields a well-crystallised sugar, very similar to the isodulcite prepared by Hlasiwetz and Pfaundler from quercitrin. The author finds that some of the statements of the two latter chemists are somewhat inaccurate, and that the two sugars are identical.—*Berichte der Deutschen.*

ANALYSIS OF A REMARKABLE  
MINERAL WATER.

By OTTO HEHNER, F.C.S., F. Inst. Chem.

I HAVE recently had to analyse a sample of mineral water, stated to have been taken from a spring about 20 miles from Cape Town, and as the results of the analysis are somewhat extraordinary I subjoin them below.

The water was of a brown colour, resembling that of dark ale, had a specific gravity of 1020.5 at 15.5° C., and was intensely acid, both to the tongue and to test paper. 100,000 parts contained:—

HCl (free) .. .. .	9.30
N <sub>2</sub> O <sub>5</sub> (free) .. .. .	0.64
P <sub>2</sub> O <sub>5</sub> (free) .. .. .	14.58
SO <sub>3</sub> (free) .. .. .	31.21
FeSO <sub>4</sub> .. .. .	1029.46
Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> .. .. .	218.20
Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> .. .. .	525.19
CaSO <sub>4</sub> .. .. .	100.74
MgSO <sub>4</sub> .. .. .	188.37
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> .. .. .	28.20
K <sub>2</sub> SO <sub>4</sub> .. .. .	2.29
Na <sub>2</sub> SO <sub>4</sub> .. .. .	7.24
	-----
	2155.42
Total Fe .. .. .	440.38

I was told that the spring was far removed from any possible source of organic or other contamination.

54, Holborn Viaduct.

OZONE AND THE ATMOSPHERE.\*

By ALBERT R. LEEDS Ph.D.

(Continued from p. 236.)

CRITICAL EXAMINATION OF OZONOSCOPES.

*Potassium Iodide.*—As the potassium iodide manufactured in this country, and sold for chemically pure, has presumably been employed in the preparation of ozone tests by American observers, it was important to examine into its purity. The principal manufacturers are four in number, and their goods were examined with the following results:—

*Analyses of C. P. Potassium Iodide Manufactured in the United States.*

Samp.	Reaction.	Carbates.	Sulphates.	Chlorides.	Iodates.	Iodine.
1	Alkaline	Absent	Absent	Absent	Absent	Absent
2	"	Present	Present	"	"	Present
3	"	Absent	Absent	"	"	Absent
4	Neutral	"	"	Present	"	"

It will be seen from this table, that of the goods purchased at the time the analyses were made, those of but one manufacturer were free from foreign salts, and had a neutral reaction; and, as nothing is easier than the introduction of minute amounts of impurities into chemicals manufactured on the large scale, the necessity of analysing each sample of potassium iodide employed in the making of ozonoscopes is evident.

In order that no unnecessary element of uncertainty, however, should be introduced into the comparison of the various ozone tests employed in this investigation, the potassium iodide was especially made for the purpose. The following method was found convenient, and yielded excellent results:—

36 grms. of iodine were introduced into a flat-bottomed half-litre flask, with 250 c.c. water, and then 12 grms. of clean pianoforte wire added in successive portions. The action at first was slow, but increased with the liberation

of heat due to chemical combination, and at the close was accelerated by heating on a water-bath until all brown colour had disappeared. To the filtrate, which was of a greenish colour, 12 grms. of iodine were added. Potassium carbonate, prepared by ignition of potassium bitartrate, was added, to decided alkaline reaction, and the flask heated on a water-bath until the precipitate separated in the form of ferrosiferrous hydrate. This precipitate, after filtering, was evaporated to dryness, and washed out carefully to obtain the last portion of potassium iodide. The filtrates were evaporated, and two portions of crystals, amounting to 13.5 grms. and 11 grms., of pure potassium iodide obtained from them. The mother-liquor was then evaporated to dryness, alcohol of 85 per cent added to dissolve out the iodide and get rid of excess of potassium carbonate, the potassium iodide crystallised from the alcoholic solution, and washed with absolute alcohol, yielding 29.5 grms. of the salt. The total yield was 54 grms. instead of 62, the theoretical amount.

*Starch.*—In order not to spend time unnecessarily in the examination of starches from various sources, a skilful pharmacist furnished me with arrowroot starch, which he had assured himself by microscopic examination contained no substances of organic origin other than the starch granules. This was washed with large excess of cold distilled water until the filtrates afforded no trace of saline matters, and then dried at the temperature of the air.

*Paper.*—A great variety of papers was examined, and all rejected for one reason or another, except the best Swedish filter-paper. This appeared to have no action on the tests, except possibly upon the thallium and the Moffat. The former, after keeping for some time, was minutely spotted with thallic oxide, and the latter turned brown on the edges. But it is probable that, in the latter case at least, the alteration of the ozonoscope was due to other causes than the paper. The paper might have been treated with dilute acid, and then repeatedly washed with distilled water, in order to remove all the impurities soluble in these menstrua; but this was not done for fear that the paper might be made too fragile to stand much subsequent handling. But fine cotton cloth, treated in this manner, might answer for certain of the tests better than paper.

*Classification of Ozonoscopes.*—The most important ozonoscopes hitherto in use may be conveniently grouped into five classes:—

I. Those depending on the decomposition of a metallic iodide, the liberated iodine indicating the reaction. Under this head the substance almost exclusively used is iodide of potassium. An examination of the tables given below will show that it is the most sensitive of all the ozonoscopes examined. Unfortunately, the action of ozone does not stop with oxidation of the potassium, but extends to the iodine; so that a paper once brown from free iodine may become quite colourless again from the formation of potassium iodate. It is proposed to examine other haloid compounds, especially the iodides of the heavy metals.

II. Class No. I., with starch added as an indicator. Very many tests included in this class have been proposed. They differ chiefly in the relative proportions of potassium iodide and starch. With some the comparison is made when dry, in others after moistening. Or the paper may contain potassium iodide only, the iodide of starch being formed subsequently, by moistening the papers, after exposure, with starch solution. We have added to this list one new test, containing iodide of cadmium (as representative of the iodides of the heavy metals) and starch. It develops the characteristic blue colour of iodide of starch very strongly and persistently on moistening, but is less sensitive than some of the other tests.

III. Those depending upon the alkaline reaction resulting from conversion of the electro-positive element into the form of oxide, litmus or some similar colouring matter being added as indicator. It will be seen from experiments detailed below that there are other bodies sometimes present in the atmosphere which decompose potas-

sium iodide as well as ozone. But if this decomposition is attended with formation of caustic potash only when ozone is the decomposing agent, the litmus-paper will be turned blue only in case of the presence of ozone. This was the ground taken by Houzeau, who proposed, and has strenuously advocated, tests of this character. He admits, however, that hydrogen peroxide will likewise develop an alkaline reaction. The tables above referred to exhibit a similar result.

The best method of preparing these tests is to saturate papers with litmus solution containing about 1 centigram. of litmus in 1 c.c. The litmus must be brought with great care to that shade of wine-red at which it is most sensitive. After drying, some of these papers are impregnated with a 1 per cent solution of potassium iodide, and again dried. Papers of both kinds, the plain and iodised litmus, are cut into slips and exposed in pairs. It is expedient to subject these tests to the action of artificially prepared ozone to see that they are really sensitive. Great differences were found in this manner, between tests not apparently differing much in colour. Even the best did not appear so sensitive as some of those in the first and second classes. (See tables.)

Two new tests were added to this class—the alizarin and phenol-phthalein potassium iodide tests distinguished by the use of alizarin or phenol-phthalein in place of litmus. The alizarin was prepared by dissolving the crystals sublimed from commercial alizarin in 80 per cent alcohol.

Papers impregnated with this solution were dried, moistened with a 1 per cent potassium iodide solution, and dried again. The latter were exposed in strips along with non-iodised alizarin papers. The phenol-phthalein was made by heating 3.3 grms. sublimed phthalic anhydride with 6.6 grms. phenol and 1.5 grms. sulphuric acid at 120° to 130° C., for three hours, thoroughly washing the brown resin obtained, which amounted to about 3 grms.,\* and dissolving in alcohol.

The phenol-phthalein potassium iodide tests were prepared in a manner similar to those of alizarin. It was found, however, that neither of these tests, especially the phenol-phthalein, was as sensitive as that made with properly prepared litmus, and their use, after some trials, was therefore abandoned.

IV. Those depending upon the oxidation of a metal or metallic compound, with the development of a corresponding change of colour.

The most important ozonoscopes in this class which have previously been studied are silver, thallos hydrate, manganous sulphate, and plumbic sulphide. Silver-leaf immersed in an atmosphere containing a sufficient percentage of ozone is very slowly affected, if at all, except in the presence of moisture. Under these circumstances its surface is energetically oxidised, with the formation of magnificent yellow, blue, and other films, passing into black at those points at which the formation of argentic oxide has reached a maximum.

Unfortunately, silver is not sufficiently sensitive to ozone. In a vessel containing in every litre of oxygen 1 m.gram. of ozone, the potassium iodide, the iodo-starch tests, the thallos oxide, Houzeau's, and some other tests were affected before a notable change had occurred upon a moistened silver surface.† It is stated by Houzeau that when a litre of oxygen containing about 1 centigram. of ozone was passed over silver, blackening took place, but when the same amount of ozone was diluted with 50 litres of oxygen the silver was unaffected.‡ Even the latter mixture contains a far larger amount of ozone than is ordinarily present in the atmosphere, if we accept the determinations of Pless and Pierre,|| who found, by titration of the iodine set free on the surface of potassium iodide paper, that 255 litres of air contained but 0.02 m.gram.

ozone. Zenger found in 100 litres of air from 0.002 to 0.01 m.gram. ozone.\*

For the present, at least, silver is inapplicable as an atmospheric ozonoscope, not from want of reliability, but from lack of sensitiveness; and the desideratum is to find some ozonoscope which will be similar to silver in its reactions towards the compounds of the atmosphere, and at the same time of adequate sensibility.

The next most important reagent of this class is thallos hydrate.† Small bars of metallic thallium were dissolved in dilute sulphuric acid, the reaction being hastened by the introduction of strips of platinum foil, and thallos sulphate crystallised out in brilliant prismatic needles. A solution of this salt was exactly neutralised with baryta, the filtrate from the barytic sulphate containing 10 per cent of thallos hydrate. Strips of filtering-paper, immersed in this filtrate, were dried over caustic potash under a bell-jar, so as to prevent them as far as possible from absorbing carbonic anhydride from the air.

When the ozonoscopes are compared dry thallos hydrate occupies a very high position, sometimes the fourth or third place, but usually the second position. After moistening, the papers of the first three classes exhibit a more striking appearance than the thallium peroxide. This result differs from that obtained by Huizinga, who thought that the thallos hydrate was more sensitive than the iodo-starch tests, when the papers were freshly prepared and the solution sufficiently concentrated.‡

On examining into the behaviour of thallos hydrate, when exposed to the disturbing influences of the other bodies which may be present in the atmosphere, we found that it was unaffected by nitrous acid, if we accept one trial in which the paper turned yellow. This was apparently due to some other cause than the formation of peroxide, which is of a brown colour. This confirms the result previously arrived at by Böttger.||

In an atmosphere containing hydrogen peroxide the thallos hydrate remained white, or if immersed, after having been turned brown by ozone, was bleached. Carbonic anhydride is rapidly absorbed by thallos hydrate, carbonate being formed, which is not decomposed with formation of peroxide in presence of ozone. Thallos hydrate is therefore not applicable to the detection of ozone in the atmosphere, though in the laboratory, to detect ozone in the presence of nitrous acid, it is of great service.§

Manganous sulphate is altogether inapplicable as an atmospheric ozonoscope, whether dry or moist: in the former condition it was scarcely affected at all, in the latter it occupied one of the lowest places in the scale. That there might be no error, from want of care in the preparation of the salt, the re-crystallised sulphate was precipitated from its solution in alcohol, and used in making the tests. Thinking that the manganous oxide might be more easily converted into peroxide, if it were in combination with a feeble acid like acetic, some manganous acetate was prepared from the former salt by conversion into carbonate and then into acetate. Tests prepared with this salt did not appear more sensitive than those with manganous sulphate. They had the further disadvantage of being powerfully affected in a dilute atmosphere of nitrous acid, turning dirty brown, whilst the sulphate was little changed. They likewise became light brown in an atmosphere containing a trace of hydrogen peroxide. The manganous sulphate ozonoscopes contained 10 m.grams. of the salt in each square centimetre of surface. Of the manganous acetate papers, some were dipped in a concentrated, others in a more dilute solution, but the results obtained with each were identical.

Similar remarks apply to the plumbic sulphide papers, which were so prepared that each square centimetre of

\* See Bayer, *Ber. der Deutsch. Chem. Gesell.*, 1871, p. 658.

† See also Frey, *Comptes Rendus*, 61, 939.

‡ *Comptes Rendus*, December 18, 1865.

|| *Fahresb. der Chemie*, 1857, 79.

\* Zenger, *Wien. Akad. Ber.*, 24, 78.

† Böttger, *Journ. Prakt. Chem.*, 95, 311.

‡ Huizinga, *Journ. Prakt. Chem.*, ci., 321.

|| Böttger, *Journ. Prakt. Chem.*, 95, 311.

§ See Lamy, *Bull. Soc. Chim.*, [2], 11, 210; March, 1869.

surface contained about 10 m.grms. of the sulphide. They were not sensitive. Moreover, in an atmosphere of hydrogen peroxide or nitrous acid they were bleached.

V. Those depending upon the oxidation of organic bodies, with the development of a characteristic change of colour.

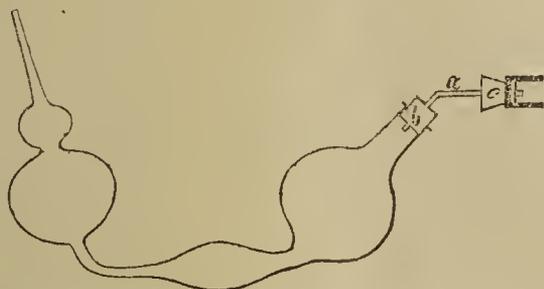
The only one of these substances particularly studied was the resin of guaiacum. It appeared essential to use this resin in the original masses, for if that which had been pulverised was used, even if it had not been exposed to light, the tincture made from it appeared deficient in sensitiveness. A tincture containing 8 per cent of the resin was prepared with 90 per cent alcohol. The papers so prepared had a slight yellow tinge. They were moderately sensitive, acquiring speedily when dry a faint blue colour, and when moistened occupying a position midway between the ozonoscopes most sensitive and those least so to the influence of ozone. They were rapidly turned greenish blue by nitrous acid, and bluish green by hydrogen peroxide. For these reasons, and on account of their deficient sensibility, they are objectionable as atmospheric ozonoscopes.\*

(To be continued).

## ON A NEW FORM OF NITROGEN BULB.

By H. H. B. SHEPHERD, F.C.S.

AGRICULTURAL and other chemists who have many nitrogen combustions to perform may find it useful to adopt the form of absorption-bulb shown in the following sketch:—



The bulb is connected with the combustion-tube by the bent glass tube, *a*, by the aid of a cork, *c*, and a caoutchouc stopper, *b*. This bulb, it will be seen, is a modification of the Will and Varrentrapp apparatus, but it possesses an advantage over the latter, inasmuch as it can more readily be charged with acid from a burette. It can also easily be provided with a new connecting tube, whereas the Will and Varrentrapp bulb is sometimes rendered useless by the fracture of this part occasioned by the heat of the furnace.

The Leighs, Charlton, S.E.

## DETECTION AND APPROXIMATE DETERMINATION OF MINUTE QUANTITIES OF ALCOHOL.†

By J. C. THRESH, Pharmaceutical Chemist.

THAT the detection of small proportions of alcohol is a matter of some importance is evident to any one who looks through the Year-books issued by our Conference, no less than sixteen papers bearing on the problem being abstracted in the volumes already published. The analyst desires a test which will enable him to detect with absolute certainty the presence of alcohol in essential oils and

other medicaments when mixed therewith, and the physiologist requires such a test to solve a number of problems relating to the action of alcohol upon the system and its presence or absence in the tissues and animal fluids. Hitherto no process has been published which is capable of giving certain results in such cases, either qualitative or quantitative.

Probably the best test as yet proposed is that of Lieben as modified by Hager (abs. *Y. B. P.*, 1871, 237), which depends upon the formation and deposition of crystals of iodoform, when solutions of iodine and potassium hydrate are added successively to the warmed fluid containing alcohol. This test is said to be capable of detecting 1 part in 2000 of water, but I have failed to obtain by it any decided reaction with so dilute a solution. Moreover, a number of other volatile and non-volatile compounds yield the same reaction under similar circumstances (*e.g.*, aldehyd, acetone, methyl alcohol, propyl alcohol, volatile oils, gum, sugar, lactic acid, &c). Another general test is Hardy's (abs. *Y. B. P.*, 1872, 161), depending upon the production of a blue colour when guaiacum resin, hydrocyanic acid, and sulphate of copper are added to an aqueous solution of alcohol, but it is incapable of detecting less than 1 part in 150. In the same year-book (p. 160) is an abstract of a method proposed by M. Berthelot. Benzoic chloride is mixed with the suspected solution, the mixture warmed, and a little caustic potash added, when a characteristic odour of benzoic ether is evolved if alcohol be present. This test is very sensitive with a 4 or 5 per cent aqueous solution, but when smaller proportions are present, or the fluid contains other odorous substances, it is quite useless.

The old chromic acid test as hitherto applied is perhaps the most fallible of all, since innumerable substances give the same reaction, in virtue of their greed for oxygen. A more modern test is that proposed by Davy (abs. *Y. B. P.*, 1877, 109), and depends upon the production of a blue colouration when molybdic acid dissolved in sulphuric acid is added to the fluid containing alcohol, but Hager (abs. *Y. B. P.*, 1877, 285) failed entirely to obtain the reaction. Besides these general tests a great many others have been proposed for use in special cases, thus Böttger (abs. *Y. B. P.*, 1873, 164) recommends solid caustic potash for detecting alcohol in ether, and anhydrous glycerine for its detection in essential oils. Fuschin, tannin, aniline red, jalap resin, and many other substances have also been similarly employed, but scarcely one of the tests enumerated, it is worthy of mark, is capable of being employed to make even an approximate quantitative determination of the ethyl hydrate.

Some time ago, when examining a solution containing aldehyd, I was struck by the remarkable delicacy of the caustic potash reaction; I found that an aqueous solution containing one one-thousandth part of pure aldehyd when boiled with a fragment of solid caustic soda or potash, and allowed to stand for a little while, exhibited a distinct yellow colour. If a solution containing 0.5 per cent of aldehyd be thus treated, the liquid becomes deep yellow, and a flocculent yellow precipitate gradually subsides, and this solution when diluted first with a little alcohol and then with 50 volumes of water, still exhibits a yellow tint when examined in a long test-tube over a sheet of white paper or a porcelain slab.

I then commenced a series of experiments, having for their object the detection of minute quantities of alcohol by converting it into aldehyd, and treating the resulting solution with caustic alkali. After making a great number of attempts I succeeded in devising a method which is not only reliable as indicating with certainty the presence of alcohol, but which within certain limits gives fairly approximate quantitative results.

Distillation with sulphuric acid and permanganate of potash was first tried, and it was found that with a given proportion of permanganate a 0.1 per cent solution of alcohol could readily be detected, but with even a slight excess of permanganate the results were entirely negative.

\* It is probable that the influence of light as well would be unfavourable to the employment of organic matters as ozonoscopes.

† From the *Pharmaceutical Journal*, November 9, 1878.

Other oxidising agents were then tried, and bichromate of potash found to be the most reliable, since an excess, unless large, did not materially decrease the yield of aldehyd. Still, the quantitative results obtained from the same solution varied very considerably, and for some time the cause was apparently inexplicable. At length, noticing that when the determinations were very low that considerable bumping took place during the distillation, several substances were added to obviate this, and it was found that when a few small pieces of pumice were placed in the flask the distillation proceeded evenly and the results were remarkably uniform. Fresh pumice must be used for each distillation. For an aqueous solution containing from 0.04 to 0.4 per cent of alcohol the following method may be relied upon for quantitative determinations, whilst it will detect with certainty 0.01 per cent, or 1 in 10,000. When the quantity of alcohol present differs much from the proportion here given the determination is too low, becoming more and more unreliable as the percentage rises above or falls below these limits.

The requisites are a saturated solution of bichromate of potash, a dilute sulphuric acid (B. P., acid and water, equal quantities), a syrupy solution of caustic soda, methylated spirit free from aldehyd, a 200 c.c. flask with good condensing arrangement attached, and a long narrow test-tube graduated to 3 and 23 c.c.

One hundred c.c. of the dilute alcohol are placed in the flask, 2 c.c. of bichromate solution, 8 c.c. of the dilute acid, and a few pieces of pumice are added and 20 c.c. distilled (not too rapidly), and the distillate conveyed by a long tube to the bottom of the test-tube in which has been previously placed 3 c.c. of the soda solution. The liquid in the tube is then heated, kept at the boiling-point for a few seconds, and placed aside for a couple of hours. If 0.1 per cent of alcohol was contained in the original solution the contents of the test-tube will be of a deep yellow colour and will have deposited flocks of aldehyd resin; with 0.05 per cent no resin is formed, but the fluid is deep yellow and perceptibly opalescent; with 0.01 per cent the colour is just perceptible, but the characteristic odour is still very distinct. To make a more accurate determination, dilute 1 part of pure aldehyd with 200 of water; to this add 30 parts of the caustic soda solution, and treat in the same way as the above distillate. After the lapse of two hours (the reaction not being complete for nearly this length of time) dilute with 200 parts of warm methylated spirit and add water to 500 parts. This solution is quite clear and of a reddish yellow colour, and will keep for some time, especially if not exposed to the light. Mix 5 c.c. of this solution with 45 c.c. of water in a glass such as is employed for Nesslerising, and take this as a standard solution. It does not keep more than two or three hours, hence fresh standards must be from time to time prepared, or a solution of bichromate of potash made of equal depth of colour (the tint being almost identical) and kept as a standard of reference. To make the quantitative determination, dilute the distillate with sufficient warm spirit to make a clear solution, and add water to 50 c.c. Upon ascertaining the quantity of this solution, which must be diluted with water to 50 c.c. to bring the depth of colour to that of the standard solution, the percentage of alcohol in the original solution is immediately known. The following are fair specimens of the results obtained.

Strength of Alcoholic Solution.	Strength Calculated from Result of Experiments.
0.02 per cent	0.012
0.10 "	0.089
0.10 "	0.100
0.10 "	0.088
0.10 "	0.092
0.20 "	0.166
0.20 "	0.208
0.05 "	0.039
0.20 "	0.170
0.40 " (3 c.c. $K_2C_2O_7$ Sol.)	0.308

Having ascertained the reliability of the method, where the alcohol was diluted with water only, the effect of the presence of other substances was tried. Städeler has shown that albumin, fibrin, gelatin, and lactic acid yield a trace of aldehyd when treated with sulphuric acid and bichromate of potash, or peroxide of manganese; hence these compounds must be removed from solution before the test is applied. No substances, with these exceptions, besides the ethyl compounds, are known to yield aldehyd when thus treated. Various essential oils, chloroform, amyl alcohol, &c., were shaken with water and the solution distilled with these oxidising agents, but no yellow colour was produced. The distillate from clove water was pink, but when 0.1 per cent of alcohol was added the pink tint was quite overpowered by the yellow colour of the aldehyd resin produced. Ether, of course, yields aldehyd when oxidised; hence this will not serve to detect alcohol in ether. To detect alcohol in essential oils and chloroform, agitate the sample with an equal quantity of water, and when the aqueous solution has become clear, remove with a pipette and distil with the bichromate and acid; 0.5 per cent is thus easily detected. The subjoined table gives the results of several quantitative experiments. Four c.c. of the substance examined were shaken vigorously with 8 c.c. of the dilute acid and 92 c.c. of water, and when clear 50 c.c. of the acid liquid placed in a flask and distilled with a sufficient quantity of bichromate. Ten c.c. of distillate are collected in a tube containing 2 c.c. of soda solution, and boiled, diluted, and Nesslerised

Name, &c.	Quantity of Bichromate Solution added.	Result.
Oil of Lemons . . . . .	2 c.c.	none
Ditto, with 5 per cent alcohol . .	2 "	3.60 p.c.
Oil of Rosemary with 5 p.c. alcohol	2 "	3.90 p.c.
Oil of Bergamotte . . . . .	2 "	none
Ditto, with 10 p. c. alcohol . . . .	2 "	9.70 p.c.
Oil of Lavender, English . . . . .	3½ "	none
Ditto, Foreign . . . . .	3½ "	3.60 p.c.
Ditto, Foreign, with 2½ p.c. alcohol	3½ "	6.30 p.c.
Ditto, Foreign, washed . . . . .	3½ "	none
A pure chloroform . . . . .	2 "	a trace
Ditto, with 5 p. c. alcohol . . . .	2 "	4.20 p.c.
With 1 p. c. alcohol . . . . .	2 "	0.92 p.c.

The oil of lavender (ext.) was undoubtedly adulterated, since, after being washed with water and examined, no reaction was obtained. Deducting 3.6 from 6.3, we have 2.7 as the percentage of alcohol added.

Alcohol is said not to suffer decomposition in presence of pure water. To confirm this a sample of well-boiled water had 0.1 per cent of alcohol added, and determinations made daily. After ten days the quantity of alcohol was found undiminished. An impure tank water, to which 0.1 per cent of alcohol had been added, did not contain a trace twenty-four hours afterwards. The presence of decaying organic matter of all kinds has this effect, and no doubt this reaction is in some degree a measure of the quality of a water.

Rajewsky (Pflüger's *Archiv.*, xi., 122, abs. *Y.B.P.*, 1876, 125) when investigating the action of alcohol upon the system, its passage into the brain and muscle, and the length of time which it remains there, came to the conclusion that the iodoform test is either not applicable to the detection of alcohol in the tissues, or that alcohol is a normal constituent of brain and muscle. I have applied the aldehyd test to a number of infusions of fresh muscle, or rather to the distillate from this infusion, but have failed to detect the slightest trace of alcohol.

The chromic acid reaction is still often quoted as a test for alcohol in the urine, but as shown by Chaumont (abs. *Y. B. P.*, 1855, 147) the test is not to be relied upon, even when applied to the distillate. A number of experiments were tried with various samples of urine, with and without the addition of alcohol. By adding a sufficient quantity of bichromate to oxidise all the oxidisable matter present in the urine good quantitative results were obtained. By

distilling the urine and estimating the alcohol in the distillate, the results were all much too low; but when about a grm. of ferrous sulphate was added to the urine previous to distillation the results were much more approximate. Should the urine contain albumen it must be distilled and the distillate examined, but otherwise equally good results are obtained without distillation. After partaking of an alcoholic fluid distinct traces of alcohol are found in the urine two hours afterwards. The quantity (after taking 12 c.c. of absolute alcohol) in the urine two hours after was about 0.02 per cent, and about the same proportion was found ten hours afterwards, and traces were present for upwards of twenty-four hours. Forty hours after no alcohol could be detected. From the quantity of urine excreted the results of two determinations went to show that not more than 0.7 per cent of the alcohol taken passes in the urine unchanged.

By concentrating fluids, supposed to contain alcohol by one or more distillations, exceedingly minute traces can be detected by this process, especially if only one-tenth instead of one-fifth be distilled.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 18, October 28, 1878.

**Decomposition of Hydracids by Metals.**—M. Berthelot.—If the metallic chlorides are arranged in a series according to the degrees of heat evolved on their formation, we are led to consequences which do not agree with the old classification of metals, arranged in sections according to their power of decomposing pure water and acids with liberation of hydrogen. According to this series the heat of formation of gaseous hydrochloric acid from its elements,  $+22^{\circ}$ , is surpassed by the heat of formation of all the anhydrous chlorides, even those of lead, copper, mercury, and silver, gold being the sole exception among the ordinary metals. All these metals, therefore, except gold, ought to decompose hydrochloric acid. Even after having made the necessary allowance for the fact that hydrogen and hydrochloric acid are gases, whilst the metals and their chlorides are solids, hydrochloric acid ought still to be decomposed, with evolution of hydrogen, by all the metals except gold, platinum, and perhaps palladium. As regards all the metals formerly arranged in the three first sections the fact is well known. Lead behaves similarly, even in the cold with concentrated acid. With copper the action is the same, though slower. Dry hydrochloric acid is decomposed by mercury at  $550^{\circ}$  to  $600^{\circ}$ . The reaction can be shown more distinctly by passing dry hydrochloric gas, charged with mercurial vapour, through a tube of porcelain heated to between  $800^{\circ}$  and  $1000^{\circ}$ . Pure silver decomposes pure hydrochloric gas at from  $500^{\circ}$  to  $550^{\circ}$ . Theory indicates and experiment confirms analogous reactions with hydrosulphuric acid, and still more decidedly with hydrobromic and hydriodic acids.

**The Didymium of Cerite, probably a Mixture.**—M. Delafontaine. — Since the interesting researches of Mosander, the results of which have been confirmed by MM. Marignac, Bunsen, Cleve, &c., didymium has been accepted as a simple body. All these chemists have worked upon the cerite of Bastnoes, and none of them seem to have made a comparative study of the didymium derived from other minerals. The author's former experiments on didymium from gadolinite led him to suspect that didymium is not a simple body, and these

suspicions have been strengthened by certain recent observations on samarskite from the United States. The solutions of didymic salts yield a fine absorption spectrum, characterised by numerous bands and rays, the positions of which have been determined by MM. Bunsen and Lecoq de Boisbaudran. But the author finds that solutions of didymic nitrate from samarskite yield a spectrum less complete than that from cerite. In the least refrangible portion of the blue ceritic didymium displays a group of four narrow bands, nearly equidistant. In didymium from samarskite the author has not been able to detect this group, and he concludes, consequently, that ceritic didymium contains a new element, characterised by the blue bands above-mentioned.

**Magnetisation of Steel Tubes.**—M. J. M. Gaugain. — On submitting to the action of a feeble current, a system formed of two parts, having different coercitive forces, the part having the smallest coercitive force will become the more strongly magnetised.

**A Warning Telephone.**—M. Perrodon.—The author points out that, to remain in communication with a telephonic correspondent, it is necessary to keep the instrument applied to the ear, and to listen very attentively. He has devised a system of giving notice when a message is about to be sent.

**Transformation of Valerylen into Terpilen.**—M. G. Bouchardat.—This change has been effected by keeping valerylen for six hours in sealed tubes at  $250^{\circ}$ — $260^{\circ}$ , and in an atmosphere of carbonic acid.

**Artificial Formation of Melanochroite.**—S. Meunier. has placed fragments of galena in a dilute aqueous solution of potassic bichromate, and after the lapse of six months has obtained substances having the physical characters of melanochroite.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*  
No. 11, 1878.

**On Certain Derivatives of Hydro-toluquinon.**—A. Nietzki.—The author obtains a diacetyl derivative by heating along with acetyl chloride. He has also prepared three derivatives of the respective compositions  $C_9H_{12}O_2$ ,  $C_{16}H_{16}O_4$ , and  $C_{16}H_{18}O_4$ .

**Oxidation of Cuminic Acid by Potassic Permanganate.**—R. Meyer.—The author obtains a new acid,  $C_{10}H_{12}O_3$ , and describes certain of its salts.

**Constitution of the Vapour of Acetic Acid.**—A. Horstmann.—The result of the author's experiments is not in accordance with the view of Playfair and Wanklyn, that the abnormally changeable vapour-density of acetic acid may be explained by the dissociation of a polymer of the acid.

**Synthesis of Indigo-Blue.**—Adolf Baeyer.—In the series of operations which, according to the author's previous communication, lead from phenyl-acetic acid to indigotin, the last link—the conversion of isatin into indigotin—was unsatisfactory, both as regards the clearness of the process and the yield. The mixture of reagents—consisting of phosphoric trichloride, acetyl chloride, and phosphorus—used to effect the reduction of isatin can act in various directions, and the product is by no means pure indigotin, but consists chiefly of indigo-purpurin. The action of phosphoric pentachloride upon acid amides, to which isatin belongs, is the key to the problem. If isatin is heated gently with this compound a lively reaction sets in, hydrochloric acid being given off, and the mass taking a brownish red colour. On the addition of water a brownish yellow mass is separated, which is insoluble in carbonate of potassa, and in contact with caustic potassa is re-converted into isatin. This substance is doubtless the imido-chloride of isatin. This compound yields indigotin by reduction. If heated gently with yellow phosphorus the red colour of the mass passes into green, and on the

addition of water indigo-blue is deposited after a short boiling. Or, if the isatin chloride is dissolved in alcohol and treated with zinc powder and acetic acid, the same result ensues. Or the mass obtained by the reaction of phosphoric pentachloride upon isatin is washed first with water, then with carbonate of soda, and is lastly treated with an alcoholic solution of yellow ammonium sulphide. When boiled the liquid turns green, and on the addition of water and repeated boiling it becomes blue. The yield is considerable.

**Diimido-phthalein of Phenol.**—A. Baeyer and J. B. Burkhardt.—An examination of the diimido-phthalein, tetra-brom-diimido-phthalein, and dibrom-dinitro-diimido-phthalein of phenol.

**Dioxy-benzophenon from Phenol-phthalein.**—A. Baeyer and J. B. Burkhardt.—The authors obtain this compound by dissolving 5 parts phenol-phthalein in a minimum of caustic potassa, and melting it over the open fire after the addition of 20 parts solid potassa. The violet colour of the melt passes gradually into red, and then into yellow. The process is interrupted when only a faint redness remains. From the aqueous solution of the melt acids cause the separation of long colourless needles, which are boiled in water to remove adhering benzoic acid, and then re-crystallised after treatment with animal charcoal.

**Brom-rosoquinon from Phenol-phthalein.**—A. Baeyer and C. Schraube.—Five parts of amorphous tetra-brom-phthalein are dissolved in 250 parts concentrated sulphuric acid, and the solution of 5 parts saltpetre in 50 parts sulphuric acid is quickly added. The mass is cooled and agitated, and allowed to stand for fifteen minutes. The precipitate obtained by mixing the deep violet liquid with water is washed first with water, then with alcohol, and boiled in a mixture of alcohol and chloroform, by which it is rendered crystalline without being perceptibly dissolved. It forms beautiful crystals, red by transmitted and steel-blue by reflected light. In concentrated sulphuric acid it dissolves without decomposition, and with a violet colour; in other solvents it is substantially insoluble. By treatment with alcoholic potassa it is converted into a colourless hydroquinon.

**Experiments on the Oxidation of certain Non-saturated Bromo-, Chloro-, and Chlorbromo-hydrocarbons, by means of Free Oxygen.**—E. Demole and H. Durr.—The conclusions drawn are that when a bromo-, chloro-, or chlorobromo- substitution-product of ethylen becomes polymerised on exposure to the air, it is also capable of absorbing oxygen at different temperatures. When such polymerisation does not occur no oxidation takes place.

**Experiments and Theory on the Conversion of  $C_2H_2Br_2$  into  $C_2H_2OBr_2$  by means of Free Oxygen.**—E. Demole.—Not adapted for useful abstraction.

**Derivatives of  $\alpha$ -Naphthoquinon.**—T. Diehl and V. Merz.—An examination of naphthalic acid, nitro-naphthalic acid, amido-naphthalic acid, with their respective salts and dioxy-naphthoquinon. This last compound differs from naphthazarin by the circumstance that the latter yields no phthalic acid.

**On certain Selenio-cyanates.**—J. W. Clarke.—An examination of the double selenio-cyanates of platinum.

**Oxidation of Xylol-sulphamides.**—M. W. Iles and Ira Remsen.—This paper forms part of a controversy between the authors and Dr. Jacobsen. (See *Berichte*, xi., 893.)

**On Dimethyl-uric Acid.**—C. J. Mabery and H. B. Hill.—This acid,  $C_7H_8N_4O_3$ , is formed by treating dry neutral urate of lead with methylic iodide in excess.

**On Diphenols.**—L. Barth and J. Schreder.—The authors distinguish two isomeric diphenols,  $\alpha$  and  $\beta$ , and describe their characteristics and certain of their derivatives.

**On a Fluorescein-carbonic Acid.**—J. Schreder.—The acid in question,  $C_{21}H_{12}O_7$ , is very sparingly soluble in boiling water and glacial acetic acid, but dissolves readily in alcohol, ether, and benzol. The author describes its calcium and barium salts, the acetyl product, and the dibrom- and tetrabrom-fluorescein carbonic acids.

**Products of the Reduction of Elemi-Resin by Zinc-Powder.**—G. Ciamician.—The products are toluol, meta- and para-ethyl-methyl-benzol, and ethyl-naphthalin. Naphthalin and methyl-anthracen are found merely in scarce distinguishable traces.

**Rosolic Acids.**—H. Caro and C. Graebe.—The authors describe the formation of dioxy-benzophenon from aurin, the synthesis of aurin from dioxy-benzophenon, and the formation of a colouring-matter from mono-oxy-benzophenon and phenol.

**Action of Phosphoric Pentasulphide upon Organic Acids.**—C. Böttiger.—The acids in question are the pyrotartaric, pyruvic, and lactic.

**Molecular Magnitude of Indigo.**—E. v. Sommaruga.—The mean of nine determinations of the vapour-density of indigo, taken at the temperature of melting sulphur, is 9.45. The number calculated for the formula  $C_{16}H_{10}N_2O_2$  is 9.06.

**Acids of Wood Vinegar and their Connection with the so-called Wood-Oils.**—G. Kramer and M. Grodzki.—The authors have found the following saturated acids present in quantity, and have succeeded in isolating them:—formic, propionic, butyric, and valerianic. Amongst unsaturated acids they have detected the crotonic and angelic.

**Diversity of the Absorption Spectra of one and the same Substance.**—H. W. Vogel.—The author sums up the results of his researches as follows:—Between the spectra of a body in its solid state, in solution, and in a gaseous condition, there exist very important distinctions. Characteristic bands which appear in one state of aggregation are found in others either not at all or changed in position, in intensity, or in appearance. Copper sulphate and chlorophyll have the same absorption in the solid state and in solution. The spectra given by one and the same body in different solvents vary in some cases not at all, in others merely by the position of the bands, and in others again by a total difference of character. Kundt's law, that the absorption-bands of a dissolved body move more towards the red the stronger the dispersion of the liquid for the region of the absorption-band, in many cases does not hold good; sometimes the bands are even moved towards the blue in a more strongly refractive liquid; in other cases their position in different media remains the same. The position of the absorption-bands in the spectra of solid and dissolved bodies can only exceptionally be taken as characteristic of the bodies in question. Totally different bodies display absorption-bands exactly in the same position, whilst other bodies which closely approximate to each other show under similar circumstances striking distinctions in the situation of their bands. The majority of polychroic substances in the solid state display different colours and different spectra according as they are viewed from different directions: most other bodies in the solid state show different from what they possess when dissolved, and in the latter case, again, differences arise according to the nature of the solvent. Thus it is an open question which is the true spectrum of the substance. We go much too far if, from the accidental coincidence of the positions of the bands of two bodies, we infer their identity or chemical similarity.

**Trinitroso- and Trinitrochloro-glucin.**—R. Benedikt.—Not adapted for abstraction.

**Contribution to the Knowledge of the Alizarin Colouring-matters and Green Alizarin Dyes.**—H. W. Vogel.—An examination of the spectra of alizarin-blue, alizarin-orange, and malachite-green. The last-mentioned

colour, when dissolved in alcohol, gives exactly the same spectrum as aldehyd-green, although the chemical behaviour of the two colours is quite distinct.

*Les Mondes, Revue Hebdomadaire des Sciences.*  
No. 6, October 10, 1878.

This issue contains no original chemical matter.

No. 7, 1878.

**Soap and Candle Manufacture.**—We have a long account of the improvements in the stearine manufacture due to M. de Milly, who is described as having been concerned in the formation of all stearic acid works in Europe.

## NOTES AND QUERIES.

**Zinc Ashes.**—These are collected from various parts of England, and sent to Swansea for reduction. I should like to know what treatment they undergo.—CARBON.

**A New Method of Testing the Purity of Milk by the Hydrometer.**—The lactometer, as used by dealers in milk and others for testing the purity of milk, is a most unsatisfactory instrument, and therefore cannot be used as a quick method of testing milk, samples of pure milk that were tried with the lactometer showing a supposed adulteration of 20 per cent of water, while those that were skimmed and watered registered pure milk upon the lactometer. The method that I have employed, of using the hydrometer for the rapid estimation of water in milk, is as follows, it being now an established fact that the sugar and the salts in milk are most constant: I propose to separate these from the other constituents, and to take the specific gravity of the serum:—Take a certain quantity of the milk to be examined, and then add about three drops of acetic or hydrochloric acid; well stir with a glass rod, and strain through a fine hair sieve; then filter through blotting-paper. If now we place the hydrometer in the serum, if water has been added the amount will be readily shown. Of course we must mark and test the hydrometer with a known sample of pure milk, and when it is properly graduated we have a most sensitive instrument, which can be used at the Railway Stations to test the milk upon arrival, the whole operation not taking more than three minutes, and will show at a glance the smallest amount of added water. If the milk has been coloured, the addition of a small piece of potash to the serum will immediately darken it: while the serum from pure milk is quite clear, that from coloured milk has a yellow tinge. Mr. E. Atkins, chemist, of 200, Essex-road, is now supplying these instruments, properly graduated, for the use of doctors, milk-dealers, and others engaged in testing milk.—A. SMITH, Chemical Laboratory, 198, Essex-road, Islington.

## MEETINGS FOR THE WEEK.

**SATURDAY, 23rd.**—Physical, 3. "On a Condenser of Variable Capacity," by C. Boys.  
**MONDAY, 25th.**—Royal Geographical, 8.30.  
Medical, 8.30.  
**TUESDAY, 26th.**—Civil Engineers, 8.  
Anthropological, 8.  
**WEDNESDAY, 27th.**—Society of Arts, 8.  
**SATURDAY, 30th.**—Royal, 4. (Anniversary).

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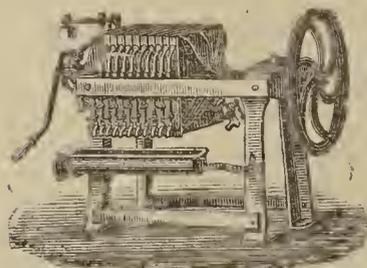
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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 992.

OZONE AND THE ATMOSPHERE.\*

By ALBERT R. LEEDS Ph.D.

(Concluded from p. 251.)

*Examination of Ozonoscopes under known Conditions.*—Having prepared pure materials, the following ozonoscopes were made, care being exercised to render them as nearly similar and uniform as the nature of the tests would permit. They were preserved in tightly-stoppered bottles in the dark, and entirely removed from the laboratory odours. The potassium iodide papers were made with a solution containing 15 grms. of the salt. The proportion of iodide of potassium and starch in the iodo-starch papers is that recommended by the observers whose names they bear. The amount of water is the same in all, in order that the papers compared may be as nearly similar as possible.

Name of Ozonoscope.	Potassm. Iodide. grms.	Starch. grms.	Water c.c.
Polli's .. .. .	2.0	1.0	60
Moffat's .. .. .	0.4	1.0	60
Lowe's (with 0.03 gm. calcium carbonate) .. .. .	0.2	1.0	60
Schönbein's .. .. .	0.1	1.1	60
Osann's .. .. .	0.1	1.0	60
Cadmium iodide 1 gm. .. .. .	—	1.0	60

The preparation of the other tests is given elsewhere. The tests prepared with great excess of potassium iodide, as recommended by Dr. Polli, were not employed, since they turned brown while drying. The sensitiveness of these tests, as will be seen from the tables, increases as a rule with the percentage of potassium iodide. Those of Lowe, which occupy an intermediate position and are not liable to change on drying, are perhaps to be preferred. Calcium carbonate was added in accordance with the recommendation of Mr. Lowe, in order to secure greater uniformity of action and prevent souring, but we were unable to perceive that the addition was of practical value.†

The tests were separately suspended in a capacious bell-jar, through which a current of ozonised oxygen (containing 1 m.gram. ozone in the litre) was caused to flow very slowly. No attempt was made to screen them from diffused light. In the first place, they were simultaneously exposed while dry for certain intervals. The effects were noted and expressed by numbers, the ozonoscope which had experienced the most striking change being placed first. They were then moistened, and the results indicated in like manner. Finally, in this moistened condition they were allowed to remain in the vessel, and their changes noted at the expiration of times indicated in the tables. The effect upon silver is not given because of its want of sensitiveness and its inapplicability as an atmospheric ozonoscope. (See Table on next page.)

It will be noted that potassium iodide is the most sensitive test, changing rapidly while dry, using this term to apply to papers having only such hygroscopic moisture as had been attracted from the atmosphere. The thallium papers are also very sensitive; but when exposed for some time in common with the other ozonoscopes, and then moistened, they fall behind the iodo-starch papers, which occupy an intermediate position between them and the potassium iodide test. The iodo-starch papers arrange

themselves in an order corresponding to the amount of potassium iodide they contain, except the cadmium iodo-starch paper, which, unlike the other ozonoscopes of this class, does not on moistening after long exposure turn brown, but remains of a persistent blue.

In some trials it fell below the thallium, alizarin, and Houzeau tests in sensitiveness. It is important to note that the alizarin and Houzeau tests, whatever may be their other merits, are less susceptible than the potassium iodide and iodo-starch tests; and the manganese and lead sulphide are evidently inapplicable as atmospheric ozonoscopes.

*Influence upon Ozonoscopes of Constituents of the Atmosphere other than Ozone.*

OZONOSCOPES WITH NITROUS FUMES (VISIBLE.)

Ozonoscopes.	Dry.	When moistnd becme
K I .. .. .	Brown (1)	Bleached (1)
Cadmium .. .. .	Lower end lilac, (2) upper brown	Bluish black (2)
Moffat .. .. .	Brown (5)	Dark blue (3)
Lowe .. .. .	Light brown (6)	Dark blue (4)
Osann .. .. .	Lilac (7)	Light blue (6)
Schönbein .. .. .	Light brown (9)	Dark blue (5)
Houzeau.. .. .	Red (8)	Red (8)
Alizarin (with K I) .. .. .	Brown (10)	Unaltered
Ditto (no KI).. .. .	Yellow (10)	Unaltered
Thallium .. .. .	Doubtful	
Manganese acetate .. .. .	Unaltered (11)	Brown (7)
Do. sulphate .. .. .	Unaltered (11)	Unaltered
Lead sulphide .. .. .	Bleached white (4)	Unaltered
Guaiaicum .. .. .	Dark blue (3)	Unaltered

The air in the bell-jar, in which the tests affected as above were suspended, contained nitrous fumes in quantity just sufficient to give a recognisable colour. In the following experiment the amount was extremely small, and no fumes were apparent:—

OZONOSCOPES WITH NITROUS FUMES (INVISIBLE).

Ozonoscopes.	Dry.		Moistened.
	20 Minutes.	One Hour.	
KI .. .. .	Yellow (1)		Turned after 12 hours. Brown
Cadmium .. .. .	Unaltered	Unaltered	Dark blue
Moffat .. .. .	Light brown(4)		(1) Dark brwn
Lowe .. .. .	Unaltered	Light brwn(6)	(2) Brown
Osann .. .. .	Light lilac (3)		(4) Brown
Schönbein .. .. .	Unaltered	Faint lilac (7)	(3) Brown
Houzeau .. .. .	Reddish (5)		Little chang'd
Alizarin (with K I) .. .. .	Unaltered		Reddened ?
Ditto (no KI) .. .. .	Unaltered		
Thallium .. .. .	Light brown		Brown
Manganese acetate .. .. .	Unaltered		
Do. sulphate .. .. .	Unaltered		
Lead sulphide .. .. .	Unaltered	Slightly blchd.	More blchd.
Guaiaicum .. .. .	Greenish (2)		Grnish-blue

OZONOSCOPES WITH SULPHUROUS ANHYDRIDE.

Ozonoscopes.	Dry.	Moistened.	Same after 12 hours.
Houzeau.. .. .	Red		
Alizarin .. .. .	Yellow red		
Mang. acetate .. .. .		Turned brown?	Became white
Lead sulphide .. .. .			A little bleach'd?

(The rest unaffected.)

*Ozonoscopes (after Ozonising) with Sulphurous Anhydride.*

- (1.) Potassium iodide and all the iodo-starch papers bleached.
- (2.) Thallium, after having been ozonised to a dark brown, is bleached,

\* From proof sheets of the *Annals of the N.Y. Academy of Sciences*, furnished by the Author.

† E. T. Lowe, *Proc. Royal Society*, [12], p. 518.

## First Series of Comparisons.

Ozonoscopes.	Dry.		Moistened.		
	Half-an-hour.		At Once.	One Hour.	Two Hours.
KI .. .. .	Dark yellow		Brown	Brown	(1) Very brown
Cadmium .. .. .	—		Lilac	Strong blue	(3) Dark blue
Moffat .. .. .	Violet		Blue	Dark blue	(2) Black
Lowe .. .. .	—		Faint blue	Dark blue	(4) Blackish blue
Osann .. .. .	Not tried		—	—	—
Schönbein .. .. .	„		—	—	—
Houzeau .. .. .	„		—	—	—
Alizarin .. .. .	„		—	—	—
Thallium .. .. .	„		—	—	—
Manganese .. .. .	—		—	—	(6) Brownish
Lead sulphide .. .. .	—		—	—	—
Guaiacum .. .. .	—		Light blue	—	(5) Blue

## Second Series.

Ozonoscopes.	Dry.		Moistened.	Third Series.	
	5 Minutes.	15 Minutes.		Dry.	Moistened.
			At Once.	15 Minutes.	At Once.
KI .. .. .	Yellow	Brown (1)	(1)	Dark brown (1)	(1)
Cadmium .. .. .	—	Yellow (5)	(6)	— (9)	(9)
Moffat .. .. .	tr.	„ (4)	(2)	Grey (5)	(2)
Lowe .. .. .	—	— (6)	(3)	Greenish (7)	(3)
Osann .. .. .	Lilac	Violet (2)	(5)	Lilac (6)	(4)
Schönbein .. .. .	—	—	(8)	Faint lilac (8)	(5)
Houzeau .. .. .	—	—	—	Blue (2)	(6)
Alizarin .. .. .	—	—	(7)	Red (3)	(7)
Thallium .. .. .	tr.	Brown (3)	(4)	Brown (4)	(8)
Manganese .. .. .	—	—	—	—	—
Lead sulphide .. .. .	—	—	—	—	—
Guaiacum .. .. .	Not tried	—	—	Not tried	—

## Fourth Series.

Ozonoscopes.	Dry.		Moistened.	
	10 Minutes.		At Once.	Half-an-hour.
KI .. .. .	Yellow (1)		Yellowish red (1)	Same as before (1)
Cadmium .. .. .	—		Blue (6)	Darker blue (5)
Moffat .. .. .	tr. (4)		Dark blue (2)	Same (2)
Lowe .. .. .	tr. (5)		Blue (3)	Same (4)
Osann (not tried) .. .. .	—		—	—
Schönbein .. .. .	—		tr. (7)	Blue (3)
Houzeau (not tried) .. .. .	—		—	—
Alizarin .. .. .	Redn'd (3)		Same as before (5)	Same (8)
Thallium .. .. .	Brown (2)		„ „ (4)	Same (6)
Manganese .. .. .	—		—	—
Lead sulphide .. .. .	—		—	—
Guaiacum .. .. .	—		—	Blue (7)

(3.) Manganese sulphate and acetate remain intensely brown.

(4.) Guaiacum, alizarin, and Houzeau test little affected. Carbonic anhydride had no effect on the ozonoscopes, either before or after ozonising.

## Ozonoscopes with Hydrogen Peroxide.

Ozonoscopes.	First Series.		Second Series.	
KI .. .. .	Light yellow	(7) Yellow	(10)	
Cadmium .. .. .	Faint lilac	(8) Intense blue	(6)	
Moffat .. .. .	Light brown	(2) Very dark brown	(1)	
Lowe .. .. .	„ „	(3) Dark brown	(2)	
Osann .. .. .	?	(9) Brown to blue	(3)	
Schönbn. .. .. .	Faint brown	(4) „ „	(4)	
Alizarin .. .. .	Red	(6) Reddened	(8)	
Houzeau .. .. .	—	Bluish	(9)	
Thallium .. .. .	?	Unchanged		
Manganese .. .. .	Light brown	(5) Not tried		
Lead sul. .. .. .	Somewhat bleached	(10) Bleached to grey	(7)	
Guaiacum .. .. .	Blue (fine colour)	(1) Beautiful blue	(5)	

The hydrogen peroxide used in the first series was made from hydrated peroxide of barium by decomposing with hydrochloric acid. The papers were suspended for about fifteen hours over a solution containing 0.0044 grm. of the peroxide. Since the solution, prepared in this way, con-

tained a little acid which had not been entirely removed, and this acid, by reacting with the peroxide, might liberate chlorine, a second series of trials was instituted. In this the solution had been prepared by decomposing with carbonic acid, and contained 0.5 per cent of the peroxide. The ozonoscopes were exposed during a like interval.

In a third series, the papers being exposed for forty-eight hours during day and night over a solution containing 0.2 per cent hydrogen peroxide, Moffat's turned to a brown colour, Osann's became brownish blue, guaiacum a beautiful light blue, alizarin reddened, Houzeau's test apparently changed somewhat in the direction of blue and afterwards was partly bleached, cadmium test became dark blue, potassium iodide quite white and damp, lead sulphide bleached to grey, silver was not affected. It is probable that the potassium iodide was decomposed, but became colourless again by conversion into iodate. This supposition was strengthened by the damp condition of the paper. The thallium test remained white, thallium peroxide undergoing reduction in contact with hydrogen peroxide, water and oxygen being liberated.

*Action of Ozone upon the Colouring Matter of Flowers.*  
—In connection with the use of organic colouring matters as ozonoscopes, experiments were made as to the action of ozone upon flowers. It is well known that indigo solu-

tion poured into a bottle filled with ozone is instantly bleached. In this case the colourless modification of indigo is formed. But attempts hitherto made to destroy the colouring matters of plants by ozone have yielded in our hands negative results. These results are striking as compared with those obtained by a reducing agent like sulphurous acid or with chlorine.

A light red rose was exposed for three hours to a current of  $3\frac{1}{2}$  litres of ozonised oxygen containing a little more than 1 m.grm. ozone per litre. No effect was discernible on either leaves or flower. In sulphurous acid it was bleached in the course of a few moments, though the chlorophyll of the leaves was unaffected. Returned to the ozone the blanched petals reddened, showing that the sulphurous acid with which they were impregnated had been ozonised. The same effect was produced by dilute sulphuric acid.

An abutilon, a yellow and a blue pansy, cineraria, red geranium, fuchsia, hyacinth, pink, violet, and heliotrope, were exposed for eighteen hours in a quart bottle filled with ozone. On opening the bottle no smell except the perfume of the flowers was apparent, and none of the flowers had changed except the violet and the heliotrope. These had turned slightly brown, due probably to natural wilting. Other specimens of the same flowers were placed in an atmosphere containing sulphurous acid. The heliotrope began to change immediately, and in ten minutes its colour had entirely disappeared. The hyacinth followed, and in the same length of time only streaks of red remained. The bouvardia was nearly white: the fuchsia, japonica, geranium, and cineraria were somewhat bleached; the yellow pansy not noticeably affected. At the end of three hours and a half the darker portion of the fuchsia was nearly bleached, the geranium had become pink, the blue pansy was of a yellow colour somewhat darker than the yellow pansy, the abutilon still unchanged. Flowers of *Salvia splendens*, *Camellia Japonica* (red), *Strelitzia regina*, *Abutilon venosum*, *Abutilon insigne*, *Inga pulcherrima*, *Ixia*, *Cineraria*, *Nasturtium*, *Azalea Indica*, and *Bouvardia* were exposed for thirty-six hours to ozonised oxygen, most of the time to a slow continuous current. A few light spots appeared on the azalea and nasturtium, and there was a slight discolouration of the camellia. Similar specimens, left for three hours in an atmosphere containing sulphurous acid, changed greatly: the camellia became lighter in spots and finally pink throughout, the azalea turned yellow and finally white, the *Abutilon venosum* saffron-yellow, the change beginning at the outer edge of the flower; the cineraria was somewhat lighter in colour; the *Salvia splendens* white in spots, other portions red.

The *Ixia* had become white; the long ends of the mimosa (*Inga*) were also bleached; the reddish markings of the nasturtium had quite disappeared. The flowers of the *Bouvardia* were bleached at their outer edge; in the *Strelitzia* neither flower nor leaf was affected. The same is true of the leaves of all the specimens.

After eighteen hours more of exposure the yellow portion of the *Strelitzia* was not affected, but the blue had become quite white; the mimosa was a faint pink, the nasturtium a deep yellow throughout; and the *Salvia* bleached entirely. Even after this length of time the chlorophyll of the leaves had undergone no change. When these same flowers were transferred from the sulphurous acid to a current of ozonised oxygen the azalea turned red on the edges and coloured somewhat throughout; the camellia reddened, so likewise the mimosa; the *Abutilon* became red along the veins; the petals of *Ixia* turned red at the edges; the nasturtiums reddened in places; the *Bouvardia* became brown; the *Strelitzia* did not change.

When similar flowers, which had been longer exposed to ozone without change, were placed in an atmosphere containing chlorine, the camellia became buff colour, its leaf unaffected; the azalea turned yellow, then white, its leaves partly changing also; the *Ixia* and *Bouvardia* became perfectly white; *Salvia*, yellow-white, its leaves yellow. The red veins of the *Abutilon venosum* were not bleached, but its green calyx and part of the stem were.

The leaf of the *Abutilon insigne* was bleached in spots the leaf and stem of the nasturtium became entirely white. The blue portion of the *Strelitzia* was bleached, the yellow in part, the red leaf not affected. Corresponding changes took place in other specimens of these flowers which had not been previously exposed to ozone.

The action of ozone as a bleaching agent differs not only from that of sulphurous acid, as might be expected, but also from that of chlorine; and it is not improbable that its use has been proposed for bleaching in cases where its precise action has been unknown.

It is a striking fact in the economy of nature that an agent like ozone, which operates as nature's purifier and disinfectant, and energetically destroys decomposing and putrescible organic substances, should have so little action upon the delicate colouring matter of flowers.

Stevens Institute of Technology, May, 1878.

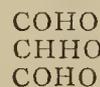
## THE URIC ACID GROUP.

By P. T. MAIN.

In the Introduction to Hermann's "Physiology" uric acid is represented as tartronic di-cyanamide, a body related to tartronic acid as oxamide is to oxalic acid, with the difference that the part played by ammonia in reference to oxamide is taken by cyanamide in uric acid. This formula has the merit of showing very conspicuously the relation of uric acid to tartronic acid; and when the facility with which cyanamide is converted into urea is borne in mind, the reactions by which uric acid itself, or derivatives of it, yield urea (or the products of its oxidation) are suggested at once by the formula, and are seen to flow from the constitution—tartronic dicyanamide—of which it is but a shorthand representation.

The following formulæ are based on a similar plan, it appearing that the derivatives of uric acid can generally be expressed by supposing them to be related to a few acids (as tartronic, mesoxalic, malonic, &c.) mostly as amides or cyanamides; while some (as alloxantin, murexide, &c.) may be considered as resulting from the coalescence of two such derivatives with elimination of water. The derivatives thus formulated are given in groups, each group under the head of the acid to which it is most nearly related.

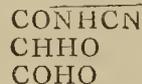
Derivatives related to *Tartronic Acid*—



Uric acid—



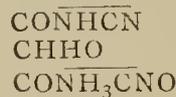
Dialuric acid—



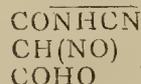
Dialuramide (uramil)—



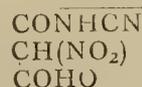
Pseudo-uric acid—



Violuric acid—



Dilituric acid—





urea is cyanammonium hydrate, *i.e.*, ammonium hydrate in which CN takes the place of H; thus,  $\text{NH}_4\text{OH}$ , ammonium hydrate; and  $\text{NH}_3\text{CNOH}$ , urea.

This view of the constitution of urea was suggested to me by its production in decompositions of uric acid and its derivatives.

The isomeric transformation of ammonium cyanate into urea suggests a similar view; for, just as Perkin has shown that ammonium glyoxylate undergoes isomeric change into an amide of glyoxylic acid, so we may suppose ammonium cyanate to become cyanamide, with the difference that in this case the water remains combined and is not—as in the formation of the amide of glyoxylic acid—eliminated; in this view urea is a hydrate of the substituted ammonia  $\text{NH}_2\text{CN}$ , and therefore differs from ammonium hydrate in the respect in which  $\text{NH}_2\text{CN}$  differs from  $\text{NH}_3$ , that is, in having H replaced by CN.

The formation of the compound ureas, and of sulphurea and the compound sulphureas, and some reactions of the latter, admit of similar explanation.

Mr. Fenton, by investigation of certain reactions of urea, has shown reason to suppose that the two nitrogens in urea are differently combined in the compound, a conclusion in harmony with some known reactions of urea, and with the view which the above considerations suggest—by whatever formula urea be represented—and inconsistent with the carbamide hypothesis. It is premature at present to give a constitution to urea; that it is carbamide is, I think, hardly possible to allow; but what it is can only be known by a further investigation of this body itself and its immediate derivatives, such as Mr. Fenton has undertaken.

In the meantime, it seems more in harmony with the present state of our knowledge to look upon urea as hydrated cyanamide or cyanammonium hydrate than as carbamide.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, November 21, 1878.

R. WARINGTON, F.R.S., in the Chair.

AFTER the reading of the minutes, &c., the following certificates were read for the first time:—C. E. Cassel, T. Gough, H. Wilson, S. Spencer, R. Gracey.

The CHAIRMAN then called on Prof. CHURCH to read his paper entitled "*A Chemical Study of Vegetable Albinism.*" The author commenced by distinguishing albinism from chlorosis and icterus. Two sets of analyses were made, one upon leaves gathered in the autumn of 1877, the second on leaves gathered in 1878. Great care was taken in gathering the leaves, that they should be of the same age, &c.; no steel implements were used to separate them. The plants chosen for the first sets of experiments were the maple, the holly, and the ivy. In the second set, the plants (for which the author was indebted to Sir Joseph Hooker) experimented with were *Elæagnus pungens*, *Plectogyne variegata*, *Cyperus alternifolius*, and *Alocasia macrorrhiza*. Both sets of analyses yielded the following results:—The ash of the white leaves contains much more potash and phosphoric acid than that of the green leaves. The ash of the white leaves contains much less lime than that of the green leaves. No deficiency of iron in the white leaves was detected. The details of all the analyses are given. The author made further enquiries with *Elæagnus pungens* as to the three following points:—The amount of matters soluble in ether; the proportion of albuminoid to total nitrogen; presence of calcium oxalate and carbonate. As regards

the first, the white leaves yield less than half the amount of extractive given by the green leaves. Nearly 60 per cent of the nitrogen in the white leaves is non-albuminoid, while the green leaves contain 30 per cent in that condition. Calcium carbonate and oxalate were present in notable quantities in the green leaves, but almost absent from the white leaves. White leaves contain more (about 10 per cent) water than green leaves, while the dry organic matter in the former is not quite two-thirds of that present in the latter. To elucidate the question the author made some analyses of a parasite of the dodder and its host, the red clover. The parasite was found to be richer in water and in potash, but poorer in lime than its host, thus resembling a white leaf. White leaves, therefore, are related to green pretty much as immature leaves to mature, tubers to foliage, petals to green bracts, vegetable parasites to their hosts. The white leaf may thus be said to be parasitic on the green. The author does not give any decided opinion as to the cause of the whiteness: he remarks that white leaves are usually weaker, thinner, and that albino cuttings cannot be "struck." Some attempts have been made to stimulate albino foliage, but without any decisive results. The author promises further experiments, especially as regards the relations of equal areas of white and green foliage to carbonic acid, and the effect of injecting various substances.

Dr. VOELCKER said the paper was one of great interest as indicating a new path which might lead to important results. He should like to ask if Prof. Church had paid much attention to the quantities of chlorides and nitrates.

The CHAIRMAN said that he had listened with great attention to Prof. Church's paper, as one opening out a new subject, and one which it was rather curious that no one, as far as he was aware, had investigated hitherto. In Germany analyses of beech leaves of all ages had been made, and in many respects the analyses of the young leaves corresponded with those of the white leaves, whilst the composition of the old leaves agreed with that of the green leaves. He should think, therefore, that in the spring Prof. Church would find less difference between the white and green leaves than in the autumn. The analyses of the parasite and its host seemed to afford a very good explanation of the differences between the composition of the white and green leaves. All the diffusible substances were found in the white leaves and the parasite, with but little non-diffusible matter.

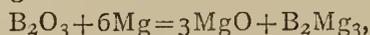
Dr. Dyer remarked that albinism was a disease, probably due to the presence in the white leaf of some minute organism; for albinism can be communicated by grafting a normal plant with an albino shoot. White leaves resembled imperfectly fed leaves, preserving a sort of lingering vitality from their connection with a healthy plant, without which connection they could not exist.

Prof. CHURCH, in reply, said that he attempted some chlorine and nitric acid determinations, but the results hitherto obtained were valueless.

The CHAIRMAN at this point announced that a ballot for Fellows would take place, and appointed Dr. Thudichum and Prof. McLeod as Scrutators. The ballot ensued, but was invalid because the requisite number of Fellows present did not vote.

The next paper was read by the SECRETARY, and was entitled "*Relation Between the Melting-Points of the Elements and their Coefficients of Expansion.*" by Dr. CARNELLY. Certain theoretical considerations led the author to the conclusion that the coefficient of expansion of an element by heat would be the greater the lower its melting-point. This conclusion the author has tested in the case of thirty-one elements, and finds that with five exceptions the coefficient of expansion increases as the melting-point diminishes; the five exceptions are As, Sb, Bi, Te, and Sn. A table and a graphic curve accompany the present paper, which the author promises to supplement by a communication, on a simple relation existing between the heat evolved by a chemical reaction and the melting-points of the reacting and resulting bodies.

The next paper was "A Preliminary Notice on a Hydride of Boron," by FRANCIS JONES. After an unsuccessful attempt to prepare the above substance, by treating a product (magnesium boride), obtained by the action of sodium on a mixture of magnesium chloride and potassium borofluoride with hydrochloric acid, the author succeeded in preparing a spontaneously inflammable gas, which is doubtless hydride of boron, by first strongly heating a mixture of magnesium dust and boron trioxide,—



and, secondly, treating the grey friable mass thus obtained with hydrochloric or nitric acid. The gas is colourless, burns with a bright green flame, and has a disagreeable odour. By using 3Mg instead of 6 in the above equation and treating the product with hydrochloric acid, amorphous boron is obtained as a brown powder.

The Society adjourned to December 5, when the following papers will be read:—"The Processes and their Comparative Value for Determining the Quality of Organic Matter in Potable Water," by Dr. Tidy; "Researches on the Action of the Copper-Zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe; "On a New Gravimetric Method for the Estimation of Minute Quantities of Carbon," by Drs. Dupré and Hake.

#### PHYSICAL SOCIETY.

November 23, 1878.

Prof. W. G. ADAMS, President, in the Chair.

PROF. W. E. AYRTON, late of the Imperial Engineering College, Tokio, Japan, read a paper written by himself and Prof. J. PERRY, of the same College, "On the Music of Colour and Visible Motion." The authors began by pointing out the well-known fact that emotion is excited by moving bodies, and they believed that upon this basis a new emotional art would be created which would receive a high development in the far distant future. All methods of exciting emotion could be cultivated; but of these, music, by reason of the facility with which its effects could be produced, had been highly perfected by the bulk of mankind. Sculpture and painting are not purely emotional arts like music, inasmuch as they involve thought. It would take a long time and much culture for the eye to behold moving figures with similar emotional results to those of the ear on hearing sweet sounds, but time and culture only might be necessary. It might be due to their neglect of this emotional tendency that the Western nations felt little emotion at moving visual displays. For among the Eastern nations they had entertainments consisting of motions and dumb show, which although incomprehensible and even ludicrous to the European, powerfully affected the feelings of a native audience. In Japan the authors had seen whole operas of "melodious motion" performed in the theatres, the emotions being expressed by movements of the body, affecting to the audience, which were quite strange to them. The accompanying orchestral music was, withal, displeasing to the authors; while, on the other hand, Western music is mostly displeasing to the Japanese. The emotions produced by rapidly moving masses—such as a train bowling up to a bridge, or by changing colours as in sunsets—have been felt by all. Harmonic instruments have been constructed to exhibit the combination of two or more pairs of harmonic motions to the eye; for example, Blackburn's pendulum, Lissajous's forks, Wheatstone's kaleidophone, and Tisley's harmonograph. Prof. Ayrton illustrated his remarks by exhibiting these instruments in action. The pendulum traced out the complex path of the combined motions by a jet of falling sand, the forks by a moving beam of light thrown on a screen, the kaleidophone by a bright bead, and the harmonograph by the involutions of an aniline pen. With none of these and such like instruments, however is the

production of mere emotion the end in view; and in most of them no change can be made in the periods of the pairs of harmonic or periodic motions combined without arresting the instrument, a proceeding which in music would be analogous to stopping the tune at the end of every chord. There is no provision either for changing the amplitude or phase. A successful instrument in the new kinematical art must visibly render changes in period, amplitude, and phase of the harmonic motions represented. Profs. Ayrton and Perry had designed an instrument, which was now in Japan, for effecting these required changes in a combination of harmonic motions given to a moving body, and which they claimed to be the first musical instrument of the visual art in question. They had not given it a name yet because the nomenclature of the subject was un-invented. A diagram of this instrument was exhibited to the meeting. It consists of a mechanical arrangement of levers, pulleys, and cords, whereby two harmonic motions, one along a vertical and the other along a horizontal line, are compounded in the resultant motion of a suspended pane of glass. A black circle painted on the pane is intended to represent the moving body as projected against a wall or screen behind. The levers moving the pane are actuated by a revolving barrel, the periphery of which is carved according to mathematical principles, so as to give the different harmonic motions to the levers in one revolution. The motion is further regulated by shifting the levers, and by the angular velocity of the barrel. In this way the period, amplitude, and phase of the component motions of the glass, either in a vertical or horizontal direction, may be changed at will, and almost immediately. Other kinds of periodic motions may be compounded in a similar way. Prof. Ayrton also suggested other forms of apparatus for this purpose. Numberless combinations of graceful motions producing emotional effects on the beholder can by its means be given to a visible body. It is the intention of the authors to construct an improved form of the apparatus, and to arrange for the blending of colour with the moving body to heighten the emotional influence. For example, they purpose having changing mosaics of different hues thrown upon the screen for a back-ground to the black spot. This can be done by means of an instrument similar to the chromotrope, with its revolving sheets of parti-coloured glass. In conclusion, Prof. Ayrton said that there might yet be invented many different ways of producing these spectacles, and there was no reason why a whole city full of people should not enjoy these displays projected upon the clouds overhead.

In the short discussion which followed,

Dr. STONE pointed out that the Japanese employ a different scale to that of the western nations, and that therefore our music may seem odd to them as theirs is to us. The ethnological difference of ear between the Chinese race and ourselves is a subject worthy of investigation. He attributed the influence of pantomime on the Japanese to association, and asserted that music not only produced emotions but suggested ideas. The harmony of music, poetry, and motion were well known, and tone poet was a name given to composers.

Dr. GLADSTONE remarked that all the senses could be harmonised when sufficiently educated, as witnessed to by the art of the cook and the perfumer. Sugar and nitre when tasted separately were not disagreeable, but when tasted together the effect was very nauseous, and great quantities of beet-sugar had been vitiated by small traces of nitre from the beet-root.

Prof. AYRTON also alluded to the curious fact that certain persons on hearing music seemed to see changing colours or landscapes arise before them, and others see bright lights on hearing shrill sounds.

Dr. SCHUSTER then described his new method of adjusting the collimator of the spectroscope for parallel rays of different refrangibility. His plan is very simple, and is based on the fact that if the rays entering the prism are parallel the focus seen in the telescope will remain con-

stant when the prism is turned round; but if they are not parallel the focus will shift. The process, therefore, consists in looking through the telescope while turning the prism. If the focus shifts the collimator has to be adjusted until no shifting takes place. The adjustment must be made with a prism whose sides are perfectly plane, and a good one may be kept for the purpose.

The Society then adjourned until December 14.

## CORRESPONDENCE.

### SODA MANUFACTURE.

*To the Editor of the Chemical News.*

SIR,—Noticing the article on the ammonia-soda process in the CHEMICAL NEWS, vol. xxxviii., p. 203, I afterwards thought it might interest some of your readers to see the outlines of a process for the manufacture of soda as a part of a process for the purification of coal-gas from carbonic acid as devised by me, and patented by Mr. R. W. Wallace and myself.

Means have long been sought to purify coal-gas by a liquid process to be carried on in permanently closed vessels, in such a way that the formation of solid refuse matter and its exposure to the surrounding atmosphere be avoided.

It is needless to enumerate the many and various methods already proposed by others for the solution of this problem, since most of them are known. All or most of them have for their basis the use of caustic ammonia in the liquid form. Everyone acquainted with the manufacture of gas admits the perfect feasibility and practicability of the purification of gas by means of liquid or gaseous ammonia. The difficulty hitherto in the way of carrying it out in practice was the economical production of caustic ammonia and its recovery over and over again without at the same time forming a solid refuse, worse to dispose of than the present lime or oxide waste.

In the process to be described the ammonia is produced by decomposing *chloride of ammonia by means of lime*. The chloride of calcium formed, which constitutes the only refuse matter arising from the working of the same, is easily disposed of, as it may be run into any river or sewer, and will there act even as an antiseptic and disinfectant.

The ammoniacal gas produced as stated above is admitted or conveyed in regulated quantities into the coal-gas as it leaves the retorts. It there takes up the impurities, carbonic acid and sulphide of hydrogen, and passes charged with these impurities along with the gas through a number of scrubbers. The ordinary open purifiers being for the most part dispensed with, a larger number of scrubbers are required. These are arranged into two or three groups, and the last one or two in each group are used for condensing or absorbing the compounds of ammonia formed.

The solution thus produced is pumped in a continuous manner from scrubber to scrubber in the direction from holder to the retorts. As it approaches the scrubbers nearest to the retorts the liquor becomes gradually poorer in sulphide of ammonium and richer in carbonate of ammonia, so that, arrived at the last of them, the liquor will be found to have absorbed *more* carbonic acid than is necessary to form with the ammonia present in it the monocarbonate of ammonia. Whilst this is the case there is generally at the same time sufficient sulphide of hydrogen present in the liquor to form, with about 15 per cent of the ammonia, sulphide of ammonium.

As the presence of bicarbonate of ammonia is, however not consistent with the simultaneous existence of sulphide of ammonium in the same liquid, the sulphide of hydrogen must exist in the free state; at any rate for the purposes of this description we will assume it to be so.

From the scrubbers yielding the liquor containing a maximum of carbonic acid and a minimum of sulphide of hydrogen, the liquor is withdrawn for the further operations of the process being described; that is to say, the liquor is either distilled and the vapours of carbonate of ammonia condensed in a solution of chloride of sodium, or, if previously concentrated, common salt is dissolved in the liquor in quantities equivalent to the carbonate of ammonia contained in the concentrated liquor, but allowing for the excess of chloride of sodium usually taken in the practice of the ordinary ammonia-soda process.

Pure carbonic acid derived from the decomposition by heat in closed vessels of bicarbonate of soda is next forced into the mixed solutions (by means of an air compressing engine); bicarbonate of soda is precipitated, which is drained or separated from the mother-liquor otherwise.

This bicarbonate of soda is heated, as mentioned, in closed vessels until it is converted into carbonate; the carbonic acid liberated is received into a gas-holder, and serves for carbonating the next batch of mixed solutions.

The mother-liquor, containing chloride of ammonium, common salt, and some undecomposed bicarbonate of ammonia, is next heated in boilers or stills, to drive off the carbonate of ammonia contained in it, which is collected.

After every trace of carbonate of ammonia is expelled the hot chloride of ammonium is run in regulated quantities into another still containing an excess of hot hydrate of lime. The ammonia liberated is admitted into the coal-gas and so forth—that is to say, the same above described operations are repeated again and again.

Thus the same quantity of ammonia will suffice to purify coal-gas to an unlimited extent of carbonic acid. This being the case, the ammonia derived from the distillation of the coals, and which accompanies the coal-gas, is therefore available for other purposes, and as the yield is equal to about four-fifths of an equivalent of the sulphide of hydrogen produced simultaneously, the whole of *this* ammonia may be used for the purification of gas from sulphide of hydrogen.

It is well known that gas lime, consisting in its early stage of sulphide of calcium and carbonate of lime, becomes by continued exposure to the impure coal-gas ultimately converted wholly into carbonate of lime, *i.e.*, the carbonic acid is retained whilst the sulphide of hydrogen is driven forward and carried along in the direction in which the coal-gas travels. Hence, whilst the nearest purifier contains carbonate of lime, some of those further removed contain sulphide of calcium only.

The same action will take place in scrubbers in which caustic ammonia is used as a purifying agent; carbonate of ammonia will be found in the first and sulphide of ammonium and caustic ammonia in the last. Thus the ammonia will absorb four-fifths of the sulphide of hydrogen contained in the coal-gas, leaving only one-fifth to be dealt with by other means.

To describe these and to enter further into the details of this process would cause this letter to become too voluminous, its object being merely to point out the enormous practical and commercial advantages arising from the combination of the two processes to each other. The purification of the gas would be capable of being carried on in permanently closed vessels—therefore no nuisance. This applies to all the operations from the generation of the ammonia for the purification of the gas to the production of the finished marketable soda-ash. Not one particle of the materials in use in all the intermediate stages of working need to see the daylight as it were. It would produce no solid refuse to be disposed of, but would, on the contrary, produce in the place of it an article of great value, selling at the present time for £11 per ton.

Looking at the process from the ammonia-soda maker's point of view, the latter will find advantages he never could dream of before. He is saved the cost and trouble of combining his caustic ammonia with carbonic acid and the loss of ammonia generally incurred in this operation,

nor has he anything to pay for his lime wherewith to decompose the chloride of ammonium.

I have it on good authority that the cost of production per ton of alkali in the works of Mr. Solvay, near Nancy, is £4 per ton. If from this figure is deducted the cost of lime and of the loss of ammonia occasioned by the combination of ammonia with carbonic acid (which loss is avoided in this process by all the ammonia compounds being conveyed back into the circuit of the gas plant); if it is further taken into consideration that a large amount for fuel may be saved in gasworks, where there is so much waste heat to be utilised, a figure as to the cost of alkali results which may appear almost ridiculous.

If a more general view is taken of the bearings of this process on the alkali trade the effect is more surprising still.

According to reliable figures obtained from several of the leading gas engineers of London and elsewhere as to the amount of carbonic acid in crude gas, the quantity of soda-ash (of 100 per cent of carbonate) which could be produced for each ton of coal carbonised in the gas works would be from 70 to 84 lbs. This means that in a gas works, like the Beckton gas works, about 750 tons per week of pure alkali could be produced, or if that works should represent, as it is assumed, or as I have heard it frequently stated, even two-thirds of the production of gas in London and suburbs, London would produce something like 1100 to 1200 tons of refined alkali per week. The remaining large towns of Great Britain would easily bring up the deficiency between that figure and, say, 4000 tons per week, or the half of total production of alkali in this country.

Any criticism on my statements by any of your readers will be welcome.—I am, &c.,

C. CLAUS.

16, Mark Lane, London, E.C.,  
November 25, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 19, November 4, 1878.

**Reciprocal Displacements between Oxygen, Sulphur, and the Halogens Combined with Hydrogen.**—M. Berthelot.—According to the quantities of heat liberated chlorine ought to displace bromine and bromine should displace iodine, both in the gaseous hydracids and in those combined with water, which agrees with general experience. Chlorine and bromine ought to displace sulphur in sulphuretted hydrogen, whether gaseous or dissolved, as is shown by experience. The reaction is effected so much the more easily, as an excess of chlorine forms, with the sulphur set at liberty, chloride of sulphur, in the anhydrous state and in presence of water, several secondary compounds. Iodine ought to displace sulphur in dissolved sulphuretted hydrogen, forming dilute hydriodic acid; but, on the other hand, sulphur ought to decompose gaseous hydriodic acid, forming gaseous sulphuretted hydrogen, as actually happens. Oxygen should displace sulphur in sulphuretted hydrogen, gaseous or dissolved. Between chlorine and oxygen the thermic theory indicates the formation of an equilibrium. Oxygen ought also to displace bromine in hydrobromic acid, and iodine in hydriodic acid, both gaseous and dissolved.

**Reciprocal Displacements between Weak Acids.**—M. Berthelot.—Two feeble acids brought in contact share the base, the partition being regulated by the state of partial decomposition of the two salts, which depends

at once on the proportion of water and on that of the corresponding acid.

**Reaction between Mercury and Hydrochloric Gas.**—M. Berthelot.—13.5 grms. of mercury and 48 c.c. of pure hydrochloric acid gas were placed in a well-sealed tube, and heated as strongly as possible for an hour. Rather more than 1 c.c. of hydrogen was obtained.

**Maturation of the Grain of Rye.**—A. Müntz.—The saccharine matter existing in the grain of rye appears to be synanthrose, a sugar discovered by M. Pope in the tubers of the Jerusalem artichoke. Synanthrose is not present in wheat, &c.

**Dangers of the Industrial Use of Methyl Alcohol.**—L. Poincaré.—Animals kept from eight to sixteen months in an atmosphere freely renewed, but charged with the vapour of methylic alcohol, presented during life an abnormal development of the abdomen. On a *post mortem* examination the liver was found greatly enlarged and in a state of fatty degeneration. A similar modification was traced in the muscular fibres of the heart, of the urinary passages, and of a great number of the pulmonary cells. There was also congestion of the nervous centres. The author urges that some other method of preparing alcohol for industrial purposes should be selected.

**An Iodised Derivative of Camphor.**—A. Haller.—The author in order to prepare a cyanogen derivative of camphor treated a benzoic solution of a mixture of iodised camphor and sodic borneol with a solution of iodide of cyanogen in the same hydrocarbon. The compound obtained was  $C_{10}H_{13}IO$ .

**Reproduction of Felspar by Fusion and by Prolonged Exposure to a Temperature Bordering on Fusion.**—F. Fouqué and M. Lévy.—The authors melted in a platinum crucible placed in a Schloësing furnace either natural pulverised felspars or artificial mixtures of their chemical constituents.

**Two Specimens of Natural Crystals of Epsomite of Remarkable Dimensions.**—P. de Rouville.—The crystals were more than a centimetre in length.

*Les Mondes, Revue Hebdomadaire des Sciences.*  
No. 8, 1878.

**Salaries of the Professors of the Faculties.**—It is very properly pointed out as unfair that whilst the salaries of professors in the faculties of law and letters have been fixed at 15,000 francs, those of the professors of medicine and science receive only 13,000.

M. Depelley proposes a contrivance by which the date, when a letter passes through the post-office, will be made to appear not merely on the envelope, but on the enclosed letter.

**Note on the Optical Properties of Leaves of Gelatin.**—A. Bertin.—The author observes that plates of glue and gelatin, as ordinarily sold, act energetically upon polarised light, after the manner of tempered glass. With a polarising microscope they yield in many parts fringes very similar to those of biaxial crystals, though irregular. The sheets of gelatin used by lithographers act differently, having constant and well-defined optical properties. They are obtained by pouring a hot concentration of glue upon a plate of glass previously washed with ox-gall to prevent adhesion, and fitted with a margin of wood or of paste-board. The sheets of gelatin should have a mean thickness of 0.5 m.m.

**Products accompanying Ethylic Alcohol.**—Isidore Pierre.—A letter addressed to Prof. Dumas, and treating on the removal of aldehyd, propylic, butylic, and amylic alcohol, &c., from distilled liquors.

**"Gluttony."**—By M. Amédée Latour, and reviewed by "Dr. Simplicé."—A work containing not a few doubtful and inconsistent propositions.

*Chemiker Zeitung.*  
No. 41, 1878.

**Chemical Industry at the Paris Exhibition (No. XI.)**  
—Dr. C. Deite.—This chapter is devoted to the manufacture of stearine, a business of great importance in France. The largest works are those of F. Fournier, of Marseilles, producing yearly 4,286,000 kilos. of stearic acid and stearine candles.

**Manufacture of Sulphate of Ammonia.**—The works at Grätz produce yearly 10,000 metric cwts., and are very remunerative. The ammonia is obtained by mixing fæces with 2 to 3 per cent of lime in the form of milk, and distilling. The ammoniacal gas and steam saturated with gas are drawn into leaden neutralising receivers. The sulphuric acid employed is of the strength of 60° (probably Baumé), and the salt obtained is almost white. The town of Grätz, with a population of 100,000, yields daily 3000 pails of semi-fluid fæcal matter, about one-third of which is consumed in the above-mentioned works.

Immense deposits of gold have been recently discovered in Patagonia, and are said to extend from the Cordilleras to the ocean, and from Santa Cruz to Tierra del Fuego.

Various ornamental articles are now made from ox-blood. The dried, pulverised, and sifted blood is forced into moulds, which are heated to from 100° to 150°, and are then submitted for a few minutes to a very strong pressure. After cooling, the articles are polished, and are then ready for sale.

According to Vulpius phosphorus is soluble in acetic acid.

To render caoutchouc tubes impervious to coal-gas, Vulpius recommends that they should be coated with soluble glass.

No. 42, 1878.

At Königsberg certain military persons have been attacked with eruptions, ascribed to the green leather lining of their helmets, in which arsenic has been detected.

Petroleum has been in use in Japan for several centuries. In the province of Etshigo, on the north-west coast of Nippon, 600 oil-wells are in full flow. The petroleum only loses one-tenth of its weight in refining.

Dynamite, if brought in contact with water, undergoes a separation of its ingredients. The infusorial earth sinks to the bottom, whilst the nitro-glycerin floats on the surface, and on a slight rise of temperature explodes with its usual violence.

No. 43, 1878.

The total yearly production of soap in France is calculated at 220 million kilos.

Vincent and Lecann, of Havre, manufacture soaps in which petroleum is kept in a state miscible with water by means of an addition of carnauba wax. This substance owes its efficacy to the presence of myricylic alcohol, which if added to petroleum renders it miscible with soap-lye.

An oil-well is said to have been discovered at Adlershof, near Berlin.

Dr. Wackenroder gives an account of the results of chemical and microscopic observations of food, &c., performed at Bernburg. The adulterations detected seem neither numerous nor novel.

*Reimann's Färber Zeitung,*  
No. 44, 1878.

**Dyeing with the Azo-Colours.**—Tropeolin, orange, &c., can be satisfactorily fixed upon wool by means of alum and tartar, and if topped with eosin give scarlets comparable with those produced with cochineal. With oxalic acid and tin crystals the colours are reduced and the resulting shades are dirty. Topping with magenta and safranin is unsatisfactory.

## MISCELLANEOUS.

**Wall Decoration.**—Under the name of Muralis, Mr. Frederick Walton is manufacturing a new Linoleum product for decorating walls. Muralis is a mixture of linseed oil and fibre, rolled on to a cotton fabric. On this material, ornamentation in relief is stamped by machinery with the greatest clearness, beauty, and sharpness of diversified outline. The use of colour in addition is optional, and the patterns may, if desired, be tooled after the first stamping. The effect produced is, according to the will of the designer, like that of carved wood, of embossed leather, of terra-cotta, or plaster ornamentation; or the work may be allowed to assume a character of its own as a subdued and graceful style of ornamentation. This new material is very durable; even a blow produces no lasting impression. For the interior decoration of houses its warm and comfortable surface makes it peculiarly applicable. There is at present at the show-rooms, at 9, Berners-street, in addition to many specimens of the material, a room entirely decorated with Muralis, which would appear to have all the qualities requisite for extensive use, being beautiful in effect and admirably clean and sanitary. A silver medal for the new product was granted this year at the Paris Universal Exhibition.

## MEETINGS FOR THE WEEK.

- MONDAY, Dec. 2nd.—Medical, 8.30.  
— London Institution, 5.  
— Royal Institution, 5. General Monthly Meeting.
- TUESDAY, 3rd.—Civil Engineers, 8.  
— Zoological, 8.30.
- WEDNESDAY, 4th.—Society of Arts, 8.  
— Geological, 8.  
— Pharmaceutical, 8.
- THURSDAY, 5th.—Chemical, 8. "The Processes and their Comparative Value for Determining the Quantity of Organic Matter in Potable Waters," by Dr. C. M. Tidy. "Researches on the Action of the Copper-zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe. "On a New Gravimetric Method for the Estimation of Minute Quantities of Carbon," by Dr. Dupré and Dr. Hake.  
— Royal, 8.30.  
— Royal Society Club, 6.30.
- FRIDAY, 6th.—Geologists' Association, 8.

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An Examination in Practical Chemistry in connection with the Institute of Chemistry will be held during the last week of January next. Examiner, Dr. W. J. Russell, F.R.S. Candidates can obtain further information on application to the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London, W.C.

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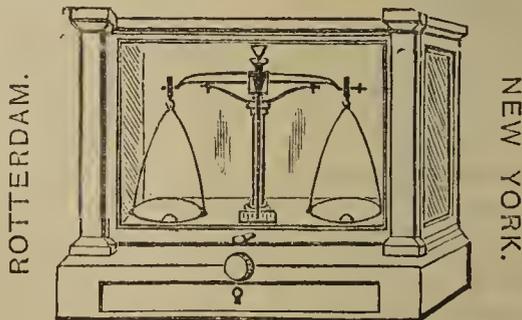
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**GEOLOGY.**—In the Preface to the Student's **ELEMENTS OF GEOLOGY**, by Sir Charles Lyell, price 9s., he says:—"As it is impossible to enable the reader to recognise rocks and minerals at sight by aid of verbal descriptions or figures, he will do well to obtain a well-arranged collection of specimens, such as may be procured from Mr. TENNANT (149, Strand), Teacher of Mineralogy at King's College, London." These Collections are supplied on the following terms, in plain Mahogany Cabinets:—

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 993.

AMMONIUM NITRATE.

By SPENCER PICKERING.

THE melting-point of ammonium nitrate given in the various text-books is apparently incorrect. In the "Dictionary of Chemistry" it is stated to be  $108^{\circ}$  C.; in Miller,  $107^{\circ}8'$  C.; and in Gmelin it is stated that it melts imperfectly at  $56^{\circ}$  C., and perfectly at  $108^{\circ}$  C. But experiments on the crystallised substance, which had been dried at  $100^{\circ}$  C., invariably gave its melting-point as  $165^{\circ}$  to  $166^{\circ}$  C., whether it had been recrystallised from water or from alcohol; it was also found that the amount of water retained by the moist crystals after being pressed between blotting-paper (about 0.55 per cent) did not lower its melting-point more than  $3^{\circ}$  C.

Ammonium nitrate dissolves easily in alcohol, but is much less soluble in this liquid than in water. From either its alcoholic or its aqueous solution it is deposited, on cooling or on evaporation, in anhydrous crystals, which deliquesce only when exposed to very moist air. Portions of the substance which had been dried at  $100^{\circ}$  C., and which weighed about 1 grm., were exposed on watch-glasses to the air of the laboratory for about eighteen hours; crystals obtained from an alcoholic solution gained in this way 0.06 per cent of moisture; and those obtained from an aqueous solution gained in one case 0.06, and in another 0.15 per cent; crystals which have been dried by being pressed between blotting-paper will even lose a portion of the small amount of moisture which they contain, the loss varying from 0.01 to 0.1 per cent. Some of the powdered substance which had been dried at  $100^{\circ}$  C. was exposed to the air of the laboratory for ten days, after which it was found to contain 0.09 per cent of water; but on subsequent exposure to air perfectly saturated with moisture for twenty-two hours, it absorbed as much as 14 per cent of water. In another experiment, where the crystals had been obtained from an alcoholic solution, the absorption amounted to 32 per cent. Some of the fused salt gained under similar circumstances 3.3 per cent, becoming, as in the two previous experiments, partially liquefied. Ammonium nitrate is insoluble in ether.

On being heated above its melting-point it begins to decompose into nitrous oxide and water at about  $185^{\circ}$  C., and not at  $250^{\circ}$  C., as stated in Miller and elsewhere.

Oxford, December 1, 1878.

NOTES ON ESTCOURT'S BUTTER APPARATUS.

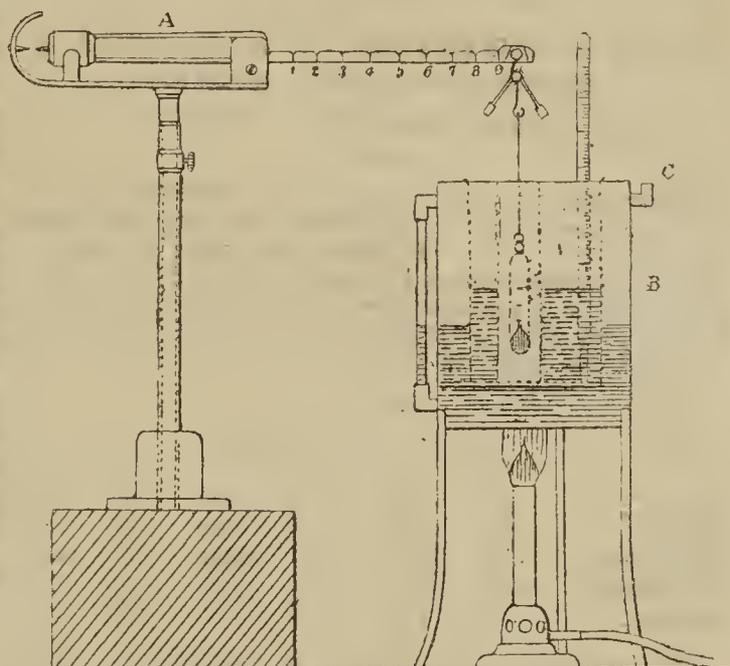
By J. CARTER BELL.

IN the CHEMICAL NEWS, vol. xxxiv., p. 254, is a description of this apparatus, together with the new method devised by Estcourt, for taking the specific gravity of fats at a constant temperature.

In the many analyses of butter which I have had to perform in my capacity as public analyst, I have found this apparatus of very great advantage, and can indeed say with truth that when once its value is known to analysts its use will be universal. I hold it to be incumbent upon all chemists who may try new methods of analyses or new forms of apparatus to give to their fellows in the scientific world the results of their experience, and with this view I have made the few preceding remarks. When I first examined the

method as described I found great difficulty in comprehending it, owing to the omission of a cut of the apparatus. Owing to this omission (of a cut of the apparatus) the description to be found in the text is by itself rather difficult to understand; I therefore append to this note a sketch of the apparatus just as I use it.

A represents the Westphal balance with bulb immersed in the test-tube, containing the fat whose gravity it is desired to obtain. B is a vertical section of the bath, the outer casing of which is filled with water (outlet and inlet for water is marked c). The inner part of the bath contains paraffin, and in this the thermometer rests along with the test-tube containing the fat. Heat being applied the boiling water in the outer jacket melts the paraffin, which gradually arrives at a constant temperature, when



the weights on the arm of the balance are correctly adjusted, and the specific gravity is read off. The only precaution needful is to see that the plunger of the balance does not rest either on the bottom or the side of the test-tube; this is avoided by gently moving the balance slightly until under each change no difference is observed in the indicated specific gravity.

PHILIPPIMUM.

By W. G. BROWN.

WHILE analysing sipylite in the laboratory of the University of Virginia during the winter of 1876-77, the solution of the earths occurring in connection with yttria was examined by means of the spectroscope.

In view of the fact that a new metal—philippium—(CHEMICAL NEWS, vol. xxxviii., p. 202) has been announced by Delafontaine, the following may prove of interest.

The earths of the yttrium group separated from those of the cerium group (CHEMICAL NEWS, xxxvi., 158) were dissolved in hydrochloric acid; the solution so obtained was placed in two cells, together about 20 c.m. in length. On passing the light of an Argand burner through this depth of solution and examining the transmitted light by means of an ordinary "Heidelberg laboratory" single prism spectroscope, an absorption-spectrum of great distinctness was obtained, consisting of thirteen bands, whose positions were noted, and a doubtful band in the extreme violet, none of which exactly agreed with the same number of bands obtained from a solution of a didymium salt with the same spectroscope. To only two of these bands need particular attention be drawn for the

present, one in the red, the other in the blue. The first gave  $\lambda=6705$ , and was noted "very faint;" the second was quite broad, its limits being  $\lambda=4580$  and  $\lambda=4490$ , and is marked "deep black." This latter line agrees with the characteristic line of philippium, and denotes in all probability the presence of that earth in sipylite. Whether the red line is the same as that mentioned by Delafontaine I cannot determine, as this chemist does not give the wave length of the red ray observed by him.

These wave-lengths (6705, 4580, and 4490) are only approximate, and were determined by interpolation after the method given in Watts's "Index of Spectra." I was aided in this work by Mr. J. R. Santos, of Guayaquil.

East Tennessee University, Knoxville, Tenn.,  
November 14, 1878.

### ON THE DISTRIBUTION OF MANGANESE IN FERRO-MANGANESE ALLOYS.

By SERGIUS KERN, M.E., St. Petersburg.

CERTAIN observers have remarked that the manganese in ferro-manganese alloys is often very unequally distributed throughout the mass. It being interesting to execute some experiments in this direction, a piece of ferro-manganese weighing 1500 grms. was provided for this purpose. Six samples from different places were analysed. The results are the following:—

	Samples.					
	Percentages.					
	A.	B.	C.	D.	E.	F.
Silicon .. ..	0'20	0'19	0'20	0'20	0'20	0'19
Sulphur .. ..	0'02	0'02	0'01	0'02	0'02	0'01
Phosphorus..	0'08	0'07	0'07	0'07	0'08	0'07
Manganese ..	45'60	47'10	46'80	45'46	44'90	46'70
Carbon .. ..	5'70	5'81	6'01	5'90	5'95	5'98

The manganese was estimated as mangano-manganic oxide by Eggertz's method. In order to study more closely this question several analyses of different ferro-manganese alloys are in execution, the results of which certainly will be of interest for metallurgists.

### ON THE METALLURGY OF NICKEL AND COBALT.\*

By W. A. DIXON, F.C.S., M.I.C.

SHORTLY after the discovery of the large deposits of nickel and cobalt ores in New Caledonia I turned my attention to the metallurgy of these metals, and began this research with a view to improvements in their extraction, keeping in view the fact that here the reagents usually employed in their extraction are exceedingly expensive.

The sources of nickel, previously to the discovery of these deposits, consisted chiefly of speiss, the residue from the manufacture of smalt, which contains from 6 to 8 per cent of nickel and 3 of cobalt, and a few pyritous ores containing copper and nickel. The details of the processes used for the extraction of the metal from the former are jealously guarded by the manufacturer as trade secrets, but the method adopted is, in general outline, to fuse the speiss with fluor-spar and chalk to remove part of the iron and obtain an enriched matt. This matt is ground, thoroughly roasted, to expel arsenic and sulphur and convert the metals into oxides, which are then dissolved in hydrochloric acid. The solution is diluted with water, any ferrous chloride converted into ferric chloride by a solution of hypochlorite of calcium, and the iron

precipitated by the cautious addition of milk of lime, any arsenic being removed at the same time. Sulphuretted hydrogen is then passed into the filtrate to precipitate copper, and from the clear solution cobalt is precipitated by hypochlorite of calcium, and afterwards the nickel by milk of lime.

It seemed probable that the nickel in the New Caledonian ore, occurring as it does in serpentine, might have been deposited from an acid solution percolating through the magnesian rocks, and that if this process could be reversed the nickel might be again obtained in solution. Digestion with ammoniacal solutions of magnesian sulphate and chloride and calcium chloride at various temperatures was therefore tried, but minute quantities only of nickel were dissolved, though in every case distinct traces were obtained.

Trials were made with the view of taking advantage of the comparatively easy decomposition of magnesium chloride by aqueous vapour at a high temperature. The nickel and magnesium were obtained together in solution evaporated to dryness and treated with steam at various temperatures ranging from 212° F. to dull redness, but much nickel chloride was invariably decomposed along with the magnesium chloride.

A portion of the ore in pea-sized pieces was then treated at a dull red heat in a combustion-tube with dry hydrochloric acid gas, with the view of converting the nickel into chloride, whilst the magnesium remained as silicate. Water was freely given off, and the pieces of ore became covered with crystals of anhydrous chloride of nickel. The effect was very beautiful, as the golden-yellow scales of chloride gradually grew out of the ore until each piece seemed converted in a golden ball. The chloride was readily dissolved out by hot water, but numerous trials gave only an average of 3'62 per cent of nickel extracted from an ore containing 10'66 per cent. The solution contained both ferrous and magnesium chlorides in small quantities. Its composition, calculating the metals as dry chlorides, was—

Ferric chloride .. ..	traces
Ferrous chloride .. ..	5'42
Magnesium chloride .. ..	12'45
Nickel chloride .. ..	82'13
	100'00

From finely-ground ore, similarly treated for five hours, 6'73 per cent of nickel was extracted, whilst no increase was observed on continuing the treatment for two hours longer.

It seemed, therefore, as if part of the metal was in more intimate combination with the silica than that extracted; so with a view to decompose this silicate different portions of the residue were treated at a red heat with hydrogen, coal-gas, and finely-divided carbon (obtained by mixing starch with the ore), and afterwards roasted to re-convert the reduced metals into oxides. On further treatment with hydrochloric acid gas 1'65 per cent was obtained, still leaving 3'93 per cent. There was little apparent difference between the reducing-agents, although on the whole the carbon seemed the best. The solutions obtained after reduction were much more impure than those got in the first instance, showing more iron than nickel. Calculated as before they contained—

Ferrous chloride .. ..	47'36
Magnesium chloride .. ..	16'80
Nickel chloride .. ..	35'84
	100'00

These results were obtained with a somewhat friable ore containing much ferric oxide, but it was observed that some dense varieties yielded scarcely any chloride of nickel by this method.

When a charcoal chauffer was used for heating the tube, on some parts of it small brilliant black crystals were

\* Read before the Royal Society of N. S. W., July 3, 1878.

deposited. These were highly magnetic, and contained ferric oxide and nickel oxide, and probably contained ferroso-ferric oxide with the whole or the greater part of the ferrous oxide replaced by nickel oxide, but sufficient for an analysis was not obtained. They seemed to be formed on those parts of the tube which were over-heated, but some other circumstances contributed to their formation, as repeated trials to obtain them in larger quantities failed.

These experiments, although failing to separate the nickel from the silicate, showed that oxide of nickel could be separated from ferric oxide by treatment with gaseous hydrochloric acid, so the behaviour of the mixed oxides was next examined.

The New Caledonian ore is very infusible, from the large proportion of magnesia it contains, and some cheap flux containing other silicates was necessary to obtain the nickel in a metallic or reguline state. This was found in copper ore furnace-slag, which with half its weight of ore yielded a sufficiently fusible charge. The alloy of iron, nickel, and copper, obtained by fusing with carbon only as a reducing agent, was too tough to grind, and was therefore difficult of conversion into oxides; but the addition of arsenical pyrites readily yielded brittle buttons, which were easily pulverised. Indeed, a piece of arsenious oxide thrust into the fused mass in the crucible gave a similar result, as was also the case with iron pyrites. Thus a mixture of 400 grains, 100 grains mispickel, and 800 grains copper slag gave a button weighing 175.6 grs., and containing 63 grains nickel, whilst the yield should have been 66 grains. Again, 400 grains ore, 800 grains slag, with 50 grains pulverised charcoal being fused, 90 grains of arsenious oxide was thrust into the molten mass, and a button was obtained weighing 271 grains, containing 64.8 grains nickel, showing a loss of only 0.3 per cent of the nickel in the ore. The various buttons were crushed and roasted, and the oxides were treated with hydrochloric acid gas (from which aqueous vapour was partially removed by passing it through a Liebig's condenser) at dull red heat. The whole caked together into a mass from the nickel chloride formed; so, to render it permeable, it was removed, crushed, and re-treated until water ceased to be evolved. With boiling water a solution was obtained containing nearly all the nickel, but at the same time a considerable quantity of ferrous chloride, whilst ferric oxide with traces of nickel remained.

It was evident, therefore, that a more thorough calcination was required to effect the separation of the iron and nickel, but it was difficult to determine when the calcination had been carried far enough, as the presence of copper and nickel obscured the usual reaction for ferrous oxide. It was found, however, that by treating a sample from the muffle with hydrochloric acid until complete solution was effected, cautiously mixing with this solution an equal bulk of sulphuric acid, boiling to expel the hydrochloric acid, and adding to the cooled solution a crystal of potassium nitrate, the characteristic brown colour was rapidly developed as long as ferrous sulphate was present.

As speiss was actually the substance under treatment, it was thought advisable to examine the behaviour of the other oxides which are generally contained in it. A speiss was therefore made with ore and various residues, and after calcination was found to contain 41 per cent of oxide of nickel with the oxides of iron, copper, zinc, cobalt, and arsenic. These oxides, treated as before, yielded in a flask attached to the outlet a solution containing arsenic and zinc which had been volatilised as chlorides, and the residue on boiling with water a solution containing nickel and cobalt with a small quantity of iron. The insoluble residue contained the ferric oxide, a small quantity of nickel oxide and copper as cuprous chloride, which could be removed by a solution of salt.

It now remained to separate the small quantity of iron in the solution from the nickel and cobalt and these metals from each other, and it seemed desirable to do so without adding fixed reagents. It was found that this could be done by passing chlorine into the solution until all the iron was in the form of ferric chloride, and then adding to the boiling solution successive small portions of anhydrous oxide of nickel, which dissolved, precipitating the iron as a basic chloride. The precipitate was dense, and contained a small quantity of oxide of nickel added in excess. From a neutral solution containing ferrous chloride it was also found that manganese dioxide completely precipitated the iron without a trace of nickel or cobalt.

On adding to the hot iron free solution rather more oxide of nickel than was equivalent to the cobalt present, and passing chlorine into it, the whole of the cobalt was precipitated as cobaltic oxide, and a pure green solution of chloride of nickel obtained. This solution, evaporated to dryness and ignited in a current of steam, evolves hydrochloric acid, and leaves oxide of nickel, which may

CALCINED SPEISS CONTAINING OXIDES OF NICKEL, COBALT, COPPER, ZINC, IRON, ARSENIC.

I. Treated with Gaseous Hydrochloric Acid gives—

<i>Distillate.</i> Containing zinc and arsenic.	<i>Residue.</i> Containing ferric oxide, cupreous chloride, ferrous chloride, nickel chloride, cobalt chloride, with traces of nickel and cobalt oxides.
--	---

II. Treated with hot water gives—

<i>Residue.</i> Containing ferric oxide, cupreous chloride. Traces nickel & cobalt.	<i>Solution.</i> Containing ferrous, nickel, and cobalt chlorides.
---	---

III. Treated with chlorine till all ferrous converted into ferric chloride, and then boiled with oxide of nickel.

<i>Precipitate.</i> Ferric oxide and oxy-chloride, with the excess of nickel oxide. Returned to roasting-furnace.	<i>Solution.</i> Containing chlorides of nickel and cobalt.
---	--

<i>Residue.</i> Containing ferric oxide, cupreous chloride, traces nickel & cobalt.	<i>Precipitate.</i> Cobaltic oxide and excess of nickel oxide added.	<i>Solution.</i> Pure nickel chloride evaporated to dryness, and ignited in current of steam.
--	---	--

<i>Residue.</i> Cobaltic oxide.	<i>Solution.</i> Nickel chloride.	<i>Gas.</i> Hydrochloric acid returned to I.	<i>Residue.</i> Oxide of nickel to reducing furnace.
------------------------------------	--------------------------------------	---	---

be reduced in the usual manner. The chloride could also be reduced directly to metallic nickel by igniting in a current of hydrogen; and in the case of a solution containing manganese this would be advantageous, as its chloride is not reduced by hydrogen, and could be separated from the nickel by washing.

The precipitated cobaltic oxide was suspended in water and treated with chlorine at the boiling-point, whilst small quantities of chloride of cobalt were added until cobalt remained in solution. All the nickel was thus removed from the precipitate to the solution, which contained also the cobalt added in excess. The same result could be obtained by digesting the precipitate with dilute hydrochloric acid, which would dissolve the nickel only.

Attached is a scheme which shows the process at a glance, with the destination of the intermediate products; and, although somewhat complicated, it must be remembered that six metals have to be separated, and that two of these—nickel and cobalt—are perhaps the most difficult of all metals to separate satisfactorily. The separation is, moreover, effected without having voluminous precipitates, such as ferric and nickel hydrates, four or five ounces of which occupy a cubic foot of space, to treat and wash, whilst the reagents used are in great part recovered in an available form. It is scarcely necessary to observe that if the number of metals present is reduced the treatment would be correspondingly shortened and simplified.

## PROCEEDINGS OF SOCIETIES.

### UNIVERSITY COLLEGE CHEMICAL AND PHYSICAL SOCIETY.

THIS Society has lately transacted the follow business:—

Thursday, October 17, 1878.—Dr. OLIVER J. LODGE, President, in the Chair.—President's retiring address, "On the Importance of Experimental Research and the Necessity for its Endowment," by Dr. LODGE.

Thursday, October 31, 1878.—Dr. C. A. BELL, B.A., President, in the Chair.—Paper on "Volumetric Analysis," by Dr. BELL.

Thursday, November 14, 1878.—Dr. C. A. BELL, B.A., President, in the Chair.—Papers on "Catalysis," by C. W. WATTS; and on "The Estimation of Nitrous Acid," by C. J. WILSON.

The next meeting will be held on Thursday, December 12th, at 7 p.m., when the following papers will be read:—"On Liebig and his Influence on the Progress of Modern Chemistry," by J. Sakurai; and "On a Colorimetric Process for the Estimation of Nitric Acid," by Charles E. Cassal.

## NOTICES OF BOOKS.

*Animal Chemistry, or the Relations of Chemistry to Physiology and Pathology.* By C. T. KINGZETT, F.C.S. London: Longmans and Co.

STRANGE as it may seem, the author of this work is fully justified in his complaint that animal chemistry is neglected. A certain number of facts relating to blood, bile, and urine have indeed been accumulated, and are duly instilled into all medical students as a necessary preparation for what is gradually being recognised as the whole duty of man—to wit, "passing." But how little has been done towards co-ordinating these facts, exhibiting them in their natural order of sequence! Text-books are doubtless compiled, but how? The condemnation of one of the most recent could not be better expressed than has

been done by our author in these few pregnant words:—"In a third and even more modern treatise, by Prof. Karl B. Hofmann, more space is devoted to 'nuclein'—an impure ordinary albuminoid—than to the whole brain chemistry, while eight pages are devoted to the structural formula of glycerin." Even Liebig, great as have been his merits in the field of physiological chemistry, can scarcely be held guiltless of the charge brought against him by Henlé:—"With consummate skill he (Liebig) draws a few crystalline threads out of the tissue of life, and holds them up to admiration as the share of chemism; he then throws us the lump which he cannot unravel as the share of vitalism." Such being the state of this department of science, our author's object has been "to collect and systematise, as far as could be, all the trustworthy work on record in relation to animal chemistry, so far as it concerns the human body." It has been no part of his undertaking to furnish an encyclopædia of facts, nor to describe well-known processes of zoochemical analysis, but to exhibit, "in as natural an order as possible, all those parts of the subject which, when properly arranged, present something like a system."

To this difficult and complicated task Mr. Kingzett has brought the special qualification of having devoted four years to successful research in this branch, and the result, we fear not to say, is the most valuable treatise on animal chemistry which has appeared since the memorable work of Liebig. The author's point of view, if we misunderstand him not, is scarcely that of a vitalist. Thus, in referring to the valuable and interesting researches of his collaborateur Dr. Hake, he writes:—"He believes that the chemical changes as they occur in the blood-system, and comprised in the act of oxidation, do not result in the evolution of heat, but force, which becomes electric by the agency of the blood corpuscles, and it is certain that this is perfectly consistent with what we know of cell-life. On this hypothesis the blood-cells form chains and conductors for the electric force thus generated, and this is subsequently metamorphosed into heat at every point of the system. On reaching the cerebro-spinal centres it becomes vital force,—another name for electric force,—and this becomes eventually heat, namely, when it is transmitted to enable the consummation of a vital act, such as sensation, &c. The experiments of Du Bois Reymond, in particular, go to prove that nerve force is only electric force manifested through media not met with out of living bodies. Of course on Hake's hypothesis nerve force is derived from the common centre, the brain, where it is stored in the grey matter of which the brain is partly composed, and from which nerve-tubes spread everywhere. He even goes further, and reasons that when this cerebro-vital force is united in action within the same organic medium with other forces influencing us from without, viz., light, sound, heat, &c., new results are obtained, and phenomena of sense and intelligence are observed. In anæmia the brain loses somewhat of its vital force, the power of attention is diminished, forgetfulness obtains, the faculties are slowly exercised, and why? Because the source of vital force, viz., blood oxidation, is interfered with. The nature and sources of the mind must be considered with Dr. Hake as the grandest problem of science. Sharing this impression, and entertaining the rational hope that even in this direction conclusions are within the attainment of future science, we have given so much attention to Dr. Hake's theory." Our author evidently, therefore, does not share the opinions of Du Bois Reymond, who, in his justly-celebrated discourse on the "Boundaries of our Knowledge of Nature," argues that consciousness, like matter and space, is an ultimate fact, inexplicable even to the hypothetical spirit of La Place. The passage we have just quoted, taken in conjunction with certain denunciations of the "dogmatism of churches," will doubtless be taken in some quarters as an unqualified avowal of materialism. Such an inference will be of doubtful legitimacy—a consideration which will not prevent it from being

drawn. Without denying that the development of science has met with opposition from religious bodies, we cannot forget that men of sufficiently heterodox views in theology—we could point out such by name—are now earnestly labouring to create additional difficulties in certain spheres of research, animal chemistry not excluded.

After certain general considerations in which occur not a few most valuable ideas, not unmixed with views which we should pause before accepting, the author enters upon the examination of the chemical principles and educts of the body. Here, *inter alia*, he points out the erroneous character of the vulgar notion that the animal function, as contradistinguished from the vegetable, is mainly or entirely one of synthesis, and he shows that most complicated acts of synthesis go on in the animal body itself.

In the second part of the work Mr. Kingzett discusses the organs, fluids, and processes concerned in digestion. In the third he treats of work and waste, introducing into the chapter on animal heat, vital force, and muscular action those daring speculations on the origin and nature of the mind which we have already quoted.

Part fourth is mainly devoted to that most important but difficult question, the chemistry of the brain. The components of this organ, as far as ascertained, and the methods for their separation, are given in some detail. The speculations of Dr. Thudichum and the writer on the "*labile equilibrium*" of the brain, and on the conditions of softening of the brain and of *delirium tremens*, are most interesting, and contain at any rate a nucleus of truth well worth experimental development. In dealing with the question what becomes of alcohol after its introduction into the system, he proposes an experiment which would be instructive, viz., administering large quantities of alcohol to horses intended to be killed, and distilling their brains, removed immediately after death. Perhaps, however, this might be pronounced "*vivisection*"—a term which seems destined to include any act soever done to an animal, with a scientific purpose in view.

The fifth and last part includes a chapter on "character"—in our opinion doubtfully relevant, though it contains declarations amply sufficient to refute those charges of materialism which will be brought against the author; a discussion of the rival theories of fermentation and putrefaction; of spontaneous generation; of the germ-theory of disease; and of antiseptics and disinfectants.

Mr. Kingzett sees nothing mutually inconsistent in the doctrines of Liebig and of Pasteur, and shows that the younger *savant* has merely advanced on the hypothesis of the older. The question of Abiogenesis he is content to leave undecided, whilst pointing out that the balance of evidence is in favour of the doctrine *Nihil vivum nisi ex vivo*. Space has not allowed us to enter upon an examination of the numerous interesting questions which are here either openly raised or at least suggested, whilst for numerous passages well worthy of quotation we must refer to the book itself.

As a sequel we find a list of "suggested matters for research," and a copious index of authorities. Every medical student and every practitioner who looks to something higher than a mere routine practice should study this book. Nor is it without its claims on the attention of the biologist, and still more of every scientific chemist who has time and opportunity for research.

*The Geological Record for 1876.* An Account of Works on Geology, Mineralogy, and Palæontology published during the Year, with Supplements for 1874 and 1875. Edited by W. WHITTAKER, F.G.S. (of the Geological Survey of England). London: Taylor and Francis.

THIS record, though of little interest to the general reader, ought to be considered a treasure by geologists and by students of other branches of science who may have occasion to make use of geological data. An ex-

amination of the list of transactions, journals, and independent works which have been abstracted in order to compile this volume ought to satisfy every one at once of the labour that has been expended and of the value of the result. We can therefore most cordially second the remark with which the editor closes his brief preface:—"Every geologist should act on the advice of Poet Close, and 'buy a copy of our little book.'"

As a fault—not of the editor's, but of geological explorers—we must again point out that so little work is done in Africa, Australia, &c., where even economical consideration should be a powerful stimulus to exertion. The observation recorded on p. 162, that "there never has been a Glacial epoch in New Zealand, and consequently none in the Southern Hemisphere," is, if confirmed, of the highest importance.

*New Weekly Journal for the Oil and Fat Trade* (Neue Wochenschrift für den Oel und Fettwaarenhandel). Jahrgang II., Nos. 43 and 46.

THIS journal represents the German oil-trade and the branches of industry therewith connected. The question of a duty on the importation and manufacture of petroleum in Germany is discussed at some length, and in addition we find a notice of the Gallician oil-wells, a paper on the oils employed in the arts and their applications, besides a great body of statistics and market-reports.

*The Speaking Telephone and Talking Phonograph, and other Novelties.* By GEORGE B. PRESCOTT. Fully illustrated. New York: D. Appleton and Co. 1878.

MR. PRESCOTT is already favourably known, both in this country and America, as the author of an excellent Manual of Electricity and Telegraphy; but we are sorry to say that the present work, although valuable in its way as a record of facts, is not calculated to add to his reputation as a scientific writer. It consists, for the most part, of verbatim reprints of most of the papers on Telephony and kindred subjects which have been read before the different scientific societies of England and America during the last two or three years, loosely strung together and interspersed with a few remarks from the author. These papers are printed in the same type as the original matter, and, as inverted commas are placed only at the beginning and end of each of them, it is often difficult to know whether it is Mr. Prescott or some one else that is speaking in the first person without referring back several pages. The very introduction itself is confused by the reprint of a speech delivered by one of the counsel at a recent telegraphic trial in New York. It is a very meagre account of the history of electrical discovery, which we cannot agree with Mr. Prescott in thinking either "interesting" or "valuable," seeing that exactly fourteen words are devoted to Faraday's discoveries in magnetic induction.

The first chapter is original, and gives us a clear and succinct account of the principles of sound; Reiss's musical telephone, and Gray's improvements on it; Gray's, Bell's, and Dolbear's articulating telephones, and Phelps's duplex telephone—the latter a very beautiful piece of apparatus, as far beyond Bell's trumpet-shaped instrument as a modern Westley Richards' central fire breech-loader is beyond a Joe Manton. The same remarks apply to Gray's latest form of instrument, in which a horse-shoe magnet is used in conjunction with a double set of vibrating diaphragms, the magnet forming the handle of the apparatus. We regret that we cannot give our readers a description of these very ingenious instruments without a number of diagrams; we can only refer them to Mr. Prescott's book. Edison's carbon disk telephone is also described, but the book appears to have been published too early in the year to have included any account of the

microphone. The chapter concludes with an extract from Baille's "Merveilles de l'Electricité," published in Paris in 1871, in which the realisation of the idea of a speaking telephone is strongly foreshadowed by the author.

Chapter II. consists of the papers read by Prof. Bell, in October last, before the Society of Telegraphic Engineers, with a few notes by Mr. Prescott.

Chapter III. is made up of articles from the *Westminster Review*, *Engineering*, and *Chambers's Journal*.

Chapter IV. is a hotch-potch from various sources, such as *Silliman's Journal*, *Poggendorff's Annalen*, De la Rive's "Electricité," &c., on the production of sounds by electricity.

Chapter V. consists of Mr. Elisha Gray's papers on Telephonic Researches, read before the American Electrical Society, and contributed to their *Transactions*. At the end we find both Mr. Gray's and Prof. Bell's original specifications, as filed by them at the New York Patent Office on the same day, *i.e.*, February 16th, 1876, by which it would appear that, on paper at least, Mr. Gray was the first discoverer of a telephone which would transmit articulate sounds. Mr. Gray, however, states that it is not his intention to raise the question of priority of invention as between himself and other parties. As Mr. Gray does not seem to wish to assert any rights in the matter, the question may very well be allowed to rest where it is, referring those of our readers who are interested in the subject to Mr. Prescott's book.

Chapter VI. contains an account of Mr. T. A. Edison's telephonic researches from his own pen, giving a most interesting account of his various discoveries and inventions, apparently written expressly for Mr. Prescott's work. Chapter VII. is a history of electro-harmonic telegraphy, read by Mr. F. L. Pope before the American Electrical Society in December last. Chapter VIII. consists of an abstract from a paper by Professor Dolbear, entitled "Researches in Telephony," in which he definitely claims to have been the first person to use a permanent magnet for vibrating the disk of a telephone.

In Chapter IX. Mr. Prescott once more resumes his task, and lucidly describes the improvements made in telephonic instruments by Messrs. Blake, Peirce, Channing, and others, in which he claims for the latter physicist the invention of the first portable telephone. Before this interesting chapter is ended, however, Mr. Prescott once more relapses into the "scissors and paste" style of literature, and gives an abstract from a paper of Dr. Channing's and a translation of Count du Moncel's account of the telephone read before the French Academy. Chapter X. is on the Talking Phonograph, and is almost entirely written by Mr. Prescott. The prophecies as to what Mr. Edison's invention will accomplish in the future, and the extract from a particularly popular article in *Scribner's Monthly*, is hardly worthy of a place in a serious scientific book.

As a piece of scientific exposition, Chapter XI., on Quadruplex Telegraphy, is undoubtedly the best in the book, and is a tantalising proof of Mr. Prescott's ability to treat of such subjects. It is certainly the most thorough description of the wonderful improvements which have lately been made in multiplex telegraphy which we have yet met with. It is a branch of telegraphy in which Mr. Prescott seems to be perfectly at home, and he evidently writes *con amore*. Would that he had done so in the other parts of the book. The same praise may be extended in a minor degree to the less important subjects—electric call bells and the electric light—which receive attention in the two last chapters of the book. The last subject might, however, have been treated of at greater length, seeing the attention it is attracting in London and Paris. We should have been glad, for instance, to have heard more of Mr. Farmer's method of obtaining a number of lights from a single source by using thin strips of platinum or iridium, and raising

their temperature to a point slightly below that of melting.

The Index is far too small for a work containing so much matter.

It is with a feeling of disappointment that we rise from the examination of Mr. Prescott's book. In the chapters which are due to his pen alone he proves to us with what lucidity he can treat a scientific subject. Had he only taken the various and unquestionably valuable papers which he reprints, and reproduced them after having mentally assimilated them in his own brain, we should have had a work of high value and surpassing interest, and the student would not have been compelled to waste time or patience in separating the useful metal from the mass of rough ore with which Mr. Prescott presents us. The principles of sound and musical vibrations, for instance, are explained over and over again, and detail after detail is repeated *ad nauseam* in nearly every one of the papers given; we are afraid to say, for instance, how many times Bell's telephone is described in different parts of the book.

We make these somewhat severe remarks in the most friendly spirit, as a proof of which we shall conclude by expressing a fervent wish that Mr. Prescott's book will sell with such excessive rapidity that a new edition will very shortly be a necessity, when we hope to have a specimen of what we already have the fullest proof of what the author can do, and we trust will do, in giving us a history of the telephone and its electrical congeners.

The work contains over two hundred woodcuts, most of them of great beauty, and many of them beyond anything that has been accomplished by our English wood engravers in the way of scientific illustration. Mr. Prescott also adopts the excellent plan of repeating a cut whenever it is necessary instead of worrying the reader by frequent cross references. The general "get up" of the book is fully worthy of the reputation of the firm by which it is issued.

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## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 20, November 11, 1878.

Vision of Colours, and especially on the Influence Exercised on the Vision of Coloured Objects moving circularly when Observed in Comparison with Stationary Objects Identical with the Former.—M. E. Chevreul.—The author treats of the vision of material colours in motion, under which head he refers to the principles of mixture and contrast; of variations of tone according to the brightness of the day, which, as is shown, exercises a decided influence on the result of the experiments; and of the differences of tone and of colour in consequence of difference of speed, from the swiftest to total repose.

The Expansion of Heated Bodies and the Pressure which they Exert.—M. de Sainte-Venant.

Energy of a Body and its Specific Heat.—M. R. Clausius.—Two mathematical papers, not admitting of useful abstraction.

Measure of Magnifying Power in Optical Instruments.—G. Govi.—It is inexact to say that such a lens or such a microscope magnifies the image of objects a certain number of times without adding at what distance must the image be in order to realise such an enlargement.

**Possibility of Obtaining by Means of Nitrous Oxide Insensibility of Long Duration, and on the Harmlessness of this Anæsthetic.**—P. Bert.—The author administers a mixture of equal volumes nitrous oxide and atmospheric air at a pressure of two atmospheres.

**Observations on M. Maurice Levy's Memoir on a Universal Law Relating to the Expansion of Bodies.**—M. Massieu.—M. Levy's proposed law is only applicable to bodies in which the internal work depends merely on the volume, whilst the specific heat for equal volumes depends solely on temperature.

**Anilised Derivatives of Sebasic Acid.**—E. Maillot.—The action of a temperature of 150° upon equal weights of sebasic acid and of aniline produces sebanilide, a neutral compound soluble in absolute alcohol at a boiling temperature, and sebanilic acid, soluble even in the cold in alcohol of 90 per cent, and especially in ether. It is monobasic, and forms salts.

**Artificial Crystallisation of Orthose.**—M. St. Meunier.—The author has arrived with orthose at a similar result to those which MM. F. Fouqué and Michel Lévy have obtained in the devitrification of oligoclase, labrador, and albite, previously converted into glass by fusion.

**Theory of Machines Like that of Gramme.**—Ant. Breguet.—If it is desired to obtain the best possible effect from a system constituted by a movable circuit animated by a rotatory movement in a magnetic field; then, if this movement is caused by the passage of a current from a foreign source, the diameter of the points of contact should be displaced in the inverse direction of the rotation, by an angle so much the greater as the intensity of the current is more considerable, and the intensity of the magnetic field more feeble. If this movement is destined, on the one hand, to produce a continuous current in the apparatus, the same diameter ought to be displaced in the direction of the rotation.

**Chemical Researches on the Tungstates of the Earthy and Metallic Sesquioxides.** Third Memoir.—J. Lefort.—In the tungstates of sesquioxides the proportion of acid to base varies almost in every metal. The author has examined the tungstates of alumina, iron (ferricum), chrome, uranium, antimony, and bismuth, and subjoins their formulæ.

**Analysis of Certain Metallic Fragments from the Peruvian Sepulchres of Ancon, near Lima.**—A. Terreil.—The author has examined five samples of metallic fragments obtained from Peruvian tombs, dating, it is supposed, from the middle of the sixteenth century.

**Synthesis of the Uric Derivatives of the Alloxan Series.**—E. Grimaux.—The author has obtained artificially alloxan, uramile, and murexide, synthetically. He heats to 150° a mixture of malonic acid and urea with excess of phosphorus oxychloride, and obtains a yellow mass consisting of two amorphous bodies, sparingly soluble in water, which appear to be condensation-products of malonyl-urea, and which are easily transformed into alloxantine, alloxan, uramile, &c.

**Some Causes of the Inversion of Cane-Sugar, and on the Consecutive Changes of the Glucoses formed.**—M. Durin.—The inversion of sugar under the combined action of water and heat is a chemical phenomenon which acquires intensity when the solutions are neutral or acid and which is suspended by alkalinity.

**Presence of the Alcoholic Ferment in Air.**—P. Miquel.—If in September and amidst the vineyards of southern France sterilised grape-juice is exposed to the air in vessels freed from all germs, it enters into fermentation in a few days, whilst similar experiments at Paris and in the park of Montsouris have invariably given a negative result.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*  
No. 12, 1878.

**Investigations on Pinakons and Pinakolins.** (Third Memoir).—W. Thörner and T. Zincke.—The authors describe  $\alpha$ -benzpinakolin, a compound formerly obtained by the oxidation of tetra-phenyl-ethylen, and known as tetra-phenyl-ethylen oxide.

**On Styrolen Alcohol or Phenyl-glycol.** (Third Memoir).—A. Breuer and T. Zincke.—The authors have performed a series of experiments in order to ascertain if two isomeric alcohols can be derived from styrol. The experiments yielded only the alcohol already known, except that in one case a small quantity of a body was obtained, which may possibly be the second alcohol.

**A Hydrocarbon from Styrolen Alcohol.**—A. Breuer and T. Zincke.—The hydrocarbon in question crystallises from hot alcohol in fine shining leaflets, fusible at 101° to 101.5°. It is readily soluble in ordinary solvents, distils without undergoing decomposition, boils at 345° to 346°, and if acted upon by chromic acid yields a well-characterised quinon, which is described at length.

**Action of Thionyl-chloride upon Aniline.**—C. Böttinger.—The reaction is violent, sulphurous acid being evolved and aniline hydrochlorate deposited, along with a body not yet examined.

**Action of Thionyl-chloride upon Benzol.**—C. Böttinger.—Hydrochloric and sulphurous acids escape, whilst a dark resinous body remains.

**Electrolytic Determination of Mercury.**—F. W. Clarke.—A solution of mercuric chloride slightly acidulated with sulphuric acid was put in a platinum capsule connected with the zinc pole of a Bunsen bichromate battery of six elements. The wire at the end of the carbon pole terminated in a thin slip of platinum foil, which plunged into the solution. At first mercurous chloride was deposited, which gradually took the metallic state, and after the lapse of an hour there was nothing in the capsule but a pure mass of mercury, covered with a solution in which ammonia occasioned not the slightest turbidity. This liquid was withdrawn with a pipette, and water poured in its place a time or two before separating the connection with the battery. The liquid was then decanted off and the mercury washed first with water, then with alcohol, and lastly with ether, and was then dried under the air-pump.

**Chlorine Compounds of Naphthalin.**—E. Fischer.—A reply to H. A. Atterberg's paper (*Berichte*, xi., Heft 10).

**Undecylenic Acid.**—F. Becker.—An account of experiments made with the newly-discovered member of the oleic series, obtained during the dry distillation of castor oil.

**Undecolic Acid.**—F. Krafft.—This acid,  $C_{11}H_{18}O_2$ , is a product of undecylenic dibromide heated in closed vessels with alcoholic potassa.

**Remarks on the Memoir of H. H. W. Vogel "On the Diversity of the Absorption-Spectra of One and the same Body.**—James Moser.—The author contends that not only every compound but every solution has its own spectrum.

**Azo-benzol-acetic Acid and its Homologues.**—J. Züblin.—A notice of some of the salts and other derivatives of this acid, and of its homologues.

**Oxidation-products of  $\beta$ -Hexyl-iodide, Hexylen-bromide, and Mono-bromo-hexylen from Mannite.**—Otto Hecht.—The author concludes that in the oxidation of the halogen compounds of hydrocarbon radicals the halogen is separated out, and the atoms of carbon formerly combined with it are converted into COOH.

**Appendix on Corallin and its Components.**—K. Zulkowsky.—This paper refers mainly to an essay on formation of crude corallin, by P. Gukassianz (*Berichte*, xi., p. 1179).

**Production of Benzol from the Tar-Oil of Lignites.**—MM. Salzmänn and H. Wichelhaus.—An investigation of the manner in which the benzol in question may originate.

**On Dioxy-benzo-phenon from Rosanilin.**—C. Liebermann.—Remarks on a paper by MM. Caro and Græbe. (*Berichte*, xi., p. 1348).

**Penta-halogen Compounds of Resorcin and Orcin.**—H. Claassen.—The author has succeeded in showing in a great number of reactions that of the five halogen atoms of penta-brom-resorcin, penta-brom-orcin, and penta-chlor-resorcin, three which are substituted behave differently from the other two which are added.

**On Diastase.**—M. Baswitz.—The author concludes that the saccharific action of diastase is accelerated by carbonic acid. In the presence of this acid a larger quantity of sugar is formed than in its absence. In either case the maximum of saccharification sets in after from two and a half hours to four hours even in presence of an excess of starch.

**Nitro-derivatives of Hydroquinon.**—R. Nietzki.—If diethyl-hydroquinon dissolved in acetic acid is added to fuming nitric acid there is formed a mixture of di- and tri-nitro-derivatives. If a more dilute acid is used, on the one hand, or sulpho-nitric acid, on the other, either of these products may be obtained separately.

**On Styrol.**—W. v. Miller.—The author undertook to separate styrol from accompanying substances by converting it into the crystallised bromide.

**Action of Sodium Amalgam upon Nitro-para-toluidines in Alcoholic Solutions.**—E. Buchney.—The author describes azoxytoluydin and its reduction-products, azotoluydin and hydrazotoluydin.

**Coloured Derivatives of Pyrogallic Ether.**—A. W. Hofmann.—The author treated the secondary ethers of pyrogallic acid with crystalline sesquichloride of carbon ( $C_2Cl_6$ ). If the dimethylic ether is mixed with so much alcoholic solution of potassa as is required for the formation of its potassic salt, and sesquichloride of carbon is then added in such quantity that the chlorine exactly suffices to convert the potassa present into potassic chloride, and the mixture is heated for six to eight hours to about  $130^\circ$  preferably in a sealed tube, the liquid takes a deep indigo-blue colour. This liquid is freed from alcohol by evaporation, the residue dissolved in water, any excess of carbon sesquichloride removed by filtration, and the liquid mixed with hydrochloric acid. The blue colour changes to a light rose. The substance when purified forms yellow crystals which form blue salts with bases. It is probably identical with the substance obtained by Grätzel from beech-wood tar, and known as eupitton, and with Reichenbach's pitakall.

**Constitution of Dioxy-benzol.**—H. Fischli.—The nature of this paper will appear from the title. The author examines the mutual behaviour of platinic chloride and guajacol.

*Chemiker Zeitung.*  
No. 44, 1878.

**Discovery of the Manufacture of Artificial Ultramarine.**—Dr. E. Büchner.—The author gives in full a paper by Gmelin, extracted from the *Naturwissenschaftlichen Abhandlungen* for the year 1828. In this document Gmelin states that he had turned his attention to the artificial preparation of ultramarine as early as 1826, and in the spring of 1827, whilst on a visit in Paris, had communicated his ideas to Gay-Lussac and to his friend Robinet, who both recommended him to keep the matter secret. He was, therefore, much surprised on learning that on Feb. 4th, 1828, Gay-Lussac announced to the Academy of Sciences that the synthesis of ultramarine had been effected by Guimet. Dr. Büchner accuses

Guimet of having appropriated the discovery of another, and hints that he may have had accomplices.

**Examination of Dynamite.**—The method proposed is lixiviation with ether, which dissolves the nitro-glycerin, leaving the infusorial earth untouched.

**Terra di Siena.**—Dr. F. Matthey announces the discovery of a deposit of this pigment in the Erzgebirge.

**Inferior Superphosphate.**—The Agricultural Station of Halle announces that a commission house in Germany is selling superphosphate of English origin, prepared from coprolites and phosphorite, which strongly resembles in colour the favourite superphosphate made from Mejilones guano, and which the writer seems to suspect is used for fraudulent purposes.

**Bolivian Nitrate of Soda.**—The monopoly established by the Peruvian Government has given a great stimulus to the nitre trade of Bolivia. From May 15th to June 16th 1,177,600 kilos. have been shipped from Antofagasta alone.

**Pictet's Artificial Ice Company** now sells ice in New York at one dollar per ton.

**Quantitative Determination of Starch in Paper.**—C. Wurster.—The author first determines the moisture, then the resin by boiling with alcohol to which a few drops of hydrochloric acid have been added. He then extracts the starch by prolonged boiling in equal parts of alcohol and water also acidulated with hydrochloric acid, and then weighs the residual paper. The action of the hydrochloric acid occasions a loss of mineral constituents. Hence the ash must be determined both in the original and in the extracted paper, and the difference, which is almost constant, and amounts to 0.8 to 1.1 per cent, is deducted from the starch.—(*Dingler's Polyt. Journal.*)

**Preparation of Hydrogen Gas.**—H. Kollmann.—Hydrogen is easily obtained by treating ferro-manganese with dilute sulphuric acid. The gas thus obtained is not merely adapted for ordinary laboratory purposes, but also for Marsh's arsenic test.

**Detection of Free Tartaric Acid in Wine.**—Professor Claus evaporates to a syrup, and agitates with ether. If free tartaric acid is present the ether leaves on evaporation a crystalline deposit, which, if dissolved in water, gives, on the addition of an alcoholic solution of potassic acetate a precipitate of tartar. The author proves the solubility of tartaric acid in ether, which is denied in most text-books.—(*Polyt. Notizblatt.*)

**Iridescent Glass.**—Glass is rendered iridescent by exposing it when very hot to the fumes of stannic chloride, to which barium- or strontium-nitrate is added if deep colours are required.—*Polyt. Notizblatt.*

**Atropin and Daturin.**—According to Planta these bases, which were formerly supposed to be identical, are chemically distinct. Atropin is optically inactive, whilst daturin turns the plane of polarisation to the left. Platinium chloride precipitates the salts of atropin, but not those of daturin. On the other hand, picric acid precipitates daturin only.—*Pharm. Central Halle.*

**New Volumetric Method for the Determination of Zinc.**—C. Mann converts the zinc into chloride and mixes with a few drops of a concentrated solution of iron-ammonia alum, and with an excess of standard silver-nitrate. By titrating back with ammonium sulpho-cyanide till a faint redness is remarked, the excess of silver is ascertained, and consequently the quantity of silver used to precipitate the chlorine, and by reducing the latter to zinc the amount of this metal is known. The zinc is converted into chloride as follows:—It is dissolved in nitric acid mixed with ammoniac acetate, sulphuretted hydrogen gas is passed through the solution, and the precipitate, after boiling and twice decanting, is filtered. The precipitate, along with the filter, is placed in a beaker mixed with about 50 c.c. of water and an excess of well-washed silver chloride, and boiled till the liquid become

perfectly clear. The precipitate, a mixture of silver sulphide and excess of silver chloride, is easily washed. When this is complete the filtrate is acidulated with nitric acid, and treated as above.

**Impurities of Commercial Nickel.**—The nickel met with in commerce contains up to 8 per cent cobalt and 12 per cent copper, besides small quantities of iron, arsenic, zinc, manganese, sulphur, carbon, silica, and alumina. —*Metall-Arbeiter.*

**New Reagent for Carbolic Acid.**—Four or five drops of a solution of 1 part of molybdic acid in 10 to 100 parts of concentrated sulphuric acid are added to one or two drops of the liquid under examination, in a porcelain capsule. If carbolic acid is present a light yellow or yellowish brown colour appears, which changes to a chestnut-brown, and finally to a fine purple. The liquid to be tested must be dilute.

**Detection of Indican in Urine.**—Thirty c.c. urine are mixed with an equal volume of fuming hydrochloric acid in a test-tube holding 80 c.c., and warmed gently over the lamp. The addition of one or two drops of nitric acid makes the test more sensitive. The mixture, which has a brown colour, is cooled by dipping the glass in cold water, covered with 2 or 3 centimetres of ether, and well shaken. If indican is present, the ether, when the liquid has become clear, will be found covered with a blue scum of indigotin. The subsequent addition of a few drops of alcohol renders the reaction more sensitive. —*Arch. Pharm.*

No. 45, November 7, 1878.

In an article on sulphur and its products by Dr. Deite, it is stated that in 1875 the total yield of sulphuric acid in Europe amounted to 841.25 million kilos., of which 500 millions fall to the share of England, 150 millions to France, 106.25 millions to Germany, 40 millions to Austro-Hungary, and 30 millions to Belgium.

A college has been opened at Litten for the study of the theoretical principles of the art of distilling.

The yield of mercury in California for the present year is estimated at 8000 bottles of the value of 2½ million dollars.

A sarcastic account is given of the recent exhibition of gas-fittings, &c., at Wolverhampton. It is said that some of the exhibitors refused the medals offered them on account of the incompetence of the judges, one of whom did not even know what a Bunsen burner was.

The mercury mines of Almaden in the Sierra Morena have produced in the last three centuries 120,179 tons of mercury, of the value of 1,440,005,000 francs.

Dr. J. S. Meyer has, it is rumoured, re-discovered the lost Egyptian art of hardening copper so as to bear a cutting edge.

The cultivation of the castor oil plant in the state of Illinois is very important, the county of St. Clair alone producing yearly 300,000 gallons.

According to the *Photograph. Zeitung* chloride of silver is decidedly soluble in concentrated hydrochloric acid.

**Determination of Nitric Acid in Spring Water.**—Eder recommends for this purpose Tiemann's method as the best. This consists in evaporating down 1 litre at 150°, extracting with water, decomposing the filtrate with hydrochloric acid and ferrous chloride, boiling and receiving the escaping nitric oxide over soda-lye for measurement. Wagner's method is also applicable. It consists in destroying the organic matter with permanganate in a boiling alkaline solution, evaporation to dryness of the liquid previously freed from alkaline earths and from any oxalic acid which may have been formed, heating the residue mixed with soda and chromic oxide in a current of carbonic acid. The quantity of nitric acid is inferred from the quantity of chromic acid formed. This process

cannot be recommended where nitrates are mixed with a large excess of organic matter.—*Zeitschrift Anal. Chemie*

**Incineration of Flour.**—The sample is mixed with pure crystallised ammoniac nitrate, heated to ignition, withdrawn from the lamp, and allowed to deflagrate. The process is repeated till all carbonaceous matter is destroyed. —*Zeitschrift Anal. Chemie.*

**Sensitiveness of Reactions for Hydrocyanic Acid.**—Sulphocyanide test, 1 : 4,000,000 ; guaiacum copper, 1 : 3,000,000 ; silver test, 1 : 250,000 ; iodide of starch, 1 : 250,000 ; prussian blue, 1 : 50,000.—*Zeitschrift Anal. Chemie.*

**New Acidimetric and Alkalimetric Indicator.**—Fresh cut orange-peel is digested for twenty-four hours in a little alcohol ; the volatile oil is removed from the yellow solution by treatment with ether and separated off. The tincture on dilution with water yields a colourless liquid, which is coloured yellow by alkalies and is not affected by acids. It gives accurate results in presence of ammoniacal salts.—*Zeitschrift Anal. Chemie.*

**Valuation of Zinc-Powder.**—To determine the metallic zinc present—the only valuable constituent—Fresenius mixes about 3 grms. of the powder in a flask with sulphuric acid, and passes the hydrogen gas evolved through refrigerating and desiccating tubes into a combustion tube filled with cupric oxide. The water formed is absorbed in a U-tube two-thirds full of broken glass and containing 12 c.c. pure concentrated sulphuric acid. Nine parts of water correspond to 32.53 parts of metallic zinc.—*Zeitschrift Anal. Chemie.*

**New Method of Determining Melting-Points.**—Carnelly places the substance (especially metallic salts) in a weighed platinum crucible, heats it over a Bunsen burner or blast, and as soon as the salt melts places the crucible in water, the weight and temperature of which are known. The increase of temperature in the water is observed, and by the aid of the equation for the specific heats the temperature of the crucible is found as the salt began to melt.—*Zeitschrift Anal. Chem.*

**Supersaturated Sulphuretted Hydrogen Water.**—Cooke recommends the use of an apparatus like those employed in the manufacture of soda water.—*Zeitschrift Anal. Chemie.*

No. 46, 1878.

A commission has been appointed for the revision of the *Pharmacopœia Germanica*.

Dr. Werner Siemens criticises recent popular newspaper essays on the conversion of mechanical power into electricity, and the re-conversion of the latter into mechanical power. He shows that, in common with others, he had pointed out the future importance of this principle for the production of light, the conveyance of motive power, and other technical purposes. But all this passed unnoticed until it was re-discovered by an American.

The electric light is finding extended applications. At Bremen a ship, bearing this light at its prow, has been able to sail down the river at full speed in the night. The Imperial dockyards at Kiel are now illuminated on Jablochkoff's principle.

At Dresden chocolate-powder has been found coloured with aniline-red, to conceal the inferior quality of the materials.

The dye manufacturers J. R. Geigy, of Basel, and P. Monnet and Co., of Geneva, have received gold medal at the late Paris Exhibition.

Poehl has detected coniin in a sample of aniseed, though microscopic examination had proved the absence of hemlock seeds. Considering that both plants belong to the same family of the Umbelliferae, and bloom about the same time, he conjectures that the seed in question was derived from hybrids, and contained simultaneously the chemical principles of both the original plants.

**Séparation of Iron and Uranium.**—E. Burker shows that the separation of these metals by means of ammoniac carbonate gives inaccurate results, as a double carbonate of uranium and ammonia is liable to be formed. He selects as accurate the method described by Rose, who precipitates the mixed solution with ammonia, weighs the ignited precipitate, and then heats it in a current of hydrogen till no further loss of weight takes place, metallic iron and uranic oxide being formed. This residue is then treated with dilute hydrochloric acid, which dissolves the iron, leaving the uranic oxide untouched.—*Chem. Centralblatt*, 1878, p. 453.

S. Marcus, of Vienna, is said to have succeeded in dividing the electric light, and to have applied for patents in all states before Mr. Edison announced his discovery.

*Reimann's Färber Zeitung*,  
No. 43, 1878.

The Färber-Academie (School of Dyeing), founded at Berlin by Dr. Reimann, does not seem to flourish as we might naturally expect, the balance this year being more unfavourable than the foregoing. The author considers that in England and in Austria more energetic steps are taken than in Germany for the scientific training of persons engaged in the tinctorial arts.

Dr. Reimann quotes from the *Deutsche Wollengewerbe* a protectionist ditty, levelled of course against the English trade, which he says "strikingly characterises our industrial misery."

*Les Mondes, Revue Hebdomadaire des Sciences*.  
No. 10, November 7, 1878.

The editor apologises for a mistake in his notice of M. Latour's work on gluttony, conveying "a grave accusation against the prelates and the curés." He intimates that an enemy has intentionally suppressed his correction of the obnoxious passage.

The "captive balloon," without its accessories, has been sold to "M. Gooch," manager of the Princess's Theatre, London.

No. 11, November 14, 1878.

**Ignition of Hydrogen by Powdered Zinc.**—In works where zinc chloride is obtained on a large scale by dissolving metallic zinc in dilute hydrochloric acid, violent explosions occur which have not been explained. M. P. W. Hoffmann thinks that these explosions are due to finely divided zinc carried along to parts where the proportions of hydrogen and of atmospheric air form an explosive mixture. The brisk effervescence which ensues when a large quantity of zinc is thrown into dilute acid renders it possible for particles of zinc to be carried to a considerable distance.—(Explosions are also said to occur occasionally when large quantities of finely divided tin are treated with hydrochloric acid.—ED. C. N.)

**Use of Brine for the Preservation of Animal and Vegetable Matter.**—M. Mercier, in the *Archives de Genève*, recommends a solution of common salt for the preservation of zoological and botanical specimens. It is cheaper than alcohol, does not evaporate, does not extract or alter the colours, and is not likely to be surreptitiously drunk. The brine is boiled to expel gas, and the specimens are immersed at about 80°, and closed up.

**Microphone Constructed by M. Trouvé.**

**Apparatus for Demonstrating the Declination and Inclination of the Magnetic Needle.**—These two papers require the accompanying illustrations.

*Revue Universelle des Mines, de la Metallurgie, &c.*,  
Tome 4, No. 1, July and August, 1878.

**On the Production of Cyanides and Chlorides in Blast Furnaces.**—A. von Kerpely.—A saline mass was repeatedly formed at the Etelka iron-works (Hungary), which consisted principally of the cyanide and chloride of potassium.

*Bulletin de la Societe Chimique de Paris*,  
Tome 30, Nos. 8 and 9, Nov. 5, 1878.

This issue contains no original matter, being made up of extracts from the *Berichte der Deutsch. Chem. Gesell.*, from *Liebig's Annalen*, the *Comptes Rendus*, and the CHEMICAL NEWS.

## COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

NOVEMBER, 1878.

THE following are the returns of the Society of Medical Officers of Health:—

Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Ni- trates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia	Chlorine	An- Sulphuric hydride.	Hardness on Clark's Scale.		
	Saline. Grs.	Organic. Grs.								Before Boiling. Degs.	After Boiling. Degs.	
<i>Thames Water Companies.</i>												
Grand Junction .. ..	Slightly turbid	0'000	0'011	0'195	0'061	21'90	7'280	0'586	0'72	1'260	14'3	3'30
West Middlesex .. ..	Slightly turbid	0'000	0'010	0'150	0'057	21'00	7'840	0'684	0'72	1'430	13'2	4'60
Southwark and Vauxhall	Clear	0'000	0'007	0'135	0'073	19'90	7'530	0'540	0'79	1'000	14'8	4'20
Chelsea .. ..	Clear	0'000	0'009	0'165	0'007	19'00	7'750	0'612	0'72	0'840	14'3	2'80
Lambeth .. ..	Clear	0'000	0'010	0'150	0'069	22'00	7'560	0'468	0'72	1'600	14'3	3'70
<i>Other Companies.</i>												
Kent .. ..	Clear	0'000	0'001	0'450	0'003	29'40	11'230	0'936	1'29	2'800	18'2	5'10
New River .. ..	Clear	0'000	0'005	0'180	0'017	20'40	6'880	0'540	0'79	1'030	13'7	2'80
East London .. ..	Clear	0'000	0'007	0'105	0'034	21'50	7'280	0'684	1'00	0'840	13'7	4'20

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours.

C. MEYMOTT TIDY, M.B.

MISCELLANEOUS.

The Royal Society.—On St. Andrew's Day the Anniversary Meeting of the Royal Society was held. The following Officers were elected for the ensuing year:—

President—William Spottiswoode, M.A., LL.D.

Treasurer—John Evans, F.G.S., V.P.S.A.

Secretaries—Prof. George Gabriel Stokes, M.A., D.C.L., LL.D.; Prof. Thomas Henry Huxley, LL.D.

Foreign Secretary—Prof. Alexander William Williamson, Ph.D.

Other Members of the Council—Frederick A. Abel, C.B., V.P.C.S.; William Bowman, F.R.C.S.; William Caruthers, F.L.S.; Major-General Henry Clerk, R.A.; William Crookes, V.P.C.S.; Sir William Robert Grove, M.A.; Augustus G. Vernon Harcourt, F.C.S.; Sir Joseph Dalton Hooker, C.B., K.C.S.I., D.C.L.; Vice-Admiral Sir Astley Cooper Key, K.C.B.; Lieut.-General Sir Henry Lefroy, C.B.; Lord Lindsay, P.R.A.S.; Sir John Lubbock, Bart., V.P.L.S.; Lord Rayleigh, M.A.; Charles William Siemens, D.C.L.; John Simon, C.B., D.C.L.; Prof. Allen Thomson, M.D., F.R.S.E.

In presenting the Medals, the President gave a brief *résumé* of the work in recognition of which the Medals were awarded. The Copley Medal was awarded to M. Boussingault, the Royal Medals to Mr. J. A. Broun and Dr. Günther, the Rumford Medal to M. Cornu, and the Davy Medal to MM. Louis Cailletet and Raoul Pictet.

The Royal Institution.—The following are the arrangements for the Lectures before Easter;—

Prof. Dewar, M.A., F.R.S.—Six Lectures adapted to a Juvenile Auditory, on a Soap Bubble; on Dec. 28 (Saturday), 31, 1878; Jan. 2, 4, 7, 9, 1879.

Prof. Edward A. Schäfer, F.R.S.—Twelve Lectures on Animal Development; on Tuesdays, Jan. 14 to April 1.

J. H. Gordon.—Four Lectures on Electric Induction; on Thursdays, Jan. 16 to Feb. 6.

Prof. Tyndall, D.C.L., F.R.S., &c.—Eight Lectures on Sound, including its Recent Applications and Methods of Reproduction; on Thursdays, Feb. 13 to April 3.

Prof. H. G. Seeley, F.L.S., F.G.S.—Three Lectures on Reptilian Life; on Saturdays, Jan. 18, 25, Feb. 1.

Reginald W. Macan (Ch. Ch. Oxford).—Four Lectures on Lessing; on Saturdays, Feb. 8 to March 1.

Walter H. Pollock, M.A.—Two Lectures on Colbert and Richelieu; on Saturdays, March 8, 15.

F. Seymour Haden.—Three Lectures on Etching; on Saturdays, March 22 to April 5.

The probable arrangements for the Friday Evening Meetings before Easter, 1879, to which Members and their Friends only are admitted, are as follows:—

Friday, Jan. 17.—Prof. Tyndall, LL.D., F.R.S., M.R.I., The Electric Light.

Friday, Jan. 24.—Prof. W. E. Ayrton, The Mirror of Japan and its Magic Quality.

Friday, Jan. 31.—H. Heathcote Statham, The Logic of Architectural Design.

Friday, Feb. 7.—Rev. H. R. Haweis, M.A., Bells.

Friday, Feb. 14.—Prof. G. Johnstone Stoney, F.R.S., The Story of the November Meteors.

Friday, Feb. 21.—Prof. Roscoe, F.R.S., A New Chemical Industry.

Friday, Feb. 28.—Sir William Thomson, LL.D., F.R.S., The Sorting Demon of Maxwell.

Friday, March 7.—Prof. Huxley, LL.D., F.R.S.

Friday, March 14.—E. B. Tylor, F.R.S., The History of Games.

Friday, March 21.—Prof. Abel, C.B., F.R.S., Recent Contributions to the History of Detonating Agents.

Friday, March 28.—Sir Henry C. Rawlinson, K.C.B., D.C.L., F.R.S., The Geography of the Oxus, and the Changes of its Course at Different Periods of History.

Friday, April 4.—Warren de la Rue, D.C.L., F.R.S., M.R.I.

NOTES AND QUERIES.

Grease, Varnish, &c.—Will any of your numerous readers kindly give me any information as to the best method of manufacturing locomotive, train, and water-wheel grease? Also black, red, and bright varnish. Could you give me any information as to the making of resin pitch. Any information will be gladly received.—R. J.

Examination of Fats, &c.—Can any reader kindly refer me to any work or papers on the qualitative and, so far as possible, the quantitative examination of mixtures of fats, oils, and resins? I am of course aware that complete separation is in many cases impossible.—F.C.S.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 9th.—Medical, 8.30.  
— Royal Geographical, 8.30.  
— London Institution, 5.

TUESDAY, 10th.—Civil Engineers, 8.  
— Photographic, 8.  
— Anthropological, 8.

WEDNESDAY, 11th.—Society of Arts, 8.  
— Microscopical, 8.

THURSDAY, 12th.—Royal, 8.30.  
— Royal Society Club, 6.30.

FRIDAY, 13th.—Astronomical 8.  
— Quekett, 8.

SATURDAY, 14th.—Physical, 3. "On a Condenser of Variable Capacity," by C. Boys. On a Differential Air Thermometer," by Dr. O. J. Lodge.

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An Examination in Practical Chemistry in connection with the Institute of Chemistry will be held during the last week of January next. Examiner, Dr. W. J. Russell, F.R.S. Candidates can obtain further information on application to the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London, W.C.

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 994.

ON THE ILLUMINATION OF LINES OF  
MOLECULAR PRESSURE,  
AND THE TRAJECTORY OF MOLECULES.\*

By WILLIAM CROOKES, F.R.S., V.P.C.S.

*Induction Spark through Rarefied Gases. Dark Space  
round the Negative Pole.*

THE author has examined the dark space which appears round the negative pole of an ordinary vacuum tube when the spark from an induction coil is passed through it. He describes many experiments with different kinds of poles, a varying intensity of spark, and different gases, and arrives at the following propositions.

*Illumination of Lines of Molecular Pressure.*

a. Setting up an intense molecular vibration in a disk of metal by electrical means excites a molecular disturbance which affects the surface of the disk and the surrounding gas. With a dense gas, the disturbance extends a short distance only from the metal; but, as rarefaction continues, the layer of molecular disturbance increases in thickness. In air at a pressure of 0.078 millim. this molecular disturbance extends for at least 8 millims. from the surface of the disk, forming an oblate spheroid around it.

b. The diameter of this dark space varies with the exhaustion; with the kind of gas in which it is produced; with the temperature of the negative pole; and, in a slight degree, with the intensity of the spark. For equal degrees of exhaustion it is greatest in hydrogen and least in carbonic acid, as compared with air.

c. The shape and size of this dark space do not vary with the distance separating the poles; nor, only very slightly, with alteration of battery power; nor with intensity of spark. When the power is great the brilliancy of the unoccupied parts of the tube overpowers the dark space, rendering it difficult of observation; but, on careful scrutiny, it may still be seen unchanged in size; nor does it alter even when, with a very faint spark, it is scarcely visible. On still further reduction of the power it fades entirely away, but without change of form.

The author describes numerous experiments, devised to ascertain if this visible layer of molecular disturbance is identical with the invisible layer of molecular pressure or stress, the investigation of which has occupied him for some years.

*The Electrical Radiometer.*

One of these experiments is as follows:—An ordinary radiometer is made, with aluminium disks for vanes, each disk coated with a film of mica. The fly is supported by a hard steel cup instead of a glass cup, and the needle point on which it works is connected by means of a wire with a platinum terminal sealed into the glass. At the top of the radiometer bulb a second terminal is sealed in. The radiometer can therefore be connected with an induction coil, the movable fly being made the negative pole.

Passing over the phenomena observed at low exhaustions, the author finds that, when connected with the coil, a halo of a velvety violet light forms on the metallic side of the vanes, the mica side remaining dark throughout these experiments. As the pressure diminishes, a dark space is seen to separate the violet halo from the metal. At a pressure of half a millim. this dark space extends to the glass, and positive rotation commences.

On continuing the exhaustion, the dark space further widens out and appears to flatten itself against the glass, and the rotation becomes very rapid.

When aluminium cups are used for the vanes instead of disks backed with mica, similar appearances are seen. The velvety violet halo forms over each side of the cup. On increasing the exhaustion the dark space widens out, retaining almost exactly the shape of the cup. The bright margin of the dark space becomes concentrated at the concave side of the cup to a luminous focus, and widens out at the convex side. On further exhaustion, the dark space on the convex side touches the glass, when positive rotation commences, becoming very rapid as the dark space further increases in size, and ultimately flattening against the glass.

*Convergence of Molecular Rays to a Focus.*

The subject next investigated is the convergence of the lines of force to a focus, as observed with the aluminium cup. As this could not be accomplished during rapid rotation, an instrument was made, having the cup-shaped negative pole fixed, instead of movable. On exhaustion, the convergence of the lines of force to a focus at the concave side was well observed. When the dark space is very much larger than the cup, it forms an irregular ellipsoid drawn in towards the focal point. Inside the luminous boundary a focus of dark violet light can be seen converging, and, as the rays diverge on the other side of the focus, spreading beyond the margin of the dark space; the whole appearance being strikingly similar to the rays of the sun reflected from a concave mirror through a foggy atmosphere.

*Green Phosphorescent Light of Molecular Impact.*

At very high exhaustions the dark space becomes so large that it fills the tube. Careful scrutiny still shows the presence of the dark violet focus, and the part of the glass on which fall the rays diverging from this focus shows a sharply defined spot of greenish yellow light. On still further exhaustion, and especially if the cup is made positive, the whole bulb becomes beautifully illuminated with greenish yellow phosphorescent light.

This greenish yellow phosphorescence, characteristic of high exhaustions, is frequently spoken of in the paper. It must be remembered, however, that the particular colour is due to the special kind of soft German glass used. Other kinds of glass phosphoresce in a different colour. The phosphorescence takes place only under the influence of the negative pole. At an exhaustion of 4 M,\* no light other than this is seen in the apparatus. At 0.9 M the phosphorescence is about at its maximum. When the exhaustion reaches 0.15 M the spark has a difficulty in passing, and the green light appears occasionally in flashes only. At 0.06 M the vacuum is almost non-conductive, and a spark can be forced through only by increasing the intensity of the coil, and well insulating the tube and wires leading to it. Beyond that exhaustion nothing has been observed.

*Focus of Molecular Force.*

In an apparatus specially constructed for observing the position of the focus, the author found that the focal point of the green phosphorescent light was at the centre of curvature, showing that the molecules by which it is produced are projected in a direction normal to the surface of the pole. Before reaching the best exhaustion for the green light, another focus of blue-violet light is observed; this varies in position, getting further from the pole as the exhaustion increases. In the apparatus described, at an exhaustion of 19.3 M, these two foci are seen simultaneously, the green being at the centre of curvature, while the blue focus is at nearly twice the distance.

*Nature of the Green Phosphorescent Light.*

The author adduces the following characteristics of the green phosphorescent light, as distinguishing it from the

\* Abstract of a paper read before the Royal Society, Dec. 5, 1878.

\* M signifies the millionths of an atmosphere.

ordinary light observed in vacuum-tubes at lower exhaustions:—

a. The green focus cannot be seen in the space of the tube, but where the projected beam strikes the glass only.

b. The position of the positive pole in the tube makes scarcely any difference to the direction and intensity of the lines of force which produce the green light. The positive pole may be placed in the tube either at the extremity opposite the negative pole, or below it, or by its side.

c. The spectrum of the green light is a continuous one, most of the red and the higher blue rays being absent; while the spectrum of the light observed in the tube at lower exhaustions is characteristic of the residual gas. No difference can be detected by spectrum examination in the green light, whether the residual gas be nitrogen, hydrogen, or carbonic acid.

d. The green phosphorescence commences at a different exhaustion in different gases.

e. The viscosity of a gas is almost as persistent a characteristic of its individuality as its spectrum. The author refers to a preliminary note and a diagram\* of the variation of viscosity of air, hydrogen, and other gases at exhaustions between 240 M and 0.1 M. From these and other unpublished results, the author finds that the viscosity of a gas undergoes very little diminution between atmospheric pressure and an exhaustion at which the green phosphorescence can be detected. When, however, the spectral and other characteristics of the gas begin to disappear, the viscosity also commences to decline, and at an exhaustion at which the green phosphorescence is most brilliant, the viscosity has rapidly sunk to an insignificant amount.

f. The rays exciting green phosphorescence will not turn a corner in the slightest degree, but radiate from the negative pole in straight lines, casting strong and sharply defined shadows from objects which happen to be in their path. On the other hand, the ordinary luminescence of vacuum tubes will travel hither and thither along any number of curves and angles.

#### *Projection of Molecular Shadows.*

The author next examines the phenomena of shadows cast by the green light. The best and sharpest shadows are cast by flat disks and not by narrow-pointed poles; no green light whatever is seen in the shadow itself, no matter how thin, or whatever may be the substance from which it is thrown.

From these and other experiments, fully described in the paper, he ventures to advance the theory that the induction spark actually illuminates the lines of molecular pressure caused by the electrical excitement of the negative pole. The thickness of the dark space is the measure of the mean length of the path between successive collisions of the molecules. The extra velocity with which the molecules rebound from the excited negative pole keep back the more slowly moving molecules which are advancing towards that pole. The conflict occurs at the boundary of the dark space, where the luminous margin bears witness to the energy of the collisions.

When the exhaustion is sufficiently high for the mean length of path between successive collisions to be greater than the distance between the fly and the glass, the swiftly moving rebounding molecules spend their force, in part or in whole, on the sides of the vessel, and the production of light is the consequence of this sudden arrest of velocity. The light actually proceeds from the glass, and is caused by fluorescence or phosphorescence on its surface. No light is produced by a mica or quartz screen, and the more fluorescent the material the better the luminosity. Here the consideration arises that the greenish yellow light is an effect of the direct impact of the molecules in the same electrical state on the surface of the glass. The shadows are not optical, but are molecular

shadows, revealed only by an ordinary illuminating effect; this is proved by the sharpness of the shadow when projected from a wide pole.

#### *Phosphorescence of Thin Films.*

An experiment is next described in which a film of uranium glass, sufficiently thin to show colours of thin plates, is placed in front of a thick plate of the same glass; the whole being enclosed in a tube with terminals, and exhausted to a few millionths of an atmosphere. Of this the following observations are recorded:—

a. The uranium film, being next to the negative pole, casts a strong shadow on the plate.

b. On making contact with the coil, the thin film flashes out suddenly all over its surface with a yellowish phosphorescence, which, however, instantly disappears. The uncovered part of the plate does not become phosphorescent quite suddenly, but the phosphorescence is permanent as long as the coil is kept at work.

c. With an exceedingly faint spark the film remains more luminous than the plate, but on intensifying the spark the luminosity of the film sinks, and that of the uncovered part of the plate increases.

d. If a single intense spark be suddenly sent through the tube, the film becomes very luminous, while the plate remains dark.

These experiments are conclusive against the phosphorescence being an effect of the radiation of phosphogenic ultra-violet light from a thin layer of arrested molecules at the surface of the glass, for were this the case the film could under no circumstances be superior to the plate.

The momentary phosphorescence and rapid fading of the film prove more than this. The molecular bombardment is too much for the thin film. It responds thereto at first, but immediately gets heated by the impacts, and then ceases to be luminous. The plate, however, being thick, bears the hammering without growing hot enough to lose its power of phosphorescing.

#### *Mechanical Action of Projected Molecules.*

When the coil was first turned on, the thin film was driven back at the moment of becoming phosphorescent, showing that an actual material blow had been given by the molecules. Experiments are next described in which this mechanical action is rendered more evident. A small rotating fly, capable of being moved about in any part of an exhausted bulb, is used as an indicator, and by appropriate means the molecular shadow of an aluminium plate is projected along the bulb. Whether entirely in or entirely out of the shadow the indicator scarcely moves, but when immersed so that one-half is exposed to molecular impact the fly rotates with extreme velocity.

#### *Magnetic Deflection of Lines of Molecular Force.*

With this apparatus another phenomenon was investigated. It is found that the stream of molecules, whose impact on the glass occasions evolution of light, is very sensitive to magnetic influence, and by bringing one pole of an electro-magnet—or even of a small permanent magnet—near, the shadow can be twisted to the right or to the left.

When the little indicator was placed entirely within the molecular shadow no movement was produced. As soon, however, as an adjacent electro-magnet was excited, the shadow was twisted half off the indicator, which immediately rotated with great speed.

#### *The Trajectory of Molecules.*

The amount of deflection of the stream of molecules forming a shadow is in proportion to the magnetic power employed.

The trajectory of the molecules forming the shadow is curved when under magnetic influence; the action of the magnet is to twist the trajectory of the molecules round in a direction at an angle to their free path, and to a

\* *Proc. Royal Society*, Nov. 16, 1876, vol. xxv., p. 305.

greater extent as they are nearer the magnet: the direction of twist being that of the electric current passing round the electro-magnet.

#### *Laws of Magnetic Deflection.*

An apparatus was constructed so that the deflection of a spot of light was used instead of that of a shadow; a horseshoe magnet being placed underneath the negative pole to deflect the trajectory. The action of the north pole being to give the line of molecules a spiral twist one way, and that of the south pole being to twist it the other way, the two poles side by side compel the line to move in a straight line up or down, along a plane at right angles to the plane of the magnet and a line joining its poles.

The ray of molecules does not appear to obey Ampère's law, as it would were it a perfectly flexible conductor, joining the negative and the positive pole. The molecules are projected from the negative, but the position of the positive pole—whether in front, at the side, or even behind the negative pole—has no influence on their subsequent behaviour, either in producing phosphorescence, or mechanical effects, or in their magnetic deflection. The magnet gives their line of path a spiral twist, greater or less according to its power, but diminishing as the molecules get further off.

Numerous experiments were tried in this apparatus with different gases, and with the magnet in and out of position.

Working with exhausted air it was found that the spot of green phosphorescence on the screen is visible at an exhaustion of 102.6 M, when the mean free path of the molecules, measured by the thickness of the dark space round the negative pole, is only 12 millims. Hence it follows that a number of molecules sufficient to excite green phosphorescence on the screen are projected the whole distance from the pole to the screen, or 102 millims., without being stopped by collisions.

#### *Alteration of Molecular Velocity.*

If we suppose the magnet to be permanently in position, and thus to exert a uniform downward pull on the molecules, we perceive that their trajectory is much curved at low exhaustions, and gets flatter as the exhaustion increases. A latter trajectory corresponds to a higher velocity. This may arise from one of two conditions; either the initial impulse given by the negative pole is stronger or the resisting medium is rarer. The latter is probably the true one. The molecules which produce the green phosphorescence must be looked upon as in a state differing from those arrested by frequent collisions. The latter impede the velocity of the free molecules and allow longer time for magnetism to act on them; for, although the deflecting force of magnetism might be expected to increase with the velocity of the molecules, Prof. Stokes has pointed out that it would have to increase as the square of the velocity, in order that the deflection should be as great at high as at low velocities.

Comparing the free molecules to cannon-balls, the magnetic pull to the earth's gravitation, and the electrical excitation of the negative pole to the explosion of the powder in the gun, the trajectory will be flat when no gravitation acts, and curved when under the influence of gravitation. It is also much curved when the ball passes through a dense resisting medium; it is less curved when the resisting medium gets rarer; and, as already shown, intensifying the induction spark, equivalent to increasing the charge of powder, gives greater initial velocity, and therefore flattens the trajectory. The parallelism is still closer if we compare the evolution of light seen when the shot strikes the target, with the phosphorescence on the glass screen from molecular impacts.

#### *Focus of Heat of Molecular Impact.*

The author finally describes an apparatus in which he shows that great heat is evolved when the concentrated

focus of rays from a nearly hemispherical aluminium cup is deflected sideways, to the walls of the glass tube, by a magnet. By using a somewhat larger hemisphere, and allowing the negative focus to fall on a strip of platinum-foil, the heat rises to the melting-point of platinum.

#### *An Ultra-gaseous State of Matter.*

The paper concludes with some theoretical speculations on the state in which the matter exists in these highly-exhausted vessels. The modern idea of the gaseous state is based upon the supposition that a given space contains millions of millions of molecules in rapid movement in all directions, each having millions of encounters in a second. In such a case, the length of the mean free path of the molecules is exceedingly small as compared with the dimensions of the vessel, and the properties which constitute the ordinary gaseous state of matter, which depend upon constant collisions, are observed. But by great rarefaction the free path is made so long that the hits in a given time may be disregarded in comparison to the misses, in which case the average molecule is allowed to obey its own motions or laws without interference; and if the mean free path is comparable to the dimensions of the vessel, the properties which constitute gaseity are reduced to a minimum, and the matter becomes exalted to an ultra-gaseous state, in which the very decided but hitherto masked properties now under investigation come into play.

#### *Rays of Molecular Light.*

In speaking of a ray of molecular light the author has been guided more by a desire for conciseness of expression than by a wish to advance a novel theory. But he believes that the comparison, under these special circumstances, is strictly correct, and that he is as well entitled to speak of a ray of molecular or emissive light when its presence is detected only by the light evolved when it falls on a suitable screen, as he is to speak of a sunbeam in a darkened room as a ray of vibratory or ordinary light when its presence is to be seen only by interposing an opaque body in its path. In each case the invisible line of force is spoken of as a ray of light, and if custom has sanctioned this as applied to the undulatory theory, it cannot be wrong to apply the expression to emissive light. The term emissive light must, however, be restricted to the rays between the negative pole and the luminous screen: the light by which the eye then sees the screen is, of course, undulatory.

The phenomena in these exhausted tubes reveal to physical science a new world—a world where matter exists in a fourth state, where the corpuscular theory of light holds good, and where light does not always move in a straight line; but where we can never enter, and in which we must be content to observe and experiment from the outside.

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### ON THE METHOD OF EXTRACTING GOLD, SILVER, AND OTHER METALS FROM PYRITES.\*

By W. A. DIXON, F.C.S., Cor. Mem. Nat. Hist. Soc. Glasgow.

SOME three years since, Mr. Wood, Under Secretary for Mines, suggested to me that the extraction of gold from complex minerals was a subject well worthy of investigation, and one which if brought to a successful issue would be of great value to New South Wales and Queensland. Both these Colonies yield minerals containing gold, and that often in considerable quantity, but so mixed up with sulphides of copper, lead, iron, and other metals, that none of the ordinary methods of treatment extract more than a very small proportion of it.

\* Read before the Royal Society of N.S.W., August 1, 1877.

Acting on this suggestion, I obtained some pyrites from Mariner's Reef, Gympie, which in the rough yielded on analysis:—

Copper .. ..	6.2 per cent.
Lead .. ..	0.19 per cent.
Gold .. ..	3 ozs. 3 dwts. 2 grs. per ton.
Silver .. ..	32 ozs. 9 dwts. 3 grs. per ton.

Another larger portion from the same reef, after being ground and washed so as to remove as much as possible of the quartz, which was found to amount to about 60 per cent of the rough mineral, gave—

Copper .. ..	17.02	or Copper pyrites .. ..	48.45
Lead .. ..	2.01	Iron .. ..	35.95
Antimony .. ..	3.90	Galena .. ..	2.31
Gold and silver .. ..	0.22	Sulphide of antimony .. ..	5.44
Iron .. ..	31.41	Sulphide of arsenic .. ..	0.68
Sulphur .. ..	37.86	Gold and silver .. ..	0.22
Silica .. ..	7.16	Silica .. ..	7.16
Arsenic and loss .. ..	0.42		

100.00

100.21

Gold .. ..	12 ozs. 10 dwts. 0 grs. }	} per ton.
Silver .. ..	62 ozs. 9 dwts. 16 grs. }	

I had also a small lot of copper pyrites from this Colony containing 24 per cent of copper, and gold equal to 78 ozs. 8 dwts., and silver 4 ozs. 2 dwts. 10 grs. per ton; arsenical pyrites containing when thoroughly roasted 11 ozs. 18 dwts. 0 grs. per ton; iron pyrites containing when roasted 5 ozs. 6 dwts. 3 grs. gold per ton.

As much attention has been given by others more conversant than myself with mechanical manipulation to the extraction of gold and silver, by grinding with mercury in variously designed apparatus, with comparatively small success so far as these complex ores are concerned, I have confined my attention principally to those chemical relations of gold which would enable me to obtain it in solution. I may note, however, that in Germany ores containing more than 1 per cent of copper, or 7 per cent of lead, have not been found suitable for amalgamation; and that an increase of density of the accompanying gangue from the presence of heavy spar, &c., or of tenacity from the presence of clay, seriously reduce the yield of precious metals, consisting in their case principally of silver; and that nearly all the gold is lost in the tailings, with about 15 ozs. of mercury per ton of ore treated.

The loss of silver by amalgamation, working with ores considered suitable for that process, has been found to vary in Germany from 5 to 10 per cent of the contained quantity.\*

With the Comstock silver ores in America, the loss is 12 per cent by barrel amalgamation, whilst with the same ores by pan amalgamation the yield never exceeded 80 per cent, seldom 75 per cent, with a general average of 66 per cent.†

At the Port Phillip Works at Clunes, Mr. Latta reports that the average loss of gold by amalgamation in a period of seven years was 6 dwts. 10 grs. per ton, the highest loss being 7 dwts. 15 grs., the lowest 4 dwts. 8 grs., the pyrites being free, or nearly so, from copper and lead.‡

In treatment by fusion it is found at Kongsbeck, in Norway, that after repeated fusion slags carry away 1 oz. 2 dwts. of auriferous silver per ton; and in Lower Hungary, by a similar process, the loss is in the slags 1 oz. 12 dwts. per ton, besides a loss of 3½ per cent of the total silver in the smoke.

Rivot says:—"The yield of gold and silver from pyritical ores does not exceed 65 per cent of the assay, which is itself open to losses. According to many synthetical experiments, the loss is greater in assays of richer than of poor ores, amounting always to more than 30 per cent,

and with fahlore and ores containing arsenical pyrites to more than 50 per cent. The loss incurred when working on a large scale is less than in laboratory assays. The difference between the yield on the large scale and the percentage by assay may exceed 30 per cent, even when the metallurgic method is quite perfect; but as the American methods are far from perfect, the difference is still greater.\*

Many of the trials made during this investigation yielded negative results, and in others the yield of the precious metals was so small as to be of no practical value, and I shall therefore only give an outline of the methods adopted, with a few results selected from numerous experiments.

The quantity of material operated on in all cases was 3667 grains, from which quantity one-tenth grain represents 1 oz. per ton.

The first process which suggested itself for the extraction of gold was to take advantage of the solubility of sulphide of gold in solutions of alkaline sulphide, for if this could be effected it would render the roasting of the ores unnecessary.

In 1859, Henderson included in his patent for the extraction of copper, a process for extracting gold as sulphide. His directions are that the pyrites be fused to obtain a matt which is to be fused with two parts of salt cake (crude sulphate of sodium), and the matt run into pigs. These placed in water crumble to pieces; and the gold is obtained in solution, whence it may be recovered by precipitation with an acid.

In 1868, a process was patented in America for the extraction of gold by "sulphur and its salts," but of this I have no details.

The first experiments were made by treating portions of each ore with solution of sulphide of sodium containing a slight excess of sulphur. The experiments were varied in concentration of solution, in time of digestion from one to seven days, and in temperature, some being conducted at ordinary temperatures, others at 212° F. Twenty experiments were made altogether, and in no case was a trace of gold obtained on neutralising with acid, filtering off the precipitated sulphur, and igniting. From arsenical pyrites much arsenic was obtained in solution.

Henderson's process was tried with Mariner's Reef ore, proceeding exactly according to his directions, but although the regulus disintegrated in water as described by him, I could not, in two trials, obtain any gold in solution. This process was modified, with equally unsatisfactory results, by fusing with sulphide of sodium, by fusion with sulphate of sodium and charcoal, and by heating finely powdered ore to a dull red with sulphite of sodium, without fusion.

The extraction of gold from its ores as chloride was proposed by Price, who, in January, 1857, patented a process in America for the extraction of gold from its ores by fusing them with sulphide of iron, and treating the regulus with aqueous chlorine or an acidified hypochlorite. This introduced a source of difficulty, as the chlorine would have to convert the sulphide into ferric sulphate before any gold could be obtained in solution.

Ziervogel proposed treating roasted pyrites with chlorine, and his process was used at Chemnitz.

This process was afterwards patented in the United States by G. F. Deetken, in 1863, and has been used with tolerably satisfactory results in California in two establishments. The process is there carried out as follows:—The concentrated pyrites are subjected to a thorough calcination, and when sulphurous anhydride ceases to be evolved, the residue is withdrawn from the furnace and cooled. It is then sprinkled with water, and turned over several times until uniformly damped, the exact condition in this respect being a matter of considerable importance. It is then placed in a large wooden vat, having a false

\* Watts's "Dictionary of Chemistry," article Silver.

† S. A. Phillips's "Mining and Metallurgy of Gold and Silver."

‡ *Trans. R. Soc., N.S.W.*

\* Rivot, *Ann. Min.* [6] vii 1. Watts's "Dict. Chem.," Second Supplement, p. 572.

bottom, and chlorine gas from a generator is admitted below until it is seen floating above the material. The tank is then closed, the current of gas stopped, and the whole left at rest for ten or twelve hours, when the cover is removed and water is run on. This dissolves the chloride of gold formed, and the solution is run into earthenware or glass vessels, where the gold is precipitated as a bronze-black powder by the addition of a solution of ferrous powder.

As it had been found that gold alloyed with much silver was not readily attacked by chlorine from the chloride of silver formed encrusting the granules, Paterno and afterwards Rösner proposed the use of chlorine dissolved in a concentrated solution of salt.

The disadvantage of the chlorine method of extraction is, that with ores containing copper the whole of that metal has to be removed before the chlorine becomes available, and also all the sulphur which otherwise becomes first oxidised to sulphuric acid.

With a view to removing the copper, I carefully roasted a quantity of ore in a muffle, at a dull-red heat, with constant stirring for seven hours, and extracted the residue with water and sufficient sulphuric acid to convert all oxide of copper into sulphate. The dried residue was found to contain 1.5 per cent of sulphur, and I therefore re-calcined the whole for seven hours longer, and extracted the copper as before, when the sulphur was found to be reduced to 0.46 per cent. A similar result was obtained in successive trials, and as this amount of sulphur would require as much chlorine, as upwards of 3300 ozs. of gold per ton, a more perfect method of getting rid of it was evidently required.

Another portion of ore was therefore partially calcined, cooled, and damped with brine, and the whole again calcined until fumes were no longer evolved.

The residue extracted with water and acid as before was found to contain 0.12 per cent of sulphur, and traces only of copper.

On assaying a portion of the residue, it was found to contain—

Gold .. .. 3 ozs. 14 dwts. 8 grs. per ton.  
Silver .. .. 39 ozs. 18 dwts. 14 grs. ,,

A portion was ground up with mercury, and sufficient water to make it of the consistence of thick cream, in which the mercury was well broken up for an hour, and afterwards carefully washed, the tailings being gone over as often as any mercury was found. This yielded—

Gold .. 1 oz. 0 dwts. 5 grs., leaving 2 ozs. 14 dwts. 3 gr.  
Silver .. 6 ozs. 16 dwts. 10 grs., ,, 33 ozs. 2 dwts. 4 gr.

Another portion, shaken up with a solution of salt and pieces of iron to decompose the chloride of silver, and the residue ground up as before, yielded—

Gold .. 1 oz. 1 dwt. 0 gr., leaving 2 ozs. 15 dwts. 8 grs.  
Silver .. 34 ozs. 3 dwts. 5 grs. ,, 5 ozs. 15 dwts. 9 grs.

These results showing that even after the most complete removal of sulphur, or at all events what would be considered complete on the large scale, the greater part of the gold present was untouched by the mercury, I proceeded to examine the effect of chlorine, of which I give the following as typical results:—

A portion treated with chlorine gas exactly as above described yielded gold, 16 dwts. 10 grs., leaving 2 ozs. 17 dwts. 22 grs.

A portion treated with  $\frac{3}{4}$  oz. of calcium hypochlorite and sulphuric acid, with sufficient water shaken up in a bottle for twenty-four hours (it then smelt strongly of chlorine), was filtered through an asbestos filter, the residue well washed, and the gold precipitated—yielded 1 oz., leaving 2 ozs. 14 dwts 8 grs. The dried residue was found to be free from sulphur.

A portion mixed with brine and the same quantity of reagents as above, and otherwise similarly treated, yielded gold 1 oz. 2 dwts. 5 grs., leaving 2 ozs. 12 dwts.

3 grs. The residue digested with water containing  $\frac{1}{2}$  oz. hyposulphite of sodium, the solution acidified and treated with sulphureted hydrogen, gave—

	Ozs.	Dwts.	Grs.
Gold .. ..	22	14	19
Silver .. ..	0	3	0

Roasted arsenical pyrites, treated with hypochlorite of calcium and sulphuric acid as above, gave—gold, 11 ozs. 15 dwts. 5 grs., leaving 2 dwts. 19 grs. Roasted iron pyrites, similarly treated, gave—gold, 5 ozs. 1 dwt., leaving 5 dwts. 3 grs.

The two last results show that with these simple pyrites the treatment with hypochlorite and acid gives very fair results, and this being a process involving no troublesome apparatus it might be sometimes applied with advantage.

(To be continued)

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, December 5, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors, reading of minutes, &c., the following certificates were read for the first time:—F. R. Japp, J. J. Broadbent, W. Stevenson, E. A. Letts.

During the meeting the following gentlemen were duly elected Fellows of the Society:—E. Waller, Shigetake Siguira, H. F. Cheshire, J. Treharne, H. J. H. Fenton, H. Green, J. Collins, W. J. Noble, D. McAlpine, A. E. Drinkwater, L. Green, Kingo Takemura, G. W. Hatter, P. H. Walsh, J. J. Watts, H. Eccles, E. W. Napper, and A. C. Arnold.

The PRESIDENT then called on C. MEYMOTT TIDY, M.B., to read his paper on "*The Processes for determining the Organic Purity of Potable Waters.*" The determination of the organic matter in potable waters, both as regards its quantity and its quality, has been a subject of late years productive of much discussion, of much difference of opinion, and of much warmth of feeling. The author wished to lead and urge the discussion in a strictly scientific groove, unfettered and unimpelled by that warmth of feeling which has in this, as in many other questions, more often retarded than helped the attainment of that scientific accuracy to which we hope and desire that all our work and all our discussions should tend. The author trusts that nothing he may say will be regarded in any other light than a desire to discuss fairly the position of water analysis and the value to be attached to the various processes employed by water analysts. The processes for estimating the organic matter in water, naturally, divide themselves under two great heads:—(1.) Where the organic matter is estimated from a water residue. (2.) Where it is estimated in the original water, *i.e.*, from the water itself, and not from the residue after evaporation. It is here to be remarked that if it be possible, by any process or processes, to estimate the organic matter in the original water, such processes must have manifest advantages over those where the quantity of organic matter is deduced from a residue. The author then proceeds to discuss the processes which come under the first head, *The Ignition Process*; the first in respect of date, the last in respect of value. This process, to be of value, presupposes three things:—First, that no organic matter is lost and none gained during the evaporation of the water: in this point the process fails, because there may be both a loss of the actual organic matter present in the water, during evaporation,—such loss being

either physical, particles being carried off mechanically with the steam; or chemical, from decomposition,—and a gain resulting from the introduction of extraneous organic matter, in the shape of impurities floating in the laboratory atmosphere. Secondly, that all the organic matter is burnt off by the ignition of the residue; and thirdly, that nothing but organic matter is lost by ignition. With regard to both these points the ignition process also fails. The author gives details of some experiments which he made some years ago, in which he made analyses of four waters where the loss on incineration was very great, although they were as nearly as possible free from organic impurity. The author notes that the process is not quite abandoned, else there would be no need to refer to it; some analyses having been, not long ago, put in evidence where the loss on incineration was entirely relied on as the indication of organic purity or impurity. He finally refers to some cases where he thinks the loss on ignition may be of value,—as, for example, in cases of sewage,—and also the value to be attached to the smell evolved during the burning. The author then considers the *Combustion Process* of Drs. Frankland and Armstrong. The objections to this process are twofold: first, general; and secondly, special. The general objection is its impracticability, arising from the manipulative skill required, and the length of time consumed in conducting the process. These two latter objections may seem to have some weight at first sight, but very little on further consideration. It is admitted that a certain amount of manipulative skill is required; but the possession by practice of this manipulative skill constitutes a man an analytical chemist, and the sooner so delicate and difficult a work as water analysis is taken out of the hands of those who imagine themselves professional chemists after a few lessons in a laboratory, the better for Chemistry and Sanitary Science. As regards the time required, the author considers that rapidity ought not to enter into the calculation if accuracy or delicacy be thereby imperilled. This objection of impracticability is therefore worthless. The question of evaporation is then reviewed, including the ingenious devices of Prof. Bischof and Dr. Mills. Until we have definite evidence, says the author, that no organic matter is oxidised, and also that no organic matter is volatilised or destroyed by the heat required in evaporation, it follows that evaporation must always constitute a possible source of error in any process where the determination is made on the residue. Indeed we cannot resist the conclusion being forced upon us that, after all our trouble, we may be simply estimating the harmless organic matter, that which was poisonous and disease-producing having been carefully got rid of by our previous work. The next difficulty—the addition of the solution of sulphurous acid—is an important one. From a careful series of observations the author concludes that if the nitrogen present as nitrates does not exceed 1 part in 100,000, or 3·15 grms. of nitric acid per gallon, the reduction of the nitrates is complete on boiling with 10 or 20 c.c. of the sulphurous acid solution. If, however, the quantity present amounts to 1·5 per 100,000, some difficulty is experienced in effecting complete reduction, even when 60 c.c. of sulphurous acid solution are used. The next step is the combustion of the residue. The author accepts without hesitation the determinations of organic carbon, and is quite satisfied as to the accuracy of the method, but at present does not attach the same value to the determinations of the organic nitrogen, and therefore he doubts how far we are justified in drawing conclusions as to the source of the organic matter, *i.e.*, whether it is vegetable or animal, from the proportion which exists between the organic carbon and nitrogen. However, the process has so much improved on acquaintance that the author believes it to be of great value.

The processes where the organic matter is estimated from the water before evaporation are two, the Ammonia Process and the Oxygen Process. The *Ammonia Process* consists of the comparative determination of the nitro-

genous organic matter by the quantity of ammonia (“albuminoid ammonia”) yielded by the destruction of the organic matter. This destruction is effected by boiling the water in the presence of potassic permanganate and a large excess of caustic potash. Waters are divided by the authors of this process into three classes. Waters of extraordinary organic purity, yielding 0·000 to 0·05 part per million of albuminoid ammonia; safe waters, yielding 0·05 to 0·10; and dirty waters, yielding more than 0·10. The objections made to the process by Dr. Frankland are, that the conversion of the nitrogen of the organic matter into ammonia is seldom or never complete, and that the proportion of nitrogen converted into ammonia in a series of nitrogenised bodies varies widely. There is a certain force in these objections. If the organic matter of all water was alike it would be of no importance whether the whole or a definite part of the nitrogen was converted; but, inasmuch as in all probability the organic matter of one water is not the organic matter of other waters, the circumstance that bodies yield their nitrogen as albuminoid ammonia in vastly different proportions constitutes an objection of some importance. Nevertheless, this objection can be overrated. If it can be shown that the ammonia process indicates clearly that the yield of albuminoid ammonia keeps pace with the purity or impurity of waters, and that it is sufficiently delicate to indicate the finer grades of purity, the fact that piperin yields all its nitrogen whilst their yields one-fourth is of little significance in water analysis, whatever interest such facts possess for the scientific chemist. It must be remembered that Mr. Wanklyn has repeatedly and distinctly condemned the course taken by certain chemists in regarding his process as a method for the quantitative determination of nitrogen, and asserts that his process only answers the question, Is this water wholesome or is it not? Whilst it leaves untouched the question, How much organic nitrogen does this water contain? The author proceeds to notice some practical difficulties in the details of the process. It is practically impossible to prepare the alkaline solution of potassic permanganate absolutely free from ammonia, and it is always necessary to estimate the quantity of ammonia in the permanganate solution and deduct this from the total amount obtained in the actual experiment. It is a matter of extreme difficulty to effect the complete (*i.e.*, as complete as the alkaline permanganate solution is capable of effecting) decomposition of the organic matter by boiling the water with the permanganate solution, thus:—You distil a water with permanganate until ammonia ceases to be evolved, and then leave the apparatus carefully protected from contamination for a few hours; on re-distilling, a second yield of ammonia, often equal or even larger than the first, is obtained, and so again, and again, and again, fresh quantities of albuminoid ammonia may be obtained until every drop of water in the retort has been distilled over. This is a serious difficulty, and has in one case at least led one analyst to report a water to be of “extraordinary organic purity,” whilst a second classed the same water as a “dirty water” and entirely unfit to drink. Sometimes, too, ammonia seems to disappear. Thus, the permanganate solution is known to yield a certain quantity of ammonia on distillation; it is added to a water and the two distilled, when the distillate from the water, plus the permanganate, contains less ammonia than the distillate from the permanganate alone. As regards Nesslerising, the author states that a serious error may creep in from the fact that eyes are very far from being equally sensitive in observing and in classifying tints. Thus, out of a large number of average men observed, 60 per cent failed to arrange a series of Nessler test solutions in the proper order of their tints. The presence of free ammonia within certain limits the author regards as of little importance, and entirely disagrees with Mr. Wanklyn when he regards the presence of more than 0·08 part of ammonia per million as evidence that that ammonia proceeds from the fermentation of urea. As a general conclusion from a wide

experience, the author thinks that the ammonia process gives fairly concordant results when uniformly conducted, *i.e.*, given solutions made by the same person, the same hands to manipulate, the same eyes to judge of the tint depths; but this is almost a fatal objection to its general employment, for if the author's statements be true, in the ammonia process every man must be a law unto himself, whilst one man's law is no one else's law. Hence, comparisons are rendered impossible. As a rule the albuminoid ammonia process enables you to say whether a water be of excellent quality or of an exceptionally bad quality, but in those more delicate and difficult cases, where a water is not what may be termed excellent, but nevertheless is not "dirty," in the opinion of the author, the ammonia process absolutely and entirely fails.

The next process considered by Prof. Tidy is the *Oxygen Process*. This process, when properly carried out, is much relied on by the author. He deprecates most strongly the ordinary method of using it. The proper plan of using the permanganate is the following:— Into two twenty-ounce flasks, cleaned by rinsing with sulphuric acid and then thorough washing under the tap, place 500 septems (1 septem = 7 grains = 1-1000th of a gallon) of the water; add to each 20 septems of dilute (1 in 3) sulphuric acid, and 20 septems of the permanganate solution (2 grains in 1000 septems). Note the exact time at which the permanganate solution was added; at the same time two similar quantities of distilled water are to be treated in precisely the same manner. At the end of one hour and of three hours the oxygen used up by the water is to be determined. To the flasks, after standing the appointed time, add a sufficiency of potassic iodide (1 in 10), and then a standard solution of sodic hyposulphite (5.4 grains in 1000 septems) until the whole of the free iodine is removed, judging of the exact spot by the addition towards the end of the experiment of a few drops of starch solution. By deducting the quantity of oxygen equivalent to the hypo-solution used from that in the quantity of permanganate originally added, we obtain the quantity of oxygen used by the water. The blank experiments with distilled water give the value of the hypo-solution. It is obvious the samples of water must have a pink tint at the end of the one hour or the three hours, otherwise fresh experiments must be made with larger doses of permanganate. The author then proceeds to consider the interference of various substances with the process. He concludes that the only important errors which can arise would be due to the presence of ferrous salts, sulphuretted hydrogen, and nitrites. The presence of the first two substances would sure to be discovered in the analysis, and by taste or smell; the nitrites act immediately on the permanganate solution, and any decolorisation taking place during the first five minutes must be due to nitrites and allowed for. Besides, even if a careless manipulator were to miss the iron, the sulphuretted hydrogen, and the nitrites, and estimate the whole as oxidisable organic matter, he would simply condemn a good water, but could never by using the oxygen process pass a bad water as harmless. It is admitted that permanganate fails to oxidise some substances, such as urea, but nevertheless the quantity of oxygen used affords evidence of the relative quantity of matter in the water which is likely to be injurious, and this is what we want in water analysis, as it enables us to speak with confidence as to the use or rejection of a water for drinking purposes. The quantity of oxygen used during the first, as compared with that used in the first three hours, gives valuable information as to the relative quantities of putrescent easily oxidisable matter and of non-putrescent and less easily oxidisable matters. The author also recommends as a valuable accessory the tint of the water as seen viewed through a 2-foot tube, 2 inches in diameter, daylight reflected from a white card being used. This tube is of special value in determining whether a water is peaty or not. In some cases the tint gives a clue to the quantity of organic matter present. The author, in conclusion, quotes Angus

Smith's words as expressing his own views:—" Nothing ever pretends to do in water analysis what the permanganate test does. Those who neglect it leave out the putrid matter or drive it off in boiling." A comparison drawn from a large body of results was then made between the ammonia process and the other two processes, sometimes described as "processes of the past, possessing merely historic interest." The author has collected and plotted out in curves the results obtained by Dr. Frankland, using the combustion process; those obtained by Dr. Letheby and himself, using the oxygen process; and those obtained with the ammonia process, with the waters of the eight London companies since 1870. He finds that the curves of the oxygen and combustion processes are strikingly concordant, whilst that of the ammonia process agrees with neither. The author has also divided these results into classes, making as far as possible classes (with the three methods of estimating the organic matter), which should be comparable with each other. Thus, Class I. contains waters of great organic purity, which require less than 0.05 part of oxygen per 100,000 to oxidise their organic matter, or which give less than 0.1 part per 100,000 of organic carbon and nitrogen, or which yield less than 0.05 part per million of albuminoid ammonia. Compared in this way, out of 1686 experiments the oxygen and combustion processes tell the same tale in 1418 cases, and of the rest a large proportion have differences depending on the third decimal place. The results by the ammonia process correspond, save in a very general way, neither with those of the oxygen process nor with those obtained by the combustion process. The author has analysed, moreover, 200 miscellaneous waters, using the three processes in each case. Of these 94 were placed in the first class by the oxygen, and 92 by the combustion process, whilst only 42 were placed in the first class by the ammonia process. It must be understood that the author deprecates most strongly the judging of a water by one constituent without reference to its complete analysis and natural history, and has only instituted these classes for the sake of comparing results. The paper comes to an end with fifteen conclusions, the substance of which has already been given in the above report as to the relative value of the three processes. They may be briefly summed up as follows:— *The Ammonia Process* furnishes results which are marked by singular inconstancy, and are not delicate enough to allow the recognition and classification of the finer grades of purity or impurity. The errors incidental to the process form an array of difficulties which become infinitely serious, seeing that the range (from 0.05 to 0.1 part per million) between pure and dirty waters is comparatively so small. *The Combustion Process* has all the evils of evaporation to encounter, but the organic carbon estimation is trustworthy; the organic nitrogen determination, however, scarcely yields absolutely trustworthy evidence on which to found an opinion as to the probable source of the organic matter. *The Oxygen Process* avoids the errors incidental to evaporation; its results are constant and extremely delicate; it draws a sharp line between putrescent or probably pernicious and the non-putrescent or probably harmless organic matter. By it a bad water would never be passed as good. As far as the three processes are concerned the oxygen and combustion processes give closely concordant results, whilst those yielded by the ammonia process are often at direct variance with both.

Prof. TIDY occupied nearly two hours in giving an account of the above paper (which is over 100 pages) to a very full meeting of the Society. At its conclusion, after various suggestions had been made, it was moved by Mr. RILEY, seconded by Mr. NEISON, and carried unanimously, that the discussion should be adjourned until after the paper had been printed, when a Special Meeting would be called for the purpose. It was understood that, if possible, the paper should be printed in the January number of the Society's Journal.

The Society then adjourned to December 19th, when

the following papers will be read:—"Researches on the Action of the Copper-Zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe; "On the Formula of Glyoxylic Acid," by Dr. Debus; "On the Action of Isobutyric Anhydride on the Aromatic Aldehyds," by Mr. Perkin; "On the Production of Oxides of Nitrogen by the Electric Arc in Air," by J. Wills; "On Baric Periodate," by S. Siguira and C. F. Cross; "The Action of Alkaline Hypobromite on Oxamides, Cyanides, Ferrocyanides, and Cyanates," by W. Foster; "On a new Hydrocarbon obtained by the Action of Sodium Hydrochloride," by Dr. Letts; "On Erbium and Yttrium," by Dr. Humpidge and Mr. Burney.

## NOTICES OF BOOKS.

*The Art of Scientific Discovery, or the General Conditions and Methods of Research in Physics and Chemistry.*  
By G. GORE, LL.D., F.R.S. London: Longmans and Co.

We have here a book which may perhaps be regarded as too ambitious in its objects, professing to be a newer and more practical *Novum Organon*. The author, however, attempts nothing essentially impossible. Unlike Bacon, he has "no wish even to suggest the idea of reducing all intellects to a level, nor to make success in research a matter merely of time and labour, nor to pretend that important discoveries can be completely made by rule alone." He pre-supposes, as necessary, "a certain amount of scientific knowledge, a disciplined mind, and manipulative skill." He fully recognises the truth that great aptitude for scientific discovery must, like any other peculiar ability, be "born in the man." Yet at the same time he contends that in this pursuit, as in all others, there are conditions of success and causes of failure, an exposition and analysis of which cannot fail to be of value to the student. To take a parallel instance, no one expects that such commanders as Napoleon, Wellington, or Moltke can be produced to order by any amount of training, yet at the same time works on the military art are considered indispensable for the young officer. In the fine arts, inborn genius is the primary condition without which all extraneous aids are idle. Yet without such aids genius is liable to go astray, to exert itself to little purpose, or to be lost altogether. It is important to know that Faraday, than whom no higher authority could be named, appears to have pronounced the framing of an art of scientific discovery by no means impossible.

Dr. Gore examines in succession the general basis of scientific research, its general conditions, the requisite personal preparations, the manner of actual working in research, and finally the special methods of discovery. Throughout the work, but especially in its latter portions, he illustrates and enforces his views by examples drawn from the history of scientific research. This feature renders the volume less "dry" to the general reader. Indeed, whoever peruses it carefully will acquire no contemptible knowledge of the career of discovery, of the difficulties it has had to encounter, and of the achievements of the leading men of science. On this account we can recommend it to the notice of all educated and thoughtful men, even though they may not have the least intention of devoting themselves to scientific research. We agree with him thoroughly in his evident estimate of the importance of research as being, intellectually considered, the highest of all human pursuits. We can fully endorse his statement of the external difficulties and hindrances with which it is beset, especially in England, and can rather wonder that so much has been done than feel any astonishment at our being outstripped by neighbouring countries in the quantity of scientific work. But we are less sanguine than he is as to any endowment of research

or any such reform in our universities as the case demands. He complains that at our old universities students are absorbed in acquiring and contemplating what is already known, instead of pressing onward to discover new truths. He goes on:—"In Germany, where the teachers themselves possess the genius of origination, and in those institutions in this country where a similar condition exists, the students are encouraged in original work by their teachers, and thus acquire the art of making discoveries." Alas, where is the institution in which the highest honours, or indeed any honours at all, can be earned by discoveries only? Men still "read"—not work—for the degrees of B.Sc. and D.Sc. of London University, just as they "read" for degrees at Oxford and Cambridge. Nor do we see much hope that newer seats of learning will either be disposed to grant honours more rationally, or if willing, will receive legislative sanction. The two great political parties can be described as equally hostile. The Conservatives prefer scholarship to research, and are more curious about "longs and shorts" than about atoms and molecules. The Liberals, on their part, bow down to the Chinese idol known as competitive examination, and would not willingly assent to any measure by which his joss-house might be endangered.

Dr. Gore fully recognises that for success in discovery "a large amount of quiet leisure is almost indispensable." He admits that the men who, by writing manuals and other compilations, giving lectures, &c., contrive to make the most noise in the scientific world, are by no means the most fruitful in discoveries. We may instance the case of Dr. Lardner, who, we doubt not, was at one time regarded as a more eminent man than either Faraday or Dalton, yet who is now regarded as merely a clever exponent of other men's researches.

Concerning the influence of age upon the ability to make discoveries, the author holds views seemingly different from those of Dr. Beard. He holds that the power of research usually continues as long as the senses and intellect remain unimpaired. Yet on the same page, in speaking of Galileo, he adds, "the latter part of the time being, as is usual, most devoted to reflection, writing, systematising his knowledge, and getting it published." In natural connection with this subject, we are led to some remarks on the influence of scientific research upon health. "Investigators," we read, "are stimulated by the health and pleasure derivable from physical and mental activity." Yet elsewhere he quotes from W. C. McIntosh (*Psychological Journal*) the utterance that "deep studies and scientific pursuits are not the most natural objects of man, but opposed to his health and well-being." Our own observations, like those of Dr. Beard, support the former view, that brain-work is conducive to health and long life.

The following remark seems paradoxical: "Notwithstanding the vast amount of knowledge which remains to be discovered, it is extremely difficult to find a scientific truth which is both new and important." Yet it is no less true. Numbers of facts, depending for their detection most exclusively upon mere patience and manipulative dexterity, remain unknown, e.g., boiling-points, melting-points, solubilities, quantities of heat evolved or absorbed during chemical or aggregational changes. Yet work of this kind, though highly useful, is "miserably unremunerative." Not only does it fall dead upon the outside public, but even in scientific circles the mere determiner of constants passes nearly unnoticed.

The author attaches great, though by no means exaggerated, importance to the study of residual phenomena and the examination of residual substances. He very judiciously advises the student to examine apparent exceptions to some law as a process not unlikely to lead to the discovery of a higher law. This advice requires a sound moral basis of character. The man not possessing a thorough love for truth turns away from exceptions, or seeks to shut his eyes to their very existence. Another

useful recommendation is to examine neglected truths, hypotheses, and substances. If, as is too often the case, we work upon something which is creating a sensation, the probability of our being anticipated is vastly greater than if we had taken up some unfashionable subject. There are many other points in this work to which we should have pleasure in drawing attention did space permit. Its chief defect seems to us a tendency to repetition, and an occasional introduction of what is commonplace, or of something which, however interesting, is beside the question. Thus an account of the persecutions undergone by discoverers would form an appropriate subject in a history of discovery. In a treatise on the art of discovery it is scarcely relevant. Advanced students, not merely of physics and chemistry, but of the organic sciences also, will derive many useful lessons from this book, and to their notice we especially recommend it.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 21, November 18, 1878.

**New System of Electric Lights.**—R. Werdermann.—This system, based on the effects of the incandescence of charcoal heated to white redness, is so arranged that when the electric generator is properly combined a great number of jets of light may be simultaneously kindled by the simple derivation of the current. It consists essentially of a loose piece of charcoal, movable in the interior of a metallic tube, which serves as a guide and as a communicator of the current. When the current was distributed between two lamps the light was equal to that of 360 standard candles. The light was white, free from the blue and red rays so frequently seen in the voltaic arc, and perfectly steady. If distributed among ten lamps the light of each equalled that of 40 candles.

**Artificial Reproduction of Felspars and of a Complex Volcanic Rock (Pyroxenic Labradorite) by means of Igneous Fusion and Prolonged Exposure to a Temperature Bordering upon Fusion.**—F. Fouqué and M. Lévy.—The nature of this paper will appear sufficiently from its title.

**New Telephone.**—C. Ader.—The author gives to his invention the name of electrophone. It consists of a sort of drum, fitted on one side only with a diaphragm of parchment paper 15 centimetres in diameter, to the centre of which are fixed circularly six small plates of tinned iron, 1 centimetre in length by 2 millimetres in breadth, acted on by six microscopic horse-shoe magnets, whose magnetic nucleus is not more than 1 m.m. in diameter, and each limb of which is about 6 m.m. in length with coils in proportion. All these electro-magnets are connected together and set in action by a speaking charcoal microphone. A Leclanché battery of three elements is sufficient.

**Action of Hydracids on Mercury Sulphate and of Sulphuric Acid on the Haloid Salts of the same Metal.**—A. Dite.—Contrary to the statement of Berzelius hydrochloric acid does not decompose sulphate of mercury with expulsion of sulphuric acid, but combines with the salt in definite proportions. The compound formed dissolves in water without decomposition. A corresponding bromine compound is formed by heating mercuric sulphate in hydrobromic acid, or by heating a mixture of mercuric bromide and sulphuric acid. With iodine no analogous product is obtained.

**Action of Platinum Wire on the Hydrocarbides.**—J. Coquillion.—Hydrogen bicarbide mixed with air is more denotating than the protocarbide; palladium produces a feebler denotation than platinum; both these metals may equally serve for burning small quantities of gas at white redness.

**Alkalinity of the Carbonates and Silicates of Magnesia, Free, Mixed, or Combined.**—M. Pichard.—Magnesian carbonates, artificial or natural, have an alkaline reaction on litmus paper, and impart this property to mixtures in which they are present in the proportion of 1 part in a thousand. Natural silicates containing magnesia have also an alkaline reaction. The natural silicates of alumina, potassa, soda, and lime, both separately and associated, are perfectly neutral.

No. 22, November 25, 1878.

**Critical Examination of a Posthumous Work of Claude Bernard on Alcoholic Fermentation.**—L. Pasteur.—The author sums up his memoir as follows:—The manuscript of Bernard is merely a sterile attempt to substitute the deductions of an ephemeral system for well-established facts. He remarks that if M. Berthelot, to whom the publication of this posthumous work is due, had not been himself biassed by pre-conceived ideas, the work of the late illustrious physiologist would not have seen the light in its present form. Bernard's fundamental doctrine is the essential opposition between phenomena of vital creation or of organising synthesis, and, on the other hand, phenomena of death or of organic destruction, to which latter general type the actions of fermentation belong. M. Pasteur, on the contrary, maintains that under certain conditions there appear acts of fermentation in direct correlation with organic acts. Bernard's especial conception was that of soluble non-organised ferments, and he often declared that it was necessary to liberate fermentation from the vitality of cellules.

**Reclamation of Priority on the Subject of M. Werdermann's Electric Lamp.**—E. Reynier.—In a note laid before the Academy on May 13, the author explained the principle of a system identical with that which M. Werdermann has just proposed.

**Novel Phenomenon of Static Electricity.**—M. E. Duter.—The author describes an experiment proving that in certain cases electrification may change the volume of bodies. In a Leyden jar the isolating matter undergoes on electrification a dilatation which can be explained neither by an increase of temperature nor by electric pressure.

**Subject of the Element called Mosandrum.**—J. Lawrence Smith.—A reply to M. Marignac (*Comptes Rendus*, 1878, p. 281). The author claims the priority of having called the attention of the scientific world, in published documents, to the absence of ceric oxide and to the novel characters of certain earths existing in the mineral samarskite, and of having pointed out among them a new one, which he has named mosandrum.

**Certain Derivatives of the Essence of Turpentine.**—J. de Montgolfier.—The author has especially studied the action of sodium upon the hydrochlorates of terebenthin. From the solid hydrochlorate he has obtained inactive camphen, and a hydride of camphen of the formula  $C_{20}H_{18}$ . There was also produced in smaller quantity a third compound, probably the hydride of dicamphen. An examination of the products of the liquid mono-hydrochlorate is incomplete.

**Cyanogen Derivative of Camphor.**—A. Haller.—The author has prepared a compound having the formula of camphor, in which an atom of hydrogen is replaced by cyanogen.

**Action of Salts of Chrome upon Salts of Aniline in Presence of Chlorates.**—S. Grawitz.—Two years ago the extraordinary action of the salts of vanadium was pointed out. With aniline salts and in presence of

chlorates they determine the formation of black in the infinitesimal proportion of 5 milligrms. per litre of unthickened colour. Vanadium is rare and very dear, the bivanadate of ammonia being worth about 1500 francs per kilo. A substitute for it has been vainly sought without thinking of trying chrome, which is its nearest neighbour in the natural classification of the metals. But the chromic salts act with an energy still greater than that of the vanadic salts; 1-10th milligrm. of bichromate of potassa to 125 grms. of aniline salt dissolved in a litre of water develops the black. The experiment may be easily made by forming an ink and developing the black upon paper. In industrial practice the use of the chromates in place of the vanadates presents numerous advantages. The author wishes to call the attention of the Academy to this fact, because this reaction upon the salts of aniline in presence of the chlorates has been proposed as a qualitative test for vanadium. [It must be remembered that Lightfoot's original patent claims the use of "metallic salts and oxides" along with chlorates for the production of aniline blacks.—*Ed. C. N.*]

*Biedermann's Central-blatt.*  
September, 1878.

**Quantity of Ammonia and Nitric Acid in Atmospheric Precipitations.**—Dr. W. Engling.—There is an evident idea that the proportion of combined nitrogen brought to the ground by rain is greater in the immediate neighbourhood of large towns than of the open country. In dry seasons the proportion of nitrogenised compounds is also greater than in wet periods. Elevated districts receive less copious, and therefore more nitrogenous, rains than the level country. The author is unable to accept Kayser's view of the non-existence of ozone in the air, and he is prepared to show that the colouration of the iodine-starch paper is not due to nitrous acid.

**Carbonic Acid in the Air and Soil of Forests, as compared with that of the Open Country.**—Prof. Ebermayer and Dr. Schwappach.—The air within an extensive forest contains in summer almost double the proportion of carbonic acid found over the open country. Forest-soil, on the other hand, is in summer very much poorer in carbonic acid than the soil of the open fields, and the amount in the latter rises with elevation of temperature much more rapidly than does the former. The diffusion of carbonic acid in the soil seems to be very slow, as it varies greatly in closely contiguous places.

**Guarantee of the Value of Bone-Dust.**—Prof. R. Heinrich and L. Hensolt.—The authors have examined the three classes of bones used in the manure-trade,—*i.e.*, (1) massive bones from the slaughter-house; (2) bones collected from house to house; (3) boiled bones from the glue-works. After determining the nitrogen and phosphoric acid in these varieties, they find—taking the price of phosphoric acid at 0.60 shilling per unit, and that of nitrogen at 1.80 shilling—the respective values of the three 11.62, 10.81, and 9.79 shilling per cwt., the difference amounting to nearly 20 per cent. Hence a guarantee of the genuineness of ground bones is insufficient unless their chemical composition is guaranteed also.

**Manurial Experiments with Precipitated Phosphate of Lime and so-called "Reverted" Phosphoric Acid.**—Prof. A. Petermann and Prof. L. Grandeau.—The authors conclude that the roots of plants take up the phosphoric acid of the precipitated phosphates, soluble in citrate of ammonia, as readily as the phosphoric acid of superphosphate soluble in water. This conclusion is still more applicable to the phosphates of iron and alumina, which in the author's experiments have given better results than precipitated phosphate of lime.

**Preservation of Liquid Extract of Rennet.**—Dr. F. Soxhlet.—The author finds thymol applicable for this purpose.

*Les Mondes, Revue Hebdomadaire des Sciences.*  
No. 12, November 21, 1878.

**Tempered Glass.**—M. F. Martial, of Ploermel, had placed a few grammes of sulphate of potassa with water in a capsule of this material, and, having set it upon his work-table, turned away to light a lamp, when the capsule burst into fragments with an explosion comparable to that of a fulminate. The observer then put the same quantity of sulphate of potassa and of water in another capsule of similar material, and succeeded in getting it to boil without accident.

## MISCELLANEOUS.

**Technological Museum for Sydney, New South Wales.**—We are informed that the Government of New South Wales has requested Mr. William Forster, Agent-General for the Colony, Prof. Liversidge, of the University of Sydney, and Mr. E. Combes, M.P., C.M.G., to collect information in the United Kingdom and on the Continent relative to the working of English and Foreign Technological Museums and Colleges, with a view to forming similar institutions in Sydney. A sum of money has been placed on the estimates by the Government of the Colony, to enable the Committee to purchase suitable specimens. We have no doubt that the Agent-General for New South Wales (3, Westminster Chambers, S.W.) will be extremely glad to receive from such institutions, or from any other source, reports or any information which would assist the Committee in its enquiries.

## NOTES AND QUERIES.

**Distillation of Coal-Tar.**—Perhaps some of your numerous readers will kindly inform me of the best method of distilling coal-tar, and the way in which the different products are procured. Is there any good treatise on the subject? and, if so, who are the publishers?—R. J.

**Soluble Blue.**—Can any of your readers tell me the name, price, and where I may obtain a bright, non-poisonous, and soluble blue which will not be affected by alkalis.—SOLUBLE BLUE.

**Hydraulic Cement.**—It may be worthy of record that in some experiments with hydraulic and Portland cement I have found that the presence of silica is not essential. It may be replaced by boric acid, and possibly also by other materials. So far as my experiments go, the cement made with borate of lime and alumina, when finished with an ordinary tool, takes a very fine polish; this polish appearing naturally on the surface in a short time, after it is left moderately smooth by the tool.—THOS. FLETCHER.

## MEETINGS FOR THE WEEK.

MONDAY, Dec. 16th.—Medical, 8.

London Institution, 5.

Society of Arts, 8. "Mathematical Instruments," by W. Mattieu Williams.

TUESDAY, 17th.—Civil Engineers, 8.

WEDNESDAY, 18th.—Society of Arts, 8. "Science Teaching in Elementary Schools," by Dr. J. H. Gladstone, F.R.S.

Meteorological, 7.

Geological, 8.

THURSDAY, 19th.—Royal, 8.30.

Chemical, 8. "Researches on the Action of the Copper-zinc Couple on Organic Compounds," by Dr. Gladstone and Mr. Tribe. "On the Formula of Glyoxylic Acid," by Dr. Debus. "On the Production of Oxides of Nitrogen by the Electric Arc in Air," by T. Wills. "On Baric Periodate," by S. Siguirra and C. F. Cross. "On Erbium and Yttrium," by Dr. Humpidge and Mr. Burney.

Philosophical Club, 6.30.

## INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

An Examination in Practical Chemistry in connection with the Institute of Chemistry will be held during the last week of January next. Examiner, Dr. W. J. Russell, F.R.S. Candidates can obtain further information on application to the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London W.C.

## THE CHEMICAL NEWS.

VOL. XXXVIII. No. 995.

THE CENTENARY OF THE BIRTH OF  
SIR HUMPHRY DAVY, DECEMBER 17, 1878.

THE day for passing eulogiums on Sir Humphry Davy has long since passed away. His name is known and honoured wherever science has penetrated or is penetrating. The reputation of Davy is spreading co-equally with the march of civilisation, and the white-turbaned softas of the Dar-ul-Founoun of Mohammedan Stamboul, the dusky students of the University of Brahma Benares, and the pigtailed votaries of the Imperial College at Buddhist Tokio are as rapidly becoming acquainted with the scientific achievements of the Cornish apothecary's apprentice as their more civilised fellow-workers on the banks of the Thames, the Seine, and the Spree. His fame is indissolubly united with substances and principles which lie at the very foundation of chemical theory and practice, and it would be as hopeless a task to attempt to separate the remembrance of his name from those little words potassium and sodium, chlorine and boron, as it would be to endeavour to deprive matter of molecular motion, or iron of its coercitive force. Instead, then, of celebrating the centenary of his birth by a string of laudatory platitudes or eulogistic commonplaces, we prefer to hold up his life and labours to the example of those of the rising generation of chemical students who desire to follow in his footsteps. It is not every one who has the desire or leisure, or indeed patience, to read through the diffuse biographies of this great man, which were published a short time after his death by his brother, Dr. John Davy, and his attached friend, Dr. John Ayrton Paris, or try to come at the facts of his life amongst the flowery periods of the *éloge*, which Baron Cuvier pronounced before the French Academy of Sciences on the occasion of his death. We think, therefore, it will not be out of place or season if we present our younger readers at any rate with a brief sketch of his career from his birth on the beautiful shores of Mount's Bay to his death on the no less lovely banks of Lake Lemman. Before doing so we would remark that one of the most prominent features in Davy's character was *thoroughness*. Whatever we find him doing, whether it is making fireworks in his guardian's kitchen while yet a child, studying medicine and pharmacy under Dr. Borlase, fly-fishing for trout in Scotch or Carinthian lakes, or trying to split up potash and boracic acid into their constituent elements, we always find his distinguishing characteristic to be *thoroughness*. The voluminous collection of note-books which he left behind him are curiosities in this respect. Observations of every kind and sort are included in these pages. At one time he notes down a peculiarity of flight in a swallow, at another a philosophical or theological puzzle, at another the anomalous behaviour of certain reagents, with a view to further investigation; whatever, in fact, he observes, down it goes for future reference or consideration. Even when on what he thought was his dying bed he kept his brother John fully employed either in reading over to him the MS. of his "Last Days of a Philosopher," or when too ill to listen to him in dissecting torpedoes in the adjoining room. Whether he shot, or fished, investigated the secrets of nature, or engaged in controversy with obstinate or ungenerous opponents, he worked with all the intellectual might of his wonderful mind, with all physical strength of his hardy body.

Humphry Davy was the eldest son of Robert and Grace Davy, and was born at Penzance, on December 17, 1778. He was a strong, active, healthy child, with a very reten-

tive memory. At six years old he was sent to a small reading and writing school at Penzance, but progressed so rapidly that his master, very disinterestedly, had him transferred to the town Grammar School, which was presided over by the Rev. Mr. Coryton. The Grammar School did not seem to have done him much good, as the principal was alternately indulgent and cruel, strict and careless. When he was nine years old he was taken charge of by a Mr. Tonkin, a friend of his mother's family, to whom she and her sisters were indebted for a father's care after the death of their parent.

Mr. Tonkin lived at Varfell, a small village situated in a beautiful part of Mount's Bay, and it was evidently during this period that he acquired that ardent love of the beauties of nature and of open-air sports, which were one of the chief pleasures of his happy life. In the intervals of study under Mr. Tonkin he was riding, fishing, shooting, gardening, or collecting and painting specimens of natural history or minerals; in fact, he does not seem to have worked very hard at his books during this period, and at one time appeared likely to grow into a sporting naturalist instead of a philosopher. When he was in his sixteenth year his father died, a sad event which seems to have had a great effect on him. He at once applied himself seriously to study; and on February 10, 1794, when only a few weeks over fifteen, he was apprenticed to Mr., afterwards Dr., Bingham Borlase, surgeon and apothecary, of Penzance. His note-books of the period show the ardour with which he began his work under Dr. Borlase. He drew up for himself an impossible course of study, comprehending almost every branch of knowledge, including the acquirement of no less than seven languages, his own profession, however, claiming the major portion of his time. His first MSS. now begin to appear, and, like those of many a clever youth of his age, were on theological, ethical, philosophical, and political subjects. He thus early showed the bias of his mind, and these fugitive productions, although boyish and incomplete, nevertheless contain the germs of the thoughts which at the close of his life he so eloquently expressed in the "Salmonia" and the "Consolations of Travel." He also began to write poetry *tant bien que mal*, a practice which he seems to have kept up almost to the day of his death. Samuel Taylor Coleridge said that if he had not been the greatest English chemist he would have been the greatest English poet, an opinion in which few critics will join. His verse is mellifluous, and the thoughts he intends to convey are always of a noble character, but the divine *afflatus* is entirely wanting.

In 1796 he took up the study of mathematics, and went through a severe twelve-months' course, thus evidently laying the foundation of that singularly exact and acute style of reasoning which he employed with such ability and success in upholding the elementary nature of chlorine against a cloud of opponents all fully worthy of his steel. In 1796 he began to study the Scotch metaphysicians, as well as Kant, and the Transcendentalists; but it was not until the following year, when he had just passed his nineteenth birthday, that he took up physical science as a study. By the end of the year he added chemistry, using the works of Lavoisier and Nicholson. Like many another poor student he converted his bedroom into a laboratory, and thoroughly examined the materials he met with in his everyday work by the aid of a collection of phials, teacups, and tobacco-pipes, adjourning to Mr. Tonkin's kitchen whenever he had any crucible operations to perform. In 1797 he began to write his "Researches on Light and Heat," published a couple of years after, which attracted the attention of Dr. Beddoes, of Bristol, with whom he entered into a long correspondence, which ended in his converting the learned Doctor to his views. He was now pursuing his profession with the greatest perseverance, receiving the most valuable assistance in a scientific sense from his intimate intercourse with Mr. Gregory Watt, the son of the great James Watt, and with Mr. Davies Gilbert, who was his senior by some years

and well versed in the science of the day. With these companions he used to ransack the country for miles round for specimens of minerals, rocks, and fossils. He was also assisted greatly by being allowed to use two excellent libraries, one belonging to his master, the other to the Rev. Dr. Tonkin, the eldest brother of his friend and guardian.

Towards the end of the fourth year of his apprenticeship he received a proposal from Dr. Beddoes, at Bristol, to take charge of a newly-founded institution, called the Pneumatic Hospital, in which every ailment under the sun was to be cured by the inhalation of gases and vapours. He joyfully accepted this offer, for he had been thoroughly fascinated by experimental research, and Dr. Beddoes's institution was provided with a well-appointed laboratory. After working for a year presumably under Dr. Beddoes's direction he set up a private laboratory at his house at Clifton, which was the beginning of his independent researches. He now began the systematic study of all the then known gases and their physiological effects on the human frame. He also took up the study of the infant science of voltaic electricity, but his great research at this time was that which ended in the discovery of nitrous oxide. This was the turning-point of his career, and the fame of young Davy's discovery spread everywhere. While at Bristol, too, he seems first to have suspected the compound nature of hydrochloric, hydrofluoric, and boracic acids. He even tried to decompose certain metallic chlorides by passing the vapour of sulphur over them at a red-heat, but without success. He also tried to decompose hydrochloric acid gas by means of the electric spark, but also failed. One of his experiments nearly proved fatal. During some researches on the physiological effects of carburetted hydrogen he inhaled too large a quantity of the poisonous gas, and became so ill from the effects of it that he had to relinquish work for a time.

In 1801 he received a communication from Count Rumford, the founder of the Royal Institution, offering him the post of Assistant Chemical Lecturer, with the right of succeeding Dr. Garnett as Principal Chemical Lecturer whenever that gentleman—who was growing too old for the post—should think fit to retire, an event which happened in the year following. He consequently resigned his position at Bristol in February, 1801, and delivered his first lecture at the Royal Institution in the April following, in the presence of Sir Joseph Banks, Count Rumford, and all the scientific and literary celebrities of the day. He seems to have taken his audience completely by storm. His manner, his personal appearance, his intelligent countenance and sparkling eyes, his youth and simplicity, as well as his happy illustrations and well-chosen experiments, made him the pet of the hour, and Davy's Royal Institution Lectures soon became as fashionable as Almack's or the Ancient Concerts. His great reason for quitting his friend Dr. Beddoes, to whom he seems to have been much attached, was his passion for research, Count Rumford having promised him the sole and uncontrolled use of the Laboratory and apparatus of the Institution. He began at once by continuing the voltaic researches he had commenced at Bristol, an account of which he had published in *Nicholson's Journal*. Invitations to dinners, balls, and soirées now began to pour in upon him, and the handsome well-bred philosopher became the rage. During his stay at the Royal Institution he seems to have seldom burned the midnight oil. He worked hard during the day, and devoted the evening to social intercourse with the aristocracy of birth and brain, with all the thoroughness of his nature. During the recesses he used to rush off to Wales, Scotland, or to any other part of Great Britain where his beloved trout could be found. He explored most parts of England in this way, always, however, bringing back with him well-filled cases of mineralogical, geological, and rock specimens. The chemistry of agriculture at this time greatly engaged his attention, and in 1802-3 he gave a series of lectures on the subject at the request of the Board of Agriculture,

which were afterwards published, in 1813, under the title of the "Elements of the Chemistry of Agriculture." Amongst his first work at the Royal Institution was a series of researches into the properties of catechu as a tanning material; but voltaic electricity and electro-chemical science, as well as the analysis of rocks and minerals in relation to geology and agriculture, took up most of his time. But the day was fast approaching when he was to make his indelible mark on the chemistry of his own and all future time. His first Bakerian Lecture was delivered in November, 1806, in which he laid down the laws of electricity in relation to chemical combination; his second Bakerian Lecture, in the following November, giving in the results of the application of these laws the amplest confirmation of their truth. His career for the next six years was a simple triumphal march of discovery. His papers on numerous subjects, each containing a crop of new discoveries, flowed into the Royal Society's archives in an uninterrupted stream; and it may be said, without exaggeration, that his work during the six years from 1806 to 1812 did more for chemistry than the sixty which followed them. There has hardly been a single discovery made during the last sixty or seventy years which is not in some way or other the more or less direct consequence of Davy's work during this time. These discoveries are too well-known to need recapitulation here: they are to be found in the first hundred pages of every half-crown Chemical Text-Book.

In 1810 and 1811 his fame spread to Ireland, and he was invited to Dublin to give two courses of lectures in those years. He received 400 guineas for the first course, and 700 guineas for the second. In the last-named year he had a strange fancy for continuing his medical studies, and even kept terms at Cambridge in preparation for taking his degree, but science after all had too many charms for him, and he relinquished his intention. Oddly enough, too, some of his influential friends tried to persuade him to enter the Church, promising him speedy preferment, but he declined. In 1812 he married a widowed lady of ample fortune—a Mrs. Appreece—with whose charms of body and mind he was greatly enamoured. A few days before his marriage he was knighted by the Prince Regent at a levée. Immediately after his marriage he resigned his position at the Royal Institution, and although he was elected Honorary Lecturer, he announced his intention of giving no more routine lectures. He considered, no doubt, that he had done enough drudgery, and that the discoveries he had made were sufficient to prevent his being considered a *dilettante* if for the future he followed up only those special lines of research which he had long before laid out for himself. Henceforth he was no longer a paid servant, but a willing volunteer fighting for the glory and advancement of science. We may mention, *en passant*, that after the delivery of his greatest Bakerian Lecture—the second, in which he announced the discovery of the elements potassium and sodium—he utterly broke down from over-excitement and hard work. He was seized with a feverish attack that seriously threatened his life in 1807, and did not resume work until the following March, when he commenced a series of lectures on electro-chemical science.

Shortly after his marriage he published his "Elements of Chemical Philosophy," dedicated to his wife, which was immediately translated into half a dozen continental languages.

In March, 1813, Sir Humphry Davy appointed Michael Faraday assistant in the laboratory of the Royal Institution, and in the following year took him abroad with him as his amanuensis.

From this time forward his life was one happy round of travel in England and on the Continent, always accompanied by his gun and his book of flies; balls, parties, and court receptions, and occasional brilliant scientific discoveries. The year following his marriage, while experimenting on nitrogen trichloride, in his friend Mr. Child-

ren's laboratory at Tunbridge, he met with a serious accident, which at one time threatened to destroy his sight. In 1813 we find him hard at work trying to decompose the fluorides, his labours resulting in the discovery of hydro-fluoric, silico-fluoric, and fluo-boric acids. In 1813 he visited the Continent for the second time, passing through Paris, where he proved to the whole of the French Academy that iodine was an element. The April following found him at Florence investigating the nature of the diamond, which he proved to be nothing more than an allotropic form of carbon. In 1814 and 1815 he does not seem to have done much beyond examining some ancient colours, and discovering chloric and iodic acids, and working on their salts.

The year 1815 was a fruitful one, although it contains only one discovery, that of the safety-lamp, to which his name is indissolubly connected. Returning in August from an excursion in Scotland, through the coal districts, he was painfully interested at the loss of life in coal-mines occasioned by the explosions of fire-damp. He had specimens of fire-damp from different coal-mines collected and sent up to him in London, and on the 9th of November he sent in two papers on the subject to the Royal Society, the lamp being perfected in the following month. This invention he gave freely to the world; had he patented it his gains would have been incalculable. In 1817 he was presented with a service of plate worth £2500 by the coal-owners and miners of England and Scotland, and shortly after he received the honour of baronetcy. The possibility of unrolling the Herculeum papyri next engaged his attention, and he published some observations on the phenomena of volcanoes and on Oersted's electro-magnetic experiments. In 1820 he succeeded Sir Joseph Banks as President of the Royal Society, a post which he retained for seven years. He did little more remarkable work from this time forward, his last remarkable papers being those on the preservation of copper-sheathing from corrosion by voltaic means and the Bakerian Lecture for 1826, on the relation of electric and chemical changes, which may be said to be the crowning point of his brilliant career.

In 1825 he fell into ill-health, and symptoms of a paralytic nature began to manifest themselves. His illness was greatly aggravated by the unexpected death of his mother in the September of the next year, and at the end of November he had a severe paralytic seizure which greatly affected his right side. He consulted the first physicians of the day without relief; but Nature, for whom he had done so much in unfolding her wonders, came to his assistance, and he soon gained sufficient strength to correct the proof-sheets of his collection of discourses before the Royal Society.

In the spring of 1827 he started for Italy, in company with his brother, and wandered about pleasantly until the October of that year, when he returned to England. In March, 1828, he once more started for his favourite Carinthia, travelling through Switzerland and Italy, and bringing up at Rome in February, 1829.

During the whole of his travels he was at work on his "Salmonia" and "Consolations of Travel," besides making numberless observations on torpedoes, the effects of voltaic electricity on muscle and nerve, and a crowd of notes on various interesting points in natural history.

He had barely arrived in Rome when he had a paralytic seizure which rendered his right side quite powerless. His brain, however, was quite unimpaired, and on the 25th of February he dictated a letter to his faithful brother John, who was Naval Surgeon at Malta. In those days Malta was nearly three weeks' journey from Rome, and he did not arrive till the 14th of March, when the illustrious patient had so far recovered as to be able to drive out. In April, Lady Davy arrived in Rome from London with the second edition of the "Salmonia," the sight of which seemed to revive him wonderfully. On the 30th of April he left Rome for Geneva, where he arrived on May 28th, apparently greatly enlivened and

improved by his journey, but at two o'clock on the following morning his brother was roused up and reached his bedside only just in time to receive his last sigh. At his own request he was buried in the cemetery outside the walls of the city in which he died.

## THE NATURE OF THE ELEMENTS.

AT a crowded meeting such as is seldom witnessed of the Royal Society on Thursday evening last Mr. J. Norman Lockyer, F.R.S., read a lengthy paper, in which he discussed the evidence derived from spectroscopic observation of the sun and stars and from laboratory experiments, which has led him to the conclusion that the so-called elements of the chemist are in reality compound bodies. In order that the line of argument followed by Mr. Lockyer may be understood, it will be necessary briefly to refer to the results of previous researches. As a rule, in observing spectra the substance to be examined is volatilised in a gas flame or by means of sparks from an induction coil, and the light is allowed to fall on the slit of the spectroscope; the spectrum is then generally one in which the lines run across the entire field, but by interposing a lens between the spark apparatus and the slit of the spectroscope, Mr. Lockyer was enabled to study the various regions of the heated vapour, and thus to establish the fact, already noted by some previous observers, but to which little attention had been paid, that all the lines in the spectrum of the substance volatilised did not extend to equal distances from the poles. He then showed by the aid of this method that in the case of alloys containing different proportions of two metals, if the one constituent were present in very small quantity its spectrum was reduced to its simplest form, the line or lines longest in the spectrum of the pure substances alone appearing, but that on increasing the amount of this constituent its other lines gradually appeared in the order of their lengths in the spectrum of the pure substance. Similar observations were made with compound bodies. It was also noticed that the lines furnished by a particular substance varied, not only in length and number, but also in brightness and thickness according to the relative amount present. Armed with these facts and with the object of ultimately ascertaining more definitely than has hitherto been possible which of the elements are present in the sun, Mr. Lockyer about four years ago commenced the preparation of a map of a particular region of the spectra of the metallic elements for comparison with the map of the same region of the solar spectrum. For this purpose about 2000 photographs of spectra of all the various metallic elements have been taken, and, in addition, more than 100,000 eye observations have been made. As it is almost impossible to obtain pure substances, the photographs have been carefully compared in order to eliminate the lines due to impurities; the absence of a particular element as impurity being regarded as proved if its longest and strongest line was absent from the photograph of the element under examination. The result of all this labour, Mr. Lockyer states, is to show that the hypothesis that identical lines in different spectra are due to impurities is not sufficient, for he finds short line coincidences between the spectra of many metals in which the freedom from mutual impurity has been demonstrated by the absence of the longest lines. He then adds that five years ago he pointed out that there are many facts and many trains of thought suggested by solar and stellar physics which point to another hypothesis—namely, that the elements themselves, or, at all events, some of them, are compound bodies. Thus it would appear that the hotter a star the more simple is its spectrum; for the brightest, and therefore probably the hottest stars, such as Sirius, furnish spectra showing only very thick hydrogen lines and a few very thin metallic lines, charac-

teristic of elements of low atomic weight; while the cooler stars, such as our sun, are shown by their spectra to contain a much larger number of metallic elements than stars such as Sirius, but no non-metallic elements; and the coolest stars furnish fluted band spectra characteristic of compounds of metallic with non-metallic elements and of non-metallic elements. These facts appear to meet with a simple explanation if it be supposed that as the temperature increases the compounds are first broken up into their constituent "elements," and that these "elements" then undergo dissociation or decomposition into "elements" of lower atomic weight. Mr. Lockyer next considers what will be the difference in the spectroscopic phenomena, supposing that A considers B as an impurity and as a constituent. In both cases A will have a spectrum of his own. B, however, if present as an impurity, will merely add its lines according to the amount present, as we have above explained; whereas if a constituent of A, it will add its lines according to the extent to which A is decomposed and B is set at liberty. So that as the temperature increases the spectrum of A will fade if A be a compound body, whereas it will not fade if A be a true element. Moreover, if A be a compound body, the longest lines at one temperature will not be the longest at another. The paper chiefly deals with a discussion from from this point of view of the spectra of calcium, iron, hydrogen, and lithium as observed at various temperatures; and it is shown that precisely the kind of change which is to be expected on the hypothesis of the non-elementary character of the elements has been found to take place. Thus each of the salts of calcium, so long as the temperature is below a certain point, has a definite spectrum of its own, but as the temperature is raised the spectrum of the salt gradually dies out, and very fine lines due to the metal appear in the blue and violet portions of the spectrum. At the temperature of the electric arc the line in the blue is of great intensity, the violet H and K lines, as they are called, being still thin; in the sun the H and K lines are very thick, and the line in the blue is of less intensity than either, and much thinner than in the arc. Lastly, Dr. Huggins's magnificent star photographs show that both the H and K lines are present in the spectrum of  $\alpha$  Aquilæ, the latter being, however, only about half the breadth of the former; but that in the spectrum of  $\alpha$  Lyræ and Sirius only the H line of calcium is present. Similar evidence that these different lines may represent different substances appears to be afforded by Professor Young's spectroscopic observations of solar storms, he having seen the H line injected into the chromosphere 75 times, the K line 50 times; but the blue line, which is the all-important line of calcium at the arc-temperature, was only injected thrice. In the spectrum of iron, two sets of three lines occur in the region between H and G which are highly characteristic of this metal. On comparing photographs of the solar spectrum and of the spark taken between poles of iron, the relative intensity of these triplets is seen to be absolutely reversed; the lines barely visible in the spark photograph being among the most prominent in that of the solar spectrum, while the triplet, which is prominent in the spark photograph, is represented by lines not half so thick in the solar spectrum. Professor Young has observed during solar storms two very faint lines in the iron spectrum near G injected 30 times into the chromosphere, while one of the lines of the triplet was only injected twice. These facts, Mr. Lockyer contends, at once met with a simple explanation if it be admitted that the lines are produced by the vibration of several distinct molecules.

The lithium spectrum exhibits a series of changes with a rise of temperature precisely analogous to those observed in the case of calcium.

In discussing the hydrogen spectrum, Mr. Lockyer adduces a number of most important and interesting facts and speculations. It is pointed out that the most refrangible line of hydrogen in the solar spectrum, *h*, is

only seen in laboratory experiments when a very high temperature is employed; and that it was absent from the solar protuberances during the eclipse of 1875, although the other lines of hydrogen were photographed. This line, also, is coincident with the strongest line of indium as already recorded by Thalèn, and may be photographed by volatilising indium in the electric arc, whereas palladium charged with hydrogen furnishes a photograph in which none of the hydrogen lines are visible. By employing a very feeble spark at a very low pressure the F line of hydrogen in the green is obtained without the blue and red lines which are seen when a stronger spark is used, so that alterations undoubtedly take place in the spectrum of hydrogen similar to those observed in the case of calcium. In concluding this portion of his paper Mr. Lockyer states that he has obtained evidence leading to the conclusion that the substance giving the non-reversed line in the chromosphere, which has been termed *helium*, and not previously identified with any known form of matter, and also the substance giving the 1474 or coronal line, are really other forms of hydrogen, the one more simple than that which gives the *h* line alone, the other more complex than that which gives the F line alone.

There can be no question that the facts brought forward by Mr. Lockyer are of the highest importance and value, and that they will have much influence on the further development of spectrum analysis, to which he has already so largely contributed. But his arguments are of a character so totally different from those ordinarily dealt with by chemists that they will hesitate for the present to regard them as proof of the decomposition of the elements until either they are assured by competent physicists that they cannot be explained by any other equally simple and probable hypothesis, or until what Mr. Lockyer has foreshadowed as taking place to such an extent in other worlds has been realised beyond question or cavil in our own laboratories. It has been suggested that the same molecule may be capable of vibrating in different ways at different temperatures, and thus of yielding different spectra, just as a bell may give out different notes when struck in different ways; and although Mr. Lockyer has replied to this objection, it can scarcely be regarded as finally disposed of. The fact, however, as Mr. Lockyer has pointed out, that the change from the spectrum of a compound to the lowest temperature spectrum of its metallic element is of a similar character to and even less in degree than the change from the lowest temperature spectrum of the metal to the spectra which it furnishes at higher temperatures does not appear to favour such an hypothesis, and from the similarity in the phenomena it is difficult to deny that in both cases decomposition does not equally take place. Professor Young's observations on the injection of particular lines into the chromosphere during solar storms are also difficult to reconcile with this view, and if the conclusions drawn from previous researches are correct, it also does not account for the short line coincidences which led Mr. Lockyer to his hypothesis.

Chemists are careful to teach that what are at present regarded as elements are not necessarily simple bodies, but merely substances which they are unable to decompose or which they have no special reason to regard as compound bodies. The remarkable relations, both in atomic weight and properties, existing between many of the elements tend, indeed, to show that they are related in the manner Mr. Lockyer supposes. We sincerely hope that he will continue his researches in this direction, and we trust that at no very distant time he may be able to bring forward evidence sufficiently clear to convince even the most sceptical.—*The Times*, Dec. 18.

The "Gros" Telegraph.—This instrument, now under official trial in the department of Aveyron, announces automatically any rise of a river, so that the inhabitants lower down the valley may be instantly warned.—*Moniteur Scientifique*.

ON THE

METHOD OF EXTRACTING GOLD, SILVER, AND OTHER METALS FROM PYRITES.\*

By W. A. DIXON, F.C.S., Cor. Mem. Nat. Hist. Soc. Glasgow.

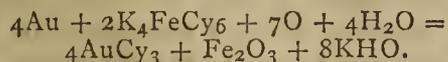
(Continued from p. 283).

It is difficult to account for the fact that in the case of the more complex mineral the chlorine even in large excess exerts so little action on the gold, and that when all the copper has been removed previous to treatment; but in every trial similar results were obtained. It seems probable, however, that the state of aggregation of the metal has some influence on its solubility in chlorine, and that as a mispickel dissolves gold, it was therefore obtained in the residue in a finely divided state, less so in the iron pyrites residue, and least divided in the complex ore. In the last, mere traces of gold were obtained by re-treating the residues from the first treatment by chlorine.

The only other salts of gold which possess sufficient stability to render their use possible for its extraction are the auricyanides of the alkali metals and bromide of gold. Bromine would, however, be more expensive and more troublesome to use than chlorine, and moreover in one or two trials gave me smaller results than were obtained by chlorine. Skey† has described a method of testing for gold by the use of bromine water, and also with tincture of iodine. I have been unable to obtain any reaction either with tincture of iodine or with solution of iodine in iodide of potassium, which, considering the unstable character of the gold iodides, is scarcely to be wondered at.

Prince Balgration and Elsner‡ have observed that precipitated gold is soluble in cyanide of potassium if exposed to the air, and the latter says also in ferrocyanide of potassium. A patent was applied for in America in 1868 for the use of cyanide of potassium for the extraction of gold from its ores, but I have no particulars of the process. It seemed to me, however, that the high price of this salt, its instability when exposed to the air and in solution, and its extremely poisonous properties, precluded its use for this purpose. On trying the reaction between precipitated gold and cyanide of potassium, I found that it was extremely slow if the gold was at all dense. In presence of alkaline oxidising agents, however, I found that the solution of the gold was sufficiently rapid. Thus, on standing overnight, the quantity of gold and cyanide of potassium solutions being similar in each case—with the cyanide alone, traces only of gold were dissolved, but with the addition of calcium hypochlorite, ferrocyanide of potassium, or binocide of manganese, all the gold was dissolved; with chromate of potassium, a small quantity; with permanganate of potassium, none.

With ferrocyanide of potassium alone I did not obtain any gold in solution after standing some days, but I thought that with suitable oxidising agents it might be obtained in solution according to the equation—



In the cold, however, with the exception of ferricyanide of potassium, none of the above oxidising agents had any effect, but heated to 212° F. the reaction with all of them was sufficiently rapid, and I found that this was also the case with permanganate. This reaction promised to be of considerable value, as the gold and silver would both be obtained in solution, from which the former could be precipitated by filtering the hot solution through finely divided metallic silver, of which an equivalent quantity would be dissolved, which, with the silver originally present, could be precipitated as sulphide. By treating the solution with ferrous hydrate, the cyanide of potassium

could be retransformed into ferrocyanide, which has the important advantages of being exceedingly stable and non-poisonous. I found, however, that copper in any form precipitated both gold and silver from the solution, or at all events that these metals were not dissolved until the copper had all gone into solution; also, that if the copper was present as sulphide, the silver was transformed into sulphide which is insoluble. Any copper dissolved cannot be precipitated as sulphide, but I found that it could be removed by digesting the solution with ferrous hydrate, the solution being kept alkaline.

A portion of roasted arsenical pyrites was digested at 212° for twelve hours with  $\frac{1}{4}$  oz. ferrocyanide of potassium, 32 grs. oxide of manganese (20 lbs. per ton), and sufficient water made alkaline by soda to make a cream—the solution yielded 9 ozs. 8 dwts. 19 grs. gold per ton, leaving 1 oz. 9 dwts. 15 grs. This was the best result obtained with this pyrites, the yield with other oxidising agents and by more prolonged digestion being all somewhat lower.

With Mariner's Reef pyrites trials were made with each oxidising agent in succession, the duration of the digestion being varied from twelve to fifty-six hours; whilst with the soluble oxidising agents the quantity used was in some cases little over the theoretical amount, and sometimes ten times as much. In some of the experiments all the oxidising agent employed was added at once, in others at successive intervals; and I found that after four or five times the theoretical quantity had been added, a further increase had little or no influence on the result. With binocide of manganese, on the other hand, from thirty-five to forty times the theoretical quantity gave the best results. The material used had been roasted with salt and extracted with acid, and contained so little copper that 50 grs. digested with nitric acid, the solution made alkaline by ammonia, and made up to 50 c.c., had only a faint colouration in a cylinder 3 inches deep. It contained—

	ozs.	dwts.	grs.
Gold .. .. .	8	0	19
Silver .. .. .	49	11	5

and yielded from 3 ozs. 12 dwts. to 5 ozs. 1 dwt. of gold, and from 46 ozs. to 46 ozs. 3 dwts. of silver per ton. This showed that all the silver which had been converted into chloride during the roasting was obtained in solution as cyanide. With the gold, on the other hand, all the results showed that with complex pyrites a portion only could be obtained in solution either in mercury or in water as cyanide or chloride, whilst none could be obtained as sulphide.

There being therefore no method by which the precious metals could be removed and the base metals left, it remained to fall back on one of the first principles of metallurgy, viz., to remove the base metals at the earliest stage possible, and leave the precious metals as a residue. In ordinary metallurgic operations this end is attained by dressing and successive smeltings. I however arrived at the conclusion that smelting was not a desirable process, as it is expensive, and the gold and silver would at last be found alloyed with a large quantity of copper, whilst considerable quantities of these metals would be lost by volatilisation and in the slags. These losses have been found elsewhere to be large, even when tested against the usual assay, which as Rivot observes is itself open to losses. That the loss of gold by any process involving smelting must be considerable is evident, when we consider that glass will hold a large amount of gold in solution. Thus, calculating from the quantity of gold used to form ruby glass, which is perfectly colourless when first melted, I find that it contains 10.88 oz. of gold per ton, imitation topaz 8.21 oz. of gold per ton, imitation garnet 27.18 and 46.33 ozs. per ton, by two different receipts. The gold is added in the form of purple of Cassius, that is, finely divided metallic gold mixed with oxide of tin; this usually contains 30 per cent. of gold which I

\* Read before the Royal Society of N.S.W., August 1, 1877.

† CHEMICAL NEWS, xxii., 245.

‡ "Watts's Dictionary," Cyanides of Gold.

have taken in calculating the above numbers, or of chloride of gold—an oxidising agent being added at the same time. In smelting operations the ferric oxide would act as an oxidising agent, and when once in solution it seems improbable that any practicable amount of smelting in presence of other metals would reduce and collect all the gold.

Thinking, however, that in spite of these objections a process of smelting was the only one which was likely to be successful, I turned my attention to the removal of the copper, so that I might obtain it separate from the gold and silver. Although many wet extraction processes have been used with success elsewhere, none of them appear to be quite suitable to the circumstances obtaining in these colonies. Perhaps the most successful has been the Longmaids' process as improved by Henderson, and so far as the recovery of gold and silver are concerned by Claudet. Worked in Great Britain, it has rendered available immense quantities of copper ores too poor to be treated by any other method; but there salt costs from 10s. to 15s. per ton, whilst here it is seldom less than £3. Their scrap iron is cheap; here if consumed in any quantity it would be very expensive, whilst inland carriage would immensely add to the cost of both. Again, in Great Britain the sulphur in the ores being used for the manufacture of sulphuric acid, it pays the whole or the greater part of the mining and carriage and the whole cost of the preliminary preparation and roasting, whilst the residual oxide of iron free from copper and sulphur is nearly of the value of hematite for fettling puddling furnaces; here both would be valueless.

With regard to Claudet's process for extracting the small quantity of gold and silver obtained in solution along with the copper by precipitation with iodide of zinc, the very small cost of which (9d. per ton of ore) has been noticed in the report of the Victorian Commission appointed to inquire into the treatment of pyrites, and others, I may note that this is only the *additional* cost of extracting those metals beyond that incurred in extracting the copper. It is only applicable to ores containing minute quantities of gold, and besides it is requisite that the whole of the copper be in solution as cupric chloride, as otherwise cuprous iodide is precipitated. As the formation of cupric chloride involves the use of more salt and its precipitation of more iron than cuprous chloride, the process has been abandoned in many places where tried.

(To be continued)

## PROCEEDINGS OF SOCIETIES.

### PHYSICAL SOCIETY.

December 14, 1878.

Prof. W. G. ADAMS, President, in the Chair.

MR. W. GLEED and Mr. J. G. McGregor were elected Members of the Society.

Prof. GUTHRIE read a note by Mr. C. BOYS "On a Condenser of Variable Capacity." This condenser was designed for use in connection with the Holtz electrical machine to show the effect of condensation on the length of the spark. It consists of a test-tube coated externally with tin-foil to form the inner armature, and a glass tube enclosing the test-tube, and having its outer surface covered with tin-foil for the outer armature. The inner tube can be slid out or in along the length of the external tube, and the capacity thereby varied. Prof. Guthrie showed that a spark from the Holtz machine could by its means be gradually reduced.

Prof. MACDONNELL stated that he had for some years used a similar apparatus, the inner coating, however, being strong sulphuric acid.

Dr. O. J. LODGE exhibited a differential thermometer in which saturated water vapour takes the place of air or other gas. This application is based on the fact that the pressure of a saturated vapour in contact with its liquid depends only on the temperature. An ordinary cryophorus answers the purpose when held so that the water occupies part of one bulb and a part of the stem next it: the greater the length of the water-column in the latter, that is, the more horizontal the cryophorus is held, the greater the sensitiveness of the instrument. When both bulbs are at one temperature the water in tube and bulb is at one level. If now there be a difference of temperature between the two bulbs there will be a difference of pressure in the vapour in their interiors, and the level of the water will change until the pressure is equilibrated. Unlike air-thermometers, the sensitiveness does not depend on the size of the bulbs or tube, and there is no increase of volume of the vapour. Another form consists of a U-tube with bulbs at the end of each arm, each bulb having some liquid, and the bend of the tube containing a short column of it, or, for greater sensitiveness, a series of films across the tube like diaphragms. This thermometer is found to be correct for temperatures below that of the ordinary temperature of the water and vapour, but inexact for high temperatures. With these latter the vapour-tension is not the same throughout the tube, and distillation is set up. The instrument is a much more sensitive thermoscope than the air thermometer, and there is almost no limit to its sensitiveness to low temperatures. The radiation from the hand held 6 inches from it sensibly affects it, as also does the radiation from a piece of ice. For class purposes it is likely to be useful from its simplicity and range of delicacy.

Mr. W. CLARK, Cooper's Hill College, from a series of experiments which he is making on the surface-tension of liquid gases by means of their capillarity, gave the surface-tension of sulphurous anhydride as 2.3 milligrms. per square millimetre at  $-15^{\circ}\text{C}$ .

The meeting then adjourned until January 25, 1879.

## MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 29, 1878.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"Note on certain Thionates," by E. J. BEVAN, Student in the Owens College. Communicated by Professor H. E. ROSCOE, F.R.S., &c.

*Thallium Trithionate.*—When thallium carbonate is treated with an equivalent quantity of trithionic acid, prepared by precipitating potassium trithionate with tartaric acid, and the aqueous solution so obtained evaporated over strong sulphuric acid, thallium trithionate separates out in long colourless needle-shaped crystals isomorphous with those of the corresponding potassium salt. Thallium trithionate decomposes slowly at the ordinary temperature, quickly on heating, and is with difficulty prepared free from sulphate. Analysis showed it to contain 68 per cent of thallium, whereas the formula  $\text{K}_2\text{S}_3\text{O}_6$  requires 67.95 per cent.

*Hypovanadic Dithionate.*—If an aqueous solution of barium dithionate be precipitated with the requisite quantity of hypovanadic sulphate, and the blue filtrate from the barium sulphate concentrated in a vacuum over strong sulphuric acid, crystals of hypovanadic dithionate separate out. If concentration be continued after the first appearance of these crystals decomposition takes place, sulphur dioxide is set free, and hypovanadic sulphate remains. This easy decomposition prevents hypovanadic dithionate being prepared in the pure state.

*Aniline Dithionate.*—This salt is obtained in beautiful

long needles, by the double decomposition of barium dithionate with aniline sulphate. Aniline dithionate is comparatively stable; its aqueous solution may be boiled without decomposition; when the dry salt is cautiously heated in a vacuum tube it sublimes, a portion, however, undergoing decomposition. It is freely soluble in water and alcohol; 100 c.c. of water at 16° dissolve 7.89 grms. of the salt. Its alcoholic solution, treated with sodium amalgam, yields aniline sulphite. Analysis showed this body to contain 18.60 per cent of sulphur, whilst  $(C_6H_3NH_2)_2H_2S_2O_1$  requires 18.40 per cent S.

*"On some Improved Methods of Producing and Regulating Electric Light,"* by Mr. HENRY WILDE.

Among the manifold functions which the elementary substance carbon performs in organic nature, not the least important is that by which it becomes the great source of artificial illumination, whether derived from oils, coal-gas, or from coke rendered incandescent by the action of powerful electric currents. Since the time when Davy first produced the voltaic arc, between two points of wood-charcoal, through which was transmitted the current from the great battery of 2000 plates belonging to the Royal Institution, many experiments have been made to determine the best kinds of carbon for developing the electric light. The carbon which, until recently, was most commonly employed for this purpose is obtained from the sides of gas-retorts, where it accumulates in the form of coke during the destructive distillation of coal. The shells of coke from the retort are sawn up into pencils from one quarter to half an inch square, and from 6 to 9 inches in length. Although very good results are obtained from carbon of this kind, it is a difficult material to work on account of its hardness, and it sometimes contains impurities which interfere with its conductivity. It is also liable to fracture when suddenly heated by the transmission of powerful electric currents. These defects have led to the introduction in electric lighting of artificial carbon, composed of powdered coke and lampblack, formed into a paste with molasses and gum. This material is pressed into cylindrical forms, and subjected for a given time to a high temperature in a special furnace. The manufacture of these carbon pencils has attained great perfection in the hands of Carré, of Paris, and they can be made into perfectly straight and cylindrical forms of from two to sixteen millimetres in diameter and half a metre in length.

When the electric light is to be used for illumination, it is necessary that it should be as continuous as other modes of lighting. For this purpose not only should the current be regular in its action, but the distance between the carbon points must not alter, which necessitates the use of some arrangement for bringing them nearer together in proportion as they are consumed. Much ingenuity has been displayed by electricians in solving this problem, and the automatic contrivances, invented by Staite, Duboscq, Foucault, Serrin, and others, leave little to be desired in regard to the steadiness of the light, when the regulators are in good order and in the hands of intelligent operators. All automatic instruments, however, from the delicacy of their mechanism, are liable to derangement, and their action is not easily understood by persons not having a special knowledge of their construction. To obviate the objection to the use of such instruments by unskilled attendants, I devised, a few years since, a regulator for use on H.M.'s ships of war, to be actuated by hand. In this arrangement the carbons are made to approach and separate from each other by means of a right- and left-handed screw connected with the carbon holders. Each of the screws, with its carbon holder, can be actuated independently of the other, for the purpose of adjusting the points of the carbons to the proper focus of the optical apparatus used in connection with it. The regulator, with its carbon points, is placed in the focus of a dioptric lens, which parallelises the divergent rays of light into a single beam of great intensity. The lens with the regulator is pivoted horizontally and vertically on the

top of a short iron column, fixed on a raised platform above the deck, and the beam of light may be projected upon any distant object within its range. This special application of the electric light, however, as will be seen, requires the frequent adjustment of the carbons by the operator; but as he is always required to be in attendance to manipulate the projector, no inconvenience is experienced through the absence of the automatic arrangement. This method of regulating the electric light has now been in use in the Royal Navy for more than three years, and has proved very satisfactory.

Simultaneously with the progress of improvements in the mechanism for regulating the electric light, experiments have been made with the object of dispensing with the regulator altogether. The most recent, as well as the most successful, of these attempts has been made by M. Jablochhoff, a Russian inventor. In the specification of his letters patent of 1877 he proposes to place the carbons side by side (as had been previously proposed by Werdermann in 1874), and to separate them by an insulating substance to be consumed along with the carbon. The inventor states that the insulating substance for separating the carbons may be kaolin, glass of various kinds, alkaline earths, and silicates, which he prefers to apply in the form of powder rammed into an asbestos cartridge case containing the carbons. A powder which the inventor found serviceable consists of one part lime, four parts sand, and two parts talc. These materials are rammed into the cartridge case surrounding and separating two parallel sticks of carbon placed in the case at a little distance apart. One of the carbons is made thicker than the other to allow for its more rapid waste. The lower ends of the carbons are inserted into pieces of copper tube or other good conductor, separated from one another by asbestos, and the ends of the tubes are pinched between two limbs of a screw-vice, connected respectively to the conducting wires. This combination of carbons and insulating materials the inventor terms an electric candle, which, when mounted on a stand or candlestick, has the appearance of the Roman candle of pyrotechnists. The inventor further states that the heat produced by the electricity fuses the material between the carbons and dissipates it; and the freedom of the passage afforded by the fused material to the electric current permits the subdivision of the light by placing several lamps in the course of one electric circuit. It is also stated that the construction of the candle may be varied; and, among the forms described, is one in which the carbons, instead of being contained in a cartridge case, are separated by a partition of kaolin or other similar insulating material.

I have thought it well to describe, as nearly as possible in the words of the inventor, the electric candle, which is now the subject of so much attention in its application to electric lighting, so that its relation to what follows may be more clearly perceived. A remarkable peculiarity of the direct current in electric lighting is that of its consuming the positive carbon at twice the rate of the negative one; and while the negative carbon is a pointed cone, like that of a pencil, the positive pole takes the form of a hollow cavity or crater.

M. Jablochhoff's early experiments seem to have been made with the direct current, and hence his carbons are described as being of unequal thickness in order that the positive and negative carbons of the candle might be evenly consumed. When the alternating current is used for producing electric light both carbons are of the same thickness, and are consumed at an equal rate, and both points terminate in regular cones. This property of the alternating current, besides other advantages, always maintains the luminous point in the focus of any optical apparatus used in connection with it, that is, when the carbons are placed end to end, as I had occasion to point out in a former paper read before the Society in 1873, "On an Electro-Magnetic Induction Machine for producing Alternating Currents."

M. Jablochhoff, in the course of his experiments, would

appear to have met with some difficulties in adapting the direct or continuous current to a system of lighting with his electric candles, and now uses the alternating current for this purpose. The candle has also been simplified by substituting a slip of plaster of Paris for the cartridge and partition of kaolin formerly employed.

To produce the alternating currents, however, to supply a number of lights, it was found necessary to employ powerful electro-magnetic induction machines, excited by the currents from other smaller machines, according to the principles laid down in my paper read before the Royal Society, and published in the *Philosophical Transactions* of 1867. From sixteen to twenty lights are produced from one of these electro-magnetic machines, each light absorbing about one horse-power.

The system of electric lighting above described would now seem to be definitely established in some places as a substitute for gas, and visitors to the French capital during the present summer will have been struck with the fine effects produced in the avenues and squares where the light is displayed.

My connection with the history of this system of lighting placed me in a position to make some experiments with the Jablochkoff candle, and led to the discovery of the following facts. One of the conditions necessary for producing a constant light from the candle, in its most recent form, was that the quantity and intensity of the alternating current should be such that the carbons consume at a rate of from 4 to 5 inches per hour. If the electric current were too powerful the carbons became unduly heated, and presented additional resistance to the passage of the current; the points at the same time lost their regular conical form. If, on the other hand, the current were too weak, the electric arc played about the points of the carbons in an irregular manner, and the light was easily extinguished by currents of air.

In the course of these experiments I was struck with the apparently insignificant part which the insulating material played in the maintenance of the light between the carbon points; and it occurred to me to try the effect of covering each of the carbons with a thin coating of hydrate of lime, and mounting them parallel to each other in separate holders, and without any insulating material between them. The use of the lime covering was intended to prevent the light from travelling down the contiguous sides of the carbons. On completing the electric circuit the light was maintained between the two points, and the carbons were consumed in the same regular manner as when the insulating material had been placed between them.

Two plain cylindrical rods of carbon three-sixteenths of an inch in diameter, and eight inches long, were now fixed in the holders parallel to each other, and one-eighth of an inch apart. The strength of the alternating current was such that it would fuse an iron wire 0.025 of an inch in diameter and 8 feet in length. On establishing the electric current through the points of the carbons by means of a conducting paste composed of carbon and gum, the light was produced, and the carbons burnt steadily downwards as before.

Four pairs of naked carbons mounted in this manner were next placed in series in the circuit of a four-light machine, and the light was produced from these carbons simultaneously, as when the insulating material was used between them. The light from the naked carbons was also more regular than that from the insulated ones, as the plaster-of-Paris insulation did not always consume at the same rate as the carbons, and thereby obstructed the passage of the current. This was evident from the rosy tinge of the light produced by the volatilisation of the calcium simultaneously with the diminution of the brilliancy of the light from the carbons.

The only function, therefore, which the insulating material performs in the electric candle, as shown by these experiments, is that it conceals the singular and

beautiful property of the alternating current to which I have directed attention.

As I have already said, the strength of the alternating current must bear a proper proportion to the diameter of the carbons used, and when a number of such lights are required to be produced in the same circuit, the quantity and property of the current will remain constant, while the tension will require to be increased with the number of lights.

This simple method of burning the carbons will, I believe, greatly further the development of the electric light, as the carbons can be used of much smaller diameter than has hitherto been possible. They may also be of any desired length, for as they are consumed they may be pushed up through the holders without interrupting the light. One of these developments will be a better method of lighting coal and other mines. In this application the alternating currents or waves from a powerful electro-magnetic induction machine may be used for generating, simultaneously, alternating secondary currents or waves in a number of small induction coils, placed in various parts of the mine. The light may be produced in the secondary circuits from pairs of small carbons enclosed in a glass vessel having a small aperture to permit the expansion of the heated air within. Diaphragms of wire gauze may be placed over the aperture to prevent the access of explosive gas. By generating secondary currents or waves without interrupting the continuity of the primary circuit, the contact breaker is dispensed with, and the subdivision of the light may be carried to a very great extent.

## CORRESPONDENCE.

### HYDROPHOBIA.

To the Editor of the Chemical News.

SIR,—It may interest some of your readers to know that I have discovered an easy, prompt, and very efficient permanent cure for hydrophobia, adapted both to man and animals. I shall be happy to attend to any such cases. Apologising for trespassing on your valuable space,—I am, &c.,

PER DOCTOR S. G.,  
G. R. DE STEFANO, Avocat.

77 and 78, Almerston Buildings,  
Old Broad Street, E.C.

### WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—In connection with the valuable paper on water analysis, by Prof. Tidy, of which an abstract appears in your issue of this week, we wish to call attention to the importance of conducting the determination of organic matter with permanganate solution, in darkness or very subdued light. We have found that in the direct rays of the summer sun a weak solution of potassium permanganate, containing free sulphuric acid, is rapidly decomposed, oxygen is given off in bubbles, the solution loses its pink colour, and a brown deposit of a lower oxide or hydrate of manganese occurs. There can, we think, be little doubt that broad daylight, when possessing any active power—not, perhaps, in mid-winter—would have an appreciable influence upon such attenuated solutions as those produced by adding the standard permanganate to water in the usual manner.

The check experiments with distilled water afford no safeguard against this source of error, since they serve for the valuation of the hyposulphite solution, and are evidently assumed to represent the original titre of the

permanganate. The gradual but steady advance in favour of a form of the permanganate process has special interest for one of us, by whom the use of the original method, at that time recently introduced by the late Prof. Miller, was strongly advocated in your columns nearly twelve years ago (CHEMICAL NEWS, vol. xv., p. 47), an advocacy which subjected its author to some rather rough criticism at the hands of an anonymous correspondent in a later number of the journal.—We are, &c.,

A. H. DOWNES, M.D.,  
THOS. P. BLUNT, M.A.

Shrewsbury, December 16, 1878.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

*Chemiker Zeitung.*

No. 47, 1878.

The Aschaffenburg Paper Company manufacture coloured papers from cellulose which strongly resemble silk in appearance. The mass is dyed to any desired shade, and the paper when made is printed with any desired pattern by means of the cylinder machine. These papers are used for covering paste-board boxes and packing cases, and for wrapping up articles *de luxe*.

Improved cork-borers, designed by Prof. Reimann, are coming into use in Berlin. The sets are accompanied with an instrument for sharpening the cutting edges.

It is rumoured in Paris that carbon, iron, silver, and gold are compound bodies, capable of dissociation at sufficiently elevated temperatures.

In the Caucasus there is now such an excess of naphtha that the proprietors do not know what to do with it.

The manufacture of fish-manure on the Atlantic coasts of the United States is rapidly extending.

Gold has been found in a mass of meteoric iron of Californian origin.

No. 48, November 28, 1878.

Notes on Porcelain Painting.—V. Joclét.—Violet colours are prepared as follows:—A limpid and as near as possible neutral solution of gold in nitro-hydrochloric acid is first obtained. It is diluted with distilled water, and a solution of freshly-prepared stannous chloride of spec. grav. 1.700 is added, with constant stirring, till the liquid takes a deep red-brown colour; a few drops of concentrated sulphuric are then added to precipitate the suspended matter, which is then washed five or six times with fresh spring water (a very fluctuating article!), and is then, whilst still moist, spread with a spatula upon a plate of glass, upon which there has been previously laid a mixture produced by the fusion of 5 per cent red lead with 2 per cent quartz sand and 1 per cent calcined borax. This intimate mixture of gold-precipitate or lead-glass is slowly dried upon the same plate in a moderately warm room, and then finely ground, still upon the plate. The proportion of the lead-glass to the gold only holds good for a certain degree of heat, at which the colour is burnt in upon the ware, and which is near the melting-point of silver. At a lower temperature, dead, brownish colours are produced. If, however, the proportion of lead-glass is greater, a less degree of heat will suffice. The above-mentioned proportions give a reddish-violet. For a blue violet, 0.5 gm. of the gold preparation is mixed with 10.5 of the lead-glass, and treated as above directed. The lead-glass is made with 4 per cent red

lead and  $1\frac{1}{2}$  quartz sand. The colour thus obtained can be used for modifying other blues, but it is unfit for colouring glass.

The rose shades, especially for light grounds upon porcelain, are difficult to prepare and to apply. They can only be laid on very thin, otherwise the gold is apt to separate out in the metallic state, leaving a colourless residue. Dr. Richter gives the following formula for a fine rose shade:—1 gm. gold is dissolved in aqua-regia; at the same time 50 grms. alum are dissolved in 20 litres of spring water, and both liquids are mixed. The whole is then stirred whilst 1.5 grms. stannous chloride at 1.700 sp. gr. are added. The alumina is then precipitated with ammonia, the clear liquid is decanted off, and the precipitate is washed from 7 to 10 times with distilled water, collected on a filter and dried at a gentle heat. The result is mixed with 2.5 grms. carbonate of silver and 70 grms. lead-glass (prepared as for reddish violets) upon a glass plate, dried and rubbed very fine.

Dark purple is prepared like the violets, but a quantity of carbonate of silver is added to the mixture of gold and lead-glass.

For light purples, tin-turnings are dissolved in boiling aqua-regia, and the solution is concentrated in the water-bath. The resulting stannic chloride is then dissolved in a mixture of equal parts of distilled water and stannous chloride, mixed again with water and a clear solution of 0.5 gm. gold in aqua-regia is then added. The whole is then precipitated by the addition of ammonia. If too much of this reagent is used, when a deep red colouration appears, the addition of a few drops of concentrated sulphuric acid is requisite. After washing, the preparation is mixed upon a glass plate with 20 parts of lead-glass, consisting of 3 per cent red lead,  $1\frac{1}{2}$  quartz sand, and 1 per cent anhydrous borax, dried in a moderately warm place, and ground up with 3 grms. carbonate of silver.

Volumetric Determination of Manganese.—Morawski and Stingl base their process on the fact that 4 mols. permanganate oxidise 6 mols. manganous chloride to hydrated peroxide. They convert the manganese into manganous chloride, and titrate with permanganate till a rose colouration sets in.—*Fourn. Prakt. Chemie.*

No. 49, December 5, 1878.

The Question of Incremation Historically Treated.—Dr. B. Kneisel.—The author doubts whether the cremation of the dead has, as is commonly asserted, the advantage of destroying the germs or emanations—be that what they may—by which epidemics are propagated.

In an article on free-trade, the writer complains that German chemists and technologists invited to Russia meet with an endurable treatment only till they have revealed all they know. They are then exposed to every kind of intrigue, and are ultimately dismissed.

Prof. E. von Gorup Besanez died suddenly on the 24th ult.

The Government of Zurich has prohibited the use of all colouring matters containing compounds of lead, arsenic, copper, chrome, zinc, antimony, bismuth, and mercury for colouring and decorating esculents, wearing-apparel, packages for chocolate, coffee, tea, chicory, tobacco, &c., toys, covers, and cushions of children's carriages, carpets, curtains, window-blinds, lamp-screens, wafers, or earthenware table services. Poisonous organic matters, e.g., gamboge, picric and picramic acids, and the aniline and phenol colours, are not to be used in colouring confectionery, wines, liqueurs, and syrups.

Platinum black of excellent quality is obtained by boiling a solution of platonic chloride with salt of Seignette. The deposit is washed and dried at a moderately high temperature.

Gold and palladium are precipitated from their neutral solutions in a finely-divided metallic state by a current of pure coal-gas.

**Reaction of Strychnin.**—Selmi finds that strychnin, moistened with a solution of iodic acid in sulphuric acid, turns yellow, brick-red, and purple. The *Apotheker Zeitung* points out that morphin gives the same colouration with the proposed reagent.

*Reimann's Färber Zeitung,*  
No. 44, 1878.

The "Congress for the Defence of Industrial Property," which met in Paris during the month of September, has for its object to bring about joint action of all governments as regards patents, designs, and trade-marks. It is announced that Switzerland is about to introduce a system of patent-laws, and will consequently be no longer the refuge of infringers.

No. 45, 1878.

In a long article the editor gives his formal adhesion to the protectionist movement.

No. 46, 1878.

This issue contains a continuation of the editor's dissertation on the benefits of protectionism.

*Biedermann's Central-blatt.*  
October, 1878.

**Composition of the Sands and of the Water of some Streams in Vorarlberg.**—Dr. W. Engling.—In these waters the proportions of sulphate of lime and of magnesian salts are very considerably smaller in winter than in summer, whilst the quantity of carbonate of lime is much increased.

**Obtaining Spaces Free from Oxygen.**—Prof. J. W. Gunning.—The author doubts the conclusions of Pasteur that certain low organisms are able to maintain the processes of fermentation and putrefaction in the absence of free oxygen, obtaining their supply of that element from compound organic molecules. He questions if the total absence of oxygen in the receptacles used in experiments has received a satisfactory demonstration.

Soda salt-petre in Holland is very extensively adulterated with kainit.

Heft 11.

**Investigation as to the Influence of the Colour of Soils upon their Temperature.**—Prof. E. Wollny.—From a long series of experiments, the results of which are here tabulated, the author concludes that during the warm season dark soils are on an average hotter than pale soils, both being air-dried. The daily oscillations of temperature are greater the darker the soil. The difference is greatest at the time of the daily maximum soil temperature, but very small at the time of the minimum. The fall of temperature in the night is therefore more rapid in dark than in pale soils, though the former do not actually reach a lower temperature than in the latter. The differences of temperature between dark and pale soils become smaller as the depth increases, and almost vanish during winter and in cloudy weather. If the proportion of humus, however, exceeds a certain limit the influence of colour may be reduced or altogether annulled.

**Excretion of Carbonic Acid through the Skin.**—S. Fubini and J. Ronchi.—The quantity of carbonic acid thrown off by the hand and fore-arm in darkness is to the quantity evolved in the light as 100 : 113. The amount given off rises with the temperature, and is greater during digestion than when the stomach is empty.

**Plants in their Dependence upon Heat.**—Dr. H. Briem.—Plants grow more luxuriantly when their earliest stages of development are accelerated by heat than if they are subject to occasional retardations.

**Occurrence of an Amid of Glutamic Acid in the Sprouts of Pumpkins.**—Prof. E. Schultze and J. Barbieri.—Not suitable for abstraction.

## MISCELLANEOUS.

**Letts's Diaries.**—Messrs. Letts, Son, and Co. have revised their entire series of Diaries, introducing for the year 1879 several new editions, and discontinuing the publication of the least popular of the old editions. The No. 8, or Office Diary, is a very useful one. Messrs. Letts also publish Saxby's "Weather Table Almanack," which gives information on the average height of tides, height of barometer, list of days on which the weather is likely to change, the principal cyclonic periods of 1879, and much other useful information.

### ROYAL INSTITUTION OF GREAT BRITAIN, ALBEMARLE STREET, PICCADILLY, W.

LECTURE ARRANGEMENTS BEFORE EASTER, 1879.

LECTURE HOUR, THREE O'CLOCK.

CHRISTMAS LECTURES.

Professor DEWAR, M.A., F.R.S.—Six Lectures on A Soap Bubble; on Dec. 28 (Saturday), 31, 1878; Jan. 2, 4, 7, 9, 1879.

BEFORE EASTER, 1879.

Professor EDWARD A. SCHAFER, F.R.S., Fullerian Professor of Physiology, R.I.—Twelve Lectures on Animal Development; on Tuesdays, Jan. 14 to April 1.

J. H. GORDON, Esq.—Four Lectures on Electric Induction; on Thursdays, Jan. 16 to Feb. 6.

Professor TYNDALL, D.C.L., F.R.S., &c.—Eight Lectures on Sound, including its Recent Applications and Methods of Reproduction; on Thursdays, Feb. 13 to April 3.

Professor H. G. SEELEY, F.L.S., F.G.S.—Three Lectures on Reptilian Life; on Saturdays, Jan. 18, 25, Feb. 1.

REGINALD W. MACAN, Esq. (Ch. Ch. Oxford).—Four Lectures on Lessing; on Saturdays, Feb. 8 to March 1.

WALTER H. POLLOCK, Esq., M.A.—Two Lectures on Richelieu and Colbert; on Saturdays, March 8, 15.

F. SEYMOUR HADEN, Esq.—Three Lectures on Etching; on Saturdays, March 22 to April 5.

Professor DEWAR will give a Course of Lectures after Easter.

Subscription to all the Courses in the Season, Two Guineas; to a Single Course, according to length, One Guinea or Half-a-Guinea; to the Christmas Course, Children under Sixteen, Half-a-Guinea. Tickets now issued daily.

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THE CHEMICAL NEWS.

VOL. XXXVIII. No. 996.

A REMARKABLE SPECIMEN OF SILICON-IRON.\*

By J. LAWRENCE SMITH, Louisville, Ky.

THE specimen of iron to which I would call attention has been in my possession for two or three years, but it is only recently that I have given it a very thorough examination. My attention was attracted to it by a jeweller to whom it had been sent to ascertain what it was, coming from a lady living not far from my place of residence (Louisville, Ky.), who had picked it up in the field, and had used it for some time as a weight to keep open the door of one of her rooms. And this is all the history I have been able to obtain of its origin.

Upon receiving it I concluded at once that it was a piece of a *fonte*, having the form of the gutters into which the iron is run from the *haut fournaux*, with the raised borders. Its brilliancy and smooth surface especially attracted my attention, and it was very evident that there was something alloyed with it causing this peculiarity. On subjecting it to chemical examination, to my amazement, I found it to resist most every chemical agent except strong fluorhydric acid and fused caustic soda or potash at a red-heat (the fused mass being subsequently soluble in the ordinary acid).† The mass is such as is now presented. It is evidently a piece of a much larger mass. Its form is of the character already specified; colour about that of platinum; sp. gr., 6.50; very brittle, being easily broken with the hammer—it is harder than ordinary *fonte*, and somewhat vesicular in structure; fuses at about the temperature of cast-iron, and if heated a little higher in the air burns brilliantly. 1 grm. in coarse powder was subjected to the following treatment:—

25 c.c. of nitric acid was added to it, and evaporated over a water to dryness, then treated with a little acid and water, and in the solution was found only 0.031 peroxide of iron. The undissolved portion, treated with the same quantity of *aqua regia* over a water-bath, evaporated to dryness, and the residue treated with water, gave 0.377 grm. peroxide of iron. The remaining iron, treated with a second portion of nitric acid, yielded only 0.0005 grm.; then treated a second time with *aqua regia*, gave 0.40 peroxide; then with nitric acid and chlorate of potash with a loss of only 0.00025 grm.; and, lastly, with 5.0 grm. of iodine in water with a little iodide of potassium, it showed a loss represented by 0.001 grm. Thus, after all these repeated treatments with reagents whose action is so marked on iron, the 1 grm. left unattacked 0.715 grm.

One grm. was pulverised finely, and fused with 6 grms. of bisulphate of potash, and after the first cooling a little sulphuric acid added, and the mass re-fused: in this instance 0.620 grm. remained unattacked.

A small lump was placed in bromine in a stoppered bottle, a portion of it being above the surface. It originally weighed 2.765 grms.; and after three months' action it was taken out perfectly bright with an increase of 0.002 milligrm. This minute increase was doubtless produced by the bromine penetrating some of the pores; and finding some little iron that it could combine with. The same experiment was repeated with iodine with the same result.

A piece weighing 4.620 grms. was placed in a bottle with pure chlorine gas, and a few drops of water on the bottom of it. It was left thus three months, and when taken out weighed 4.390, showing a loss of 0.230 grm., equal to about 5 per cent of the original mass. Treated

with fluor-hydric acid, it is dissolved, leaving a residue of 0.601 per cent of scaly graphite; the hydrogen evolved had no odour of hydrocarbon, evincing the absence of combined carbon.

Analyses were made of fragments broken from different parts of the original mass. By pulverising the iron finely and adding 2 parts of caustic soda and 2 parts of carbonate of potash, and fusing it on a gold lined crucible at a red heat, the action is vigorous, inflammable gas bursting through the fused matter. After all action ceased the mass was allowed to cool, and treated with hydrochloric acid, which dissolves completely the contents of the crucible, the little graphite having been oxidised by the fused caustic soda. The analysis is then completed in the ordinary way. The result obtained was—

Iron .. .. .	84.021
Silica .. .. .	15.102
Scaly graphite .. .. .	0.601
Manganese .. .. .	trace

99.723

The difference in composition between the pieces examined was very slight, the silicon varying only one or two tenths of one per cent. The result of my investigation, then, is that this metallic mass is a silicon iron, remarkably rich in silicon, and evidently the product of a blast-furnace.

As regards its source all I can say is in the immediate vicinity of the place where it was found, there is no *haut fournaux*, but not many miles distant there are, and at about 100 miles distance there is a blast-furnace that has furnished iron to commerce containing as much as 8 per cent of silicon, and had to cease working in consequence, at that time there being no use for iron rich in silicon, such iron, in fact, being considered of an inferior quality; and it is barely possible that at some time this furnace may have produced this iron, although I cannot find any history of it, nor any other piece of the same description of metal.

Although I have enquired of a number of workers in iron I have not learnt that any of them has encountered a similar product from the furnaces. I have, however, more recently seen in a collection of meteoric irons a similar mass about the same weight. It is in the collection of Prof. Shepard, at Amherst, and came from the N.W. portion of North Carolina; not being able to account for its origin he attributed it to a meteoric source. As soon as I had completed my examination of the iron just described, I referred to description of the silicon meteoric iron described by Prof. Shepard,\* and at once recognised a parallel to mine, but was more confirmed in this opinion when I subjected some fragments he sent me to the test already described, finding, however, that the silicon in this latter iron run up to 17 per cent, being much higher than it had been made out by Prof. Shepard, or M. Wöhler, who also examined it at the time of its discovery. It resists, in the same way, the action of the strong acids, and of chlorine, iodine, and bromine. From the above examination I expected to find the mass in all respects to be like mine, which was the case when I did see it some months after the examination; its structure being only a little less vesicular, its shape was the same, being that of a fragment of the rough *fonte* from the *haut fournaux*, having two fractured surfaces on the end.

The accidental discovery of these masses of silicon-iron is not without an important significance. For it demonstrates that iron can be produced on a large scale with a percentage of silicon that is very much greater than has been made even in laboratory operations, and fully twice the amount contained in the silicon-ferro-manganese of *Terre-noire*.

If the manganese in any way interferes with the introduction of a larger portion of silicon, it might be prefer-

\* Presented to the Académie des Sciences, December 8, 1878.

† Chlorhydric acid attacks the iron slightly, with the evolution of a little gas.

able to omit the manganese and enrich the iron with silicon. The two alloys (ferro-manganese and silicon-iron) could be then introduced separately in the proper proportion into the melted iron, for the value of silicon during the converting process cannot be too highly appreciated. If at the same time a ferric aluminium alloy could be introduced, we should have a valuable element for the elimination of phosphorus, for the sesquioxide of aluminium once combined with phosphoric acid resists very persistently subsequent decomposition, and in this way the phosphorus would escape with the slag.

A specimen of the above silicon-iron was submitted, at the *Ecole Normale*, to the action of the oxy-hydrocarbon blowpipe. It acted exactly like specimens of silicon-iron, made in that laboratory and experimented with by MM. Troost and Hautefeuille, which iron contained 15 per cent of silicon; when melted on a piece of lime it presented the same appearance as the button of silver in a cupel, there being not the slightest scintillation. A piece of ordinary cast-iron heated along side of this with the same flame melted, and then burnt with the most brilliant scintillation. The largest amount of silicon that was present in richest specimens of iron alloys at the recent French exposition was 10 per cent.

#### NOTE ON THE DETERMINATION OF SPECIFIC GRAVITIES.

By WILLIAM A. TILDEN.

BEING desirous of comparing some results of my own with others that have been published, my attention has been drawn very peremptorily to the inconvenience arising from a want of agreement among chemists as to the meaning of the terms specific gravity, boiling-point, and the like. The entire absence of uniformity in regard to these matters combined with the practice, which seems to be on the increase, of omitting experimental details in the statement of results renders a large amount of otherwise important work entirely valueless. An example or two will make clear my meaning, my remarks applying chiefly to the specific gravities of liquids.

The following appears in a paper by P. and A. Saytzeff in *Liebig's Annalen*, Bd. 193, 363:—

"Weight of water at 0° = 1.0015 gm. Weight of diallyl-propyl-carbinol at 0° = 0.8730; at 20° = 0.8577. Specific gravity of diallyl-propyl-carbinol at 0° = 0.8707; at 20° = 0.8564, compared with water at 0°."

The term specific gravity is here used in a sense which is commonly understood, but which is nevertheless inaccurate. For the term specific gravity, if it means anything, must be defined as the ratio of the mass of a given substance to that of an equal volume of water or some other standard, taken not necessarily at the same temperature but at least at some temperature universally agreed upon. The number 0.8564, given as the specific gravity at 20°, is not the specific gravity, because equal volumes of the liquid and the water were not compared. Doubtless they were weighed in the same vessel, but the water was weighed only at 0°, whilst the liquid was weighed at 20°, and no account is taken of the expansion of the vessel or of the difference of density of water at 0° and 20°. Making allowance for the difference in the capacity of the vessel, the specific gravity referred to water at 0° would be 0.8551 (approximately) instead of 0.8564. In the present case the authors show how the number 0.8564 was arrived at, and no great harm is done. Nevertheless this number will be abstracted into chemical literature as representing the specific gravity.

Again F. V. Spitzer (*Deut. Chem. Ges. Ber.*, xi., 1815) gives the specific gravity of a camphene at 99.84° C. as 0.8345. This is the bare statement, and as it stands it has no meaning. It might have been arrived at by either of the following methods:—

- By weighing both the camphene and the water at the same temperature.
- By weighing the vessel full of camphene at 99.84°, whilst the same vessel full of water was weighed at some other temperature, as 0°, 4°, or 15°.
- By weighing the camphene at 99.84°, ascertaining the weight of water which at 4° fills the vessel, and then calculating the increased capacity of the vessel at 99.84°, and hence the weight of that volume of water assumed to be still at maximum density.
- Or by some other method, not depending upon the filling of a bottle or tube.

Each of these would lead to a different result.

Without information as to which method was adopted the number given for this specific gravity is useless as a character of the substance.

If we adopt strictly the definition of specific gravity already given, the ratio of the weight of a given mass to that of an equal volume of water at 4° taken as unit, or as the quotient obtained by dividing the weight of a given mass by the weight of an equal volume of water at 4°, the necessary calculations become somewhat formidable.\*

It would be useless to expect chemists generally to undertake such labour, and in ordinary cases very little would be gained by it, because the experimental errors would be greater than the corrections. On the other hand, so long as these corrections are ignored, the numbers, including six, five, or even four places of decimals, which are frequently set down with a pretence at extreme accuracy, are to be deprecated as misleading.

To get rid of the anomalies to which I have referred would be easy enough, if in publishing results chemists would in all cases mention the experimental data from which the specific gravity is to be calculated, or at least the method of calculation. And a great deal of trouble in the way of re-calculation would be saved if some uniform procedure were generally adopted. At the present time the very common practice in determining the specific gravity of a liquid is to weigh the liquid and the water successively in the same vessel at the same temperature. This plan recommends itself on the score of simplicity; but it has one disadvantage, viz., that if the specific gravity has been determined at two or more temperatures, the numbers so obtained are not available without correction for the calculation of the co-efficient of expansion of the liquid.

I prefer to proceed thus: Fill the specific gravity bottle or tube with water, carefully adjusting the temperature to 4°; weigh with proper precautions, and record the result once for all. This gives not only the weight of the water at 4°, but the capacity of the vessel in cubic centimetres. From this the capacity at any other temperature can be calculated by the well-known formula—

$$V = v(1 + kt)$$

The co-efficient of expansion of glass,  $k$ , may be taken as 0.000026;  $t$  is the difference of temperature from 4° C.

A table of values can thus be drawn up and kept with the specific gravity bottle. Now, suppose a specific gravity has to be determined at 25°. Fill the vessel at this temperature and weigh. Look to the table and find the capacity of the vessel at 25°. The number of c.c. there recorded represents the number of grms. of water at 4° which would be equal in bulk to the weighed quantity of liquid taken at 25°. Then divide the weight of the liquid by the weight of this quantity of water.

A partial avoidance of the error arising from weighing in air may be accomplished by employing a glass vessel of nearly the same shape and capacity as counterpoise for the vessel in which the liquid is weighed, in place of the usual metallic counterpoise. This has the advantage not only of displacing the same volume of air, but of condensing and retaining the same amount of atmospheric

\* Compare Matthiessen and Hockin, "Laboratory," p. 189.

gases, and so altering in weight at different times to the same extent as the specific gravity bottle.

Another consideration here suggests itself. The so-called empty bottle is really weighed full of air; is it worth while to take this into account? In general, the advantage to be gained is very small, for the density of normal air being only about 0.00129 as compared with water at the same temperature, this correction affects only the fourth figure in the quotient. When this degree of accuracy is required the operator ought not to stop here, but reduce all his apparent weights to their true equivalent *in vacuo*.

Lastly, I may mention that except for rough purposes I have discarded all specific gravity bottles as being completely unmanageable. I have found great advantages in the use of the tube described by Dr. Sprengel a few years ago (*Journ. Chem. Soc.*, [2] xi., 577).

### ON THE PURIFICATION OF CAST-IRON FROM PHOSPHORUS.

By SERGIUS KERN, M.E., St. Petersburg.

MANY readers of this journal certainly remember the able and well illustrated article of Mr. J. E. Stead, "Phosphorus in Cleveland Iron-stone and Iron" (*CHEMICAL NEWS*, vol. xxxviii., pp. 14, 39, and 43). The experiments on the elimination of phosphorus in cast-iron by Mr. Edward Williams, mentioned in this article, were so interesting that they were repeated by the author of this paper, and gave very good results. It will be seen that various pig-irons were used. The process of Mr. Williams is based on the following operation:—

Fluid pig-iron is poured into a crucible containing mill-scale in a fluid state with an addition of pure sand. The quantity of sand used is about 20 per cent. Next, the contents of the crucible are violently shaken for about a quarter of a minute, and after this operation the refined metal is poured into moulds. The sand used during these experiments had the following composition:—

Silica .. .. .	87.90 per cent.
Lime .. .. .	2.52 "
Alumina	} .. .. 4.38 "
Ferrie oxide	
Phosphorus .. .. .	none "
Sulphur .. .. .	trace "
Moisture .. .. .	5.20 "

The scale during the process used had the following average composition:—

Protoxide of iron .. .. .	73.22 per cent.
Peroxide of iron .. .. .	12.98 "
Silica .. .. .	10.13 "
Phosphorus .. .. .	none "
Sulphur .. .. .	0.02 "
Protoxide of manganese	0.48 "
Lime	} .. .. 3.07 "
Magnesia	
Alumina	

The following table shows distinctly the value of this process for the elimination of phosphorus in cast-irons:—

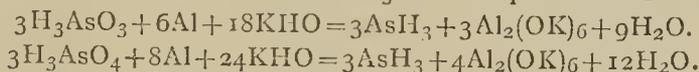
Nos. of Samples of Cast-irons.	Per cent of Phosphorus.	
	In Cast-iron.	In Refined Metal.
1. . . . .	0.94	0.052
2. . . . .	1.03	0.047
3. . . . .	0.54	0.028
4. . . . .	0.67	0.031
5. . . . .	0.43	0.013
6. . . . .	0.12	0.010
7. . . . .	0.75	0.049
8. . . . .	0.68	0.032
9. . . . .	1.25	0.050
10. . . . .	1.05	0.047

The author remarked that in this process much depends upon the temperature of the cast-iron, and the overheating of the metal spoils all the work.

### A NEW TEST FOR ARSENIC.

By OTIS JOHNSON.

PLACE the mixture containing arsenious or arsenic compounds in a Marsh apparatus with a concentrated solution of potassic hydrate and a little aluminum wire. Upon warming,  $AsH_3$  will be evolved, which may be subjected to the usual tests. If, however, the gas blackens argentic nitrate the proof is quite conclusive, since antimony by this process is not converted into  $SbH_3$ . The equations are:—



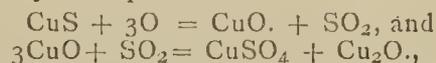
University of Michigan,  
November 30, 1878.

### ON THE METHOD OF EXTRACTING GOLD, SILVER, AND OTHER METALS FROM PYRITES.\*

By W. A. DIXON, F.C.S., Cor. Mem. Nat. Hist. Soc. Glasgow.

(Continued from p. 294).

As the formation of sulphate of copper during the calcination of pyrites is believed to take place in two stages, represented by the equations—



I tried whether the addition of successive portions of raw ore would not gradually convert the greater part of the copper into sulphate during the roasting. After well roasting a quantity of pyrites, I extracted the sulphate formed with water from a sample; this was then dried, and the copper present as oxide was dissolved by dilute hydrochloric acid, and its amount determined. It was found to be equal to 6.54 per cent of copper.

To 700 grains of the remainder (from which the sulphate had not been extracted), I added 40 grs. of fresh pyrites and roasted sweet at a dull red heat in a small muffle, which took about an hour, treated a portion as before, and found the copper present as oxide to be 6.01 per cent. The remainder was again made up to 700 grs. with once-roasted ore, 40 grs. raw pyrites added, and roasted sweet, when other 40 grs. was added and the calcination continued until complete, when the copper present as oxide was found to be 4.79 per cent. The oxide was thus steadily reduced, but the process was evidently too slow to be of use practically.

I then calcined 400 grs. of pyrites, mixed the residue with 200 grs. of raw ore and again calcined, then added 100 grs. of raw ore, and continued the operation until fumes were no longer evolved, when the residue was found to contain 6.46 per cent of copper as oxide. This process was therefore of no value; but I noticed that after each addition of pyrites considerable quantities of white vapours were evolved, and as the ore contained but little arsenic this could only arise from the formation of sulphuric anhydride. I therefore proceeded to determine how much sulphuric acid could be obtained by calcining a mixture of raw pyrites and roasted residue.

A combustion-tube was fitted with a smaller tube leading through water in a Woolfe's bottle, the second neck of which was connected with an aspirator, and mixtures of raw and roasted pyrites were heated to a dull-red in

\* Read before the Royal Society of N.S.W., August 1, 1877.

the combustion-tube, a current of air being maintained through the whole apparatus, and the ore occasionally stirred with a bent wire. In this arrangement, however, I found that a large quantity of the white fumes escaped condensation, and I therefore substituted for the Woolfe's bottle a flask containing a small quantity of water, the exit tube of which was connected with an inverted Liebig's condenser. The water in the flask was kept gently boiling, and I found that by this arrangement the condensation was very good. 100 grs. of raw pyrites containing 37·86 per cent of sulphur, mixed with 50 grs. of the same which had been well roasted and the copper extracted, was thus treated. The residue in the tube was digested with hydrochloric acid, and the sulphuric acid formed determined in one-half of the solution, whilst in the condensed water sulphuric acid was determined in one-fourth:—

$\frac{1}{2}$  of residue gave barium sulphate .. .. . 31·65 grs.  
 $\frac{1}{4}$  of condensed water gave barium sulphate .. 35·82 "

Calculated on the 100 grs. used, this gave—

Sulphuric acid in residue = 8·68 sulphur.  
" " water = 19·86 "

Total .. 28·54 sulphur.

Similarly, 100 grs., with 20 grs. residue gave—

$\frac{1}{2}$  residue, barium sulphate .. .. . 31·69 grs.  
 $\frac{1}{4}$  water " " " .. .. . 34·59 "

Which calculated on 100 grs. used gave—

Sulphuric acid in residue = 8·70 sulphur.  
" " water = 19·0 "

Total .. 27·70 sulphur.

On reducing the roasted ore to 15 grs., a smaller return was obtained; but these results showed that by proper management nearly three-fourths of the sulphur present in the ore could be obtained as sulphuric acid, either in the free state or in combination with copper and iron—this quantity is nearly sufficient to dissolve both the copper and iron, the latter as ferrous sulphate, the theoretical quantity required with the ore operated on being 29·67 per cent of the sulphur converted into sulphuric acid—and opened at once a prospect of the attainment of the desired result.

As it was probable that such a result would not be attained on a large scale, I proceeded to examine the action of aqueous sulphurous acid, and found that by treating ore calcined at a low temperature therewith, a considerable quantity of sulphate of iron was obtained in solution along with the sulphate of copper; also that, as Muspratt had observed, aqueous sulphurous acid readily attacks finely divided metallic iron, forming sulphite and hyposulphite.

The form the process now presented itself in was to calcine the ore at a low temperature and extract the sulphates of copper and iron formed with the mixed sulphurous and sulphuric acids formed during the roasting, then to reduce all the iron to the metallic state and remove it in the same manner, when the gold, silver, antimony, and lead would be left. The only points that remained to be decided were, how to reduce the iron to the metallic state and to obtain the copper from solution.

The reduction of the iron was necessary, because the sulphuric acid obtained would be too dilute to act on the ferric oxide, and the quantity would be insufficient to form ferric sulphate, whilst sulphurous acid has no action on the ferric oxide. I first attempted the reduction of the iron by hydrogen at a faint red heat, which gave the metal in a form very suitable for the action of sulphurous acid. This had to be abandoned, however, on account of the cost and the danger of explosion. Coal-gas reduced the iron readily, but at a low temperature much finely divided carbon was deposited amongst the iron, which rendered wetting it difficult, and the powder was very pyrophoric.

Reduction by finely ground carbon at a low red heat, I found could be so managed as to obtain the iron as a metallic powder which was readily attacked.

For the removal of the copper from solution the use of metallic iron had to be abandoned, on account of the quantity required to precipitate it from its solution as sulphate, which on the large scale is found to be about three times the quantity of the copper precipitated. As it would be advantageous to recover some of the sulphuric acid, the use of sulphuretted hydrogen presented itself, but after repeated trials the exceeding bulk of the precipitate presented an obstacle which on any considerable scale would be insuperable, and has indeed been found to be so where tried.

I therefore determined to try whether it could not be recovered by crystallisation; and the result of many trials showed that by taking a cold saturated solution of sulphate of copper, and, after adding sulphuric acid, saturating it with sulphurous acid, I had a solution which would render all but traces of the copper and sulphate of iron in well-roasted pyrites soluble without dissolving any. In fact it deposited crystals on being mixed with the calcined ore from the sulphates of copper and iron withdrawing crystallisation water. By then washing by displacement with a solution of sulphate of copper saturated in the cold made boiling hot as long as the escaping solution deposited crystals on cooling, the residue was obtained saturated with a solution of sulphate of copper which would not deposit crystals. This solution could be so displaced by water equal to one-half the bulk of the residue as to leave only 0·67 per cent of copper in a soluble form, whilst if an equal bulk of water was used the copper left was only 0·12 per cent. Practically, therefore, it was possible to remove all the copper in such a way as to deposit it in crystals without increasing the bulk of the fluid, so that no evaporation would be required.

The mixed crystals of sulphate of copper and sulphate of iron evolve on calcination large quantities of sulphurous and sulphuric anhydrides, which could be condensed in a solution of sulphate of copper and used to extract a future lot.

I now proceeded to treat twelve pounds of the dressed pyrites of which an analysis is given above. One-half pound at a time was calcined in a muffle having the draft-holes closed with clay, and an iron door fitted at the front. From the back of the muffle an iron pipe led into a small upright leaden tower fitted with movable perforated leaden trays, so that the evolved gases passing over the trays in succession finally escaped to the chimney at the top. On the upper tray water was allowed to drop through a trapped tube, and dripping from tray to tray flowed off through a pipe at the bottom, whilst steam was admitted at the bottom in sufficient quantity to keep the lower half of the tower warm. Half a pound having been calcined, the copper and sulphate of iron was extracted with water containing sulphuric and sulphurous acids, the residue was reduced with carbon at a dull red heat, and the metallic powder being spread on the trays was subjected to the action of the gases from the second half-pound, the residue from which was treated as before, and to the gases from the third and so on, until the whole was operated on. The last half-pound was, after reduction, treated with dilute sulphuric acid, my parcel of ore being exhausted. The whole of the soluble matter was then extracted with water, which reduced it to a small bulk which was almost entirely free from iron, but contained a small quantity of copper as sulphide. It was therefore calcined on an iron tray, and the copper extracted by dilute sulphuric acid. The dried residue weighed 21½ ozs., and being melted with some oxide of iron and a little carbonate of sodium and carbon gave a brittle button weighing 5¼ ozs. To remove the antimony, as being the most convenient for laboratory use, this button was fused with carbonate of sodium and nitrate of potassium, which left a button weighing 3¾ ozs., which was cupelled to ob-

tain the gold and silver. These were parted with nitric acid; the finely-divided gold, folded up in lead foil, was again cupelled, giving a button weighing 37.54 grs. The silver was precipitated as chloride, to which was added a small quantity precipitated from the copper solution, and on fusion with carbonate of sodium gave a button weighing 158.65 grs. The first cupel button was ground up and fused with sodium carbonate and charcoal, when it gave a button of lead weighing 2 ozs.

The mother-liquors from the sulphate of copper crystals were evaporated to dryness (this evaporation was necessary in the experiment, to recover all the copper, but would be unnecessary on the large scale, the mothers being then used again and again indefinitely so long as there was fresh material to be extracted), and the whole of the sulphate was dried. One-half was heated to a full-red heat, to reduce the sulphates to oxides; the other half was heated to a dull red to decompose the sulphate of iron, then mixed with carbon and a little sand and heated to fusion, when the oxides were added and metallic copper obtained, which with a prill obtained on re-fusing the slags weighed 31½ ozs.

With the exception of using extraneous sulphuric and sulphurous acids for the extraction of the copper and sulphate of iron formed during the calcination, the whole process was carried out as nearly as practicable in a laboratory as it would be on a large scale. There are good working methods for smelting out the lead and antimony with the gold and silver, and for separating these metals, which I need not detail. The large quantity of sulphate of iron extracted from the roasted pyrites by the use of sulphurous acid would give on calcination more than enough sulphuric acid to extract the oxide of copper formed. The average quantity of sulphate of iron obtained from this ore was about one-half the weight of the sulphate of copper produced.

To conclude, the yields obtained from 12 lbs., as compared with those shown by analysis and assay, were—

	Analysis.	Yield.
Copper	.. 17.02 per cent.	16.5 per cent.
Lead	.. 2.01 „	1.04 „
Antimony	.. 3.9 „	Not recovered.
Silver	.. 62 ozs. 9 dwts. 18 grs.	61 ozs. 13 dwts. 22.7 grs.
Gold	.. 12 ozs. 10 dwts. 0 grs.	14 ozs. 11 dwts. 23.2 grs.

These numbers are very satisfactory; and, although it is scarcely to be expected that the results would be equally satisfactory working on a large scale, it seems more than probable that returns better than those by any other process would be obtained.

Whilst experimenting on the removal of copper from solution, I found that this could be conveniently done by filtering the slightly acid solution by ground matt obtained from the same ore by simple melting. This method of separating copper from solution may be of advantage in treating poor copper ores or pyrites containing small quantities of copper; but it is obvious that for ores in which gold and silver form an important constituent, it is not so advantageous as the process already described—as, first, the gold and silver, so far as contained in the matt used for precipitating the copper, would remain with that metal, and be lost; secondly, the sulphuric and sulphurous acids, which in the process above described are obtained by calcination of the sulphates of copper and iron, and are available for the extraction of roasted ore, giving with those evolved during the roasting a superabundant supply of acid, would be lost. Neither of these objections would, however, have any force if copper were the only metal to be extracted. The matt obtained by simply melting poor cupreous pyrites, with the addition of sufficient roasted ore to form a flux for the silica present, consists of sulphide of iron containing more or less sulphide of copper; and by filtering through a bed of this matt the solution of sulphate of copper obtained by calcining and extracting a large portion of the ore, the copper is deposited, whilst the iron goes into solution. I

expected to find that the whole of the iron could be thus removed from the matt which would be converted into sulphide of copper, but found that in all cases the action stopped short of this. The percentage of copper in the treated matt varied from 30 per cent to 33 per cent, approaching therefore to copper pyrites, which contains 34.6 per cent of copper. From this residue refined copper could be made in three operations.

This method of treatment, as well as the one above described, for the separation of the various metals, have in common with ordinary copper smelting the advantage that no materials except those yielded by the ore are required, with the exception of fuel, water, and air.

In working ores on the large scale for the recovery of gold and silver by the process, which I have founded on the experiments, of which I have given a brief *résumé*, it is advisable to obtain the sulphides as free as possible from vein stuff before proceeding to the actual treatment. To this end the crushed ore may be washed when any free gold contained in the quartz may be recovered by amalgamation, or in particular cases the ore may be subjected to a preliminary smelting. The method of getting rid of the quartz must depend entirely on the price of labour, fuel, &c., and the composition of the ore. I have found, on the one hand, that nearly all the gold and silver are obtained in a matt if it amounts to from one-half to two-thirds of the original ore, whilst if the matt is smaller both gold and silver are left to a considerable extent in the slags; but there are few ores which would give such a proportion of matt without preliminary dressing. On the other hand, ores containing sulphide of silver lose much of that metal by washing; the sulphide being exceedingly friable, it is carried away in the slimes, which are often richer in silver than the original ore.

(To be continued):

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, December 19, 1878.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed, the following certificates were read for the first time:—E. H. Rennie, A. J. G. Lowe, P. P. Badson, C. F. Cross, C. W. Smith, and A. E. Menke.

The PRESIDENT then called on Mr. FRANCIS JONES to demonstrate some points in connection with the preparation and properties of hydride of boron. Mr. Jones read a paper on this subject at the meeting held on Nov. 21, and an abstract of the paper will be found in our report of that meeting.

The experiments shown by the author consisted of the preparation of some magnesium boride by heating a mixture of magnesium dust and boron trioxid. Some magnesium boride was then treated with hydrochloric acid; the gas which came off burned with a vivid green flame. The flame of a Bunsen burner held above the burning jet was also coloured green. On heating the glass tube through which the gas passed to redness the green colour of the flame disappeared.

Dr. FRANKLAND asked the author if he had endeavoured to purify the gas from the hydrogen which it doubtless contained by absorption with ammonia, &c.

Mr. JONES, in reply, said that from preliminary experiments with the silver compound he thought that there was but little hydrogen present; he was endeavouring to obtain the gas in a perfectly pure state.

Dr. FRANKLAND then took the Chair whilst the PRESIDENT communicated a paper entitled "*Researches on the*

*Action of the Copper-Zinc Couple on Organic Bodies (Part IX., Preparation of Zinc Methyl),* by Dr. GLADSTONE, F.R.S., and Mr. TRIBE. The authors, from theoretical considerations, came to the conclusion that methylic iodide would be slowly acted upon by the copper-zinc couple at ordinary temperature. A number of dry couples prepared from half a metre of zinc-foil (as described in the *Chem. Soc. Journ.*) were placed in small flasks containing 5 c.c. of methyl iodide. The flasks were then well corked, and examined from time to time. The liquid became gradually somewhat yellow and diminished in quantity. Crystalline plates began to appear in about thirty days, until the whole appeared in from thirty to forty days as a uniform crystalline mass. On removing the corks a slight outrush of gas took place. In two instances out of thirty the flasks burst. This the authors attribute to the accidental presence of moisture, but suggest the use of a mercury valve in the cork. The crystalline mass consisted of zinc methiodide, the analogue of Frankland's zinc ethiodide. On distillation, after filling the apparatus with dry hydrogen at 60°, a clear colourless liquid began to come over: in fifteen minutes the distillate ceased. On examination it presented all the properties ascribed by Frankland to zinc methyl. The residue in the flask consisted of zinc iodide. The authors find that both at the ordinary temperature and at the boiling-point the formation of zinc methyl takes place in a rapidly diminishing ratio with regard to time. On doubling the quantity of the zinc-copper couple present, the time required to decompose a given quantity of iodide is twelve times less, and by trebling it thirty-six times less. So that 5 c.c. of methyl iodide can be completely decomposed in one day by trebling the zinc-foil used. By further experiments the authors prove that zinc methiodide is alone formed, and that the methiodide splits up very readily by heat without fusing into zinc iodide and zinc methyl. The methiodide is also decomposed by light. Zinc-foil alone has no action at ordinary temperatures on methyl-iodide. The authors conclude by pointing out the additional proof afforded by these experiments as to the value of the copper-zinc couple in bringing about a chemical change at low temperatures, which can only be brought about by its more positive element at such a temperature and under such conditions as occasion the formation of secondary products. It has also given a perfect and simple method of preparing Frankland's most valuable reagent, zinc-methyl; for in two experiments, the details of which are given, 91.7 and 99.2 per cent of the possible quantities were respectively obtained.

Dr. FRANKLAND said that organic chemists would receive this new method with gratitude. He had already pointed out that large quantities of zinc methyl could not be prepared by substituting copper or iron digesters for the glass tube employed on the small scale, whilst recourse to the dangerous and poisonous mercuric methide was to be avoided if possible. The present plan placed this valuable reagent in the hands of chemists. The yield (99.2 and 91.7 per cent) was exceedingly encouraging. He would like to ask if the method had been tried on the large scale, with half a pound of methylic iodide. He had found that with large quantities of ethylic iodide the yield was not so good as on the small scale.

Dr. GLADSTONE had not tried the reaction with more than 15 c.c. at a time, but saw no reason why the reaction should not succeed on the large scale.

Mr. TRIBE said that the materials should be perfectly dry. He had operated with 115 grms. of the ethylic iodide, and obtained a yield of 88.2 per cent of zinc ethyl.

Dr. GLADSTONE then took the Chair, and called on Dr. Debus to make some remarks on the formula of glyoxylic acid.

Dr. DEBUS commenced by giving a historical sketch of this substance. In 1856 he obtained it amongst the products of the oxidation of alcohol by nitric acid. He gave it the formula  $C_2H_4O_4$ . Afterwards, for various reasons, he considered this formula to be erroneous, and he altered it

to  $C_2H_2O_3(+H_2O)$ . The potassium and sodium salts contain 1 molecule of water, but the ammonium salt is anhydrous. Perkin obtained this acid by boiling silver dibromacetate with water; and in various papers, but specially in one (*Chem. Soc. Journ.*, 1877, II., 96), considers the correct formula to be  $C_2H_4O_4$ , and not  $C_2H_2O_3$ . The ammonium salt, says Perkin, is decomposed by evaporation *in vacuo* into amido-glyoxylic acid and water. This he proves by testing the reaction of the solution of the ammonium salt before and after condensation. Before evaporation it is neutral, after it is distinctly acid, and therefore the salt is decomposed during the evaporation. To this argument Dr. Debus objects. Ammonium oxalate, when evaporated *in vacuo* over sulphuric acid, becomes acid, though perfectly neutral to test-paper before. Again, dilute sulphuric acid, 1 in 40,000, does not give an acid reaction to litmus-paper by daylight (by gaslight the blue turned most distinctly), but if concentrated by evaporation it gives an acid reaction. So that the reaction of a substance in solution depends on the strength of that solution, and (as litmus-paper varies in delicacy) on the litmus-paper. Perkin's observation, therefore, that ammonium glyoxylate solution was neutral before, but acid after evaporation proves nothing. The author has prepared glyoxylate of ammonium, made a solution, tested its reaction, evaporated it, made it up again to the same strength, and found it not to be more acid than at first. Perkin's conclusions as to the decomposition of this ammonium salt rest, therefore, on a sheet of litmus-paper. On the other hand, this ammonium salt is as much an ammonium salt as ammonium chloride. It gives off ammonia by treating it with cold caustic potash. A precipitate is obtained with platinum chloride, &c. Moreover, the body has all the properties of an aldehyd. In conclusion the author stated the arguments derived from the analogy of the substance to aldehyd, and its place in the series of oxidised products, ending in oxalic acid, as the ordinary aldehyd series ends with acetic acid. In a paper he was about to publish he would go still further into the subject.

Dr. FRANKLAND said that Dr. Debus had given a very learned and interesting exposition of the subject, but he ventured to think that the whole point of the question was whether two semi-molecules of hydroxyl could be united to one carbon atom or not. It had struck him that against the solid facts—obtained by Perkin from elaborate quantitative experiments, and from which he came to the conclusion that the formula of glyoxylic acid was  $C_2H_4O_4$ —Dr. Debus had offered nothing but surmises. Dr. Debus had dwelt much on the ammonium salt and the loss of water on evaporation, but in his opinion this was quite beside the question; and apart from the theory that two semi-molecules of hydroxyl could not be united to the same carbon atom, no chemist could come to any other conclusion than that arrived at by Perkin.

Dr. ARMSTRONG apologised for the unavoidable absence of Mr. Perkin. He agreed with Dr. Frankland that the ammonium salt had nothing to do with the point at issue. He thought, too, that there was no force in the argument from analogy of the oxidation products because one term in the reaction was missed out.

Dr. DEBUS, in reply, denied that the theory above referred to by Dr. Frankland had influenced him in changing the formula, and still thought that the question as to whether the ammonium salt was really an ammonium salt or not was of great importance in deciding the true formula of the acid.

The PRESIDENT then called on Mr. T. WILLS to give a short communication "*On the Production of Oxides of Nitrogen by the Electric Arc in Air.*"

In the discussion which followed the reading of a paper by L. T. WRIGHT on November 7, Dr. FRANKLAND remarked that it was most important to ascertain whether at the enormously high temperature of the electric arc an oxidation of nitrogen did or did not take place. The author has made experiments to investigate the subject.

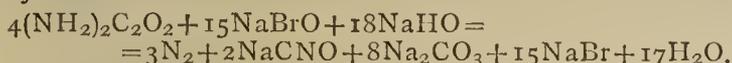
Sixty Grove cells were used; they were placed in another room quite removed from the place in which the experiments were made. The carbon points were placed under an inverted funnel, and the air aspirated through dilute potash; the nitrates, &c., were converted into ammonia with aluminium, &c.; the experiment lasted twenty minutes.  $N_2O_5$  was formed equal to 0.54 grm. per hour. A second experiment gave 0.55 grm. A second set of experiments with more efficient aspiration gave 0.6 and 0.7 grm.

Dr. GLADSTONE observed that the amount of nitric acid formed was very considerable; it was a most important observation, especially at the present time.

Dr. FRANKLAND said that the results had surprised him, especially as he had used the electric light for twenty years by the hour together without observing any corrosion of the brass or delicate clockwork of the lantern; it would be a very serious matter if anything like this quantity of nitric acid was produced, under all circumstances, by the electric light.

Mr. WILLS, in reply, intimated that he was about to continue his experiments, using a Siemens magneto-electrical machine.

The next paper was read by Prof. W. FOSTER "On the Action of Alkaline Hypobromite on Oxamide, Urea, and Potassium Ferrocyanide (Part II.)." When alkaline hypobromite acts on oxamide 75 per cent of the nitrogen is evolved; the suppressed nitrogen remains behind as cyanate—



By quantitative experiments the N evolved, after neutralising with hydrochloric acid in the presence of sodium sulphite, &c., and again treating with alkaline hypobromite, amounted to 7.73 per cent and 7.84 per cent. A similar reaction takes place between urea and hypobromite; 92 per cent of the nitrogen is evolved, and the rest suppressed as cyanate. By quantitative experiments the author obtained 7.5 per cent of the suppressed nitrogen as the amount existing in the urea residue as cyanate. When hypobromite is boiled with potassium ferrocyanide solution a deep red liquid is obtained capable of evolving oxygen. The author states that it has the appearance and leading properties of sodium ferrate. About one-third of the total nitrogen of ferrocyanide is evolved as gas, the remaining portion being oxidised to cyanate. Cyanides also under similar conditions are converted into cyanates. The author has also investigated the action of hypobromite on acetamide and benzamide; he also intends to observe its behaviour with cyanamide if he can obtain some of the latter substance.

The next paper was read by Dr. LETTS "On Two New Hydrocarbons Obtained by the Action of Sodium on Turpentine Hydrochloride." The author gave some account of his research at the meeting of the British Association, 1876. The action of sodium on solid turpentine hydrochloride fused in a flask is violent: on distilling a white solid substance passes over, followed at a much higher temperature by an oily liquid. The solid substance boils at 157° to 158°. 86 grms. of hydrochloride gave 38 grms. solid and 14.5 grms. liquid. To this solid hydrocarbon, after many analyses, purifications, determinations of the hydrogen evolved during the reaction of the sodium on the hydrochloride, vapour density determinations, &c., the author assigns the formula  $C_{10}H_{17}$ . It fuses at 94°. It distils at a constant temperature under diminished pressure. The molecular weight determined from vapour density determinations is 136.4 to 137.0. The body by the action of chlorine gives rise to various substances. Bodies with the formulæ  $C_{10}H_{17}Cl$  and  $C_{10}H_{16}Cl_2$  were obtained. Br has a similar action; but the body  $C_{10}H_{17}Br$  was not isolated. To check his results the author analysed australen and camphen. He concludes that the formula  $C_{10}H_{17}$  is correct, and gives the name turpenyl to the new body. The liquid portion of the distillate boils

at about 321° C. It has the formula of diturpcnyl,  $C_{20}H_{34}$ . The author has also investigated the action of sodium on liquid hydrochloride of turpentine. Solid turpenyl was obtained, and a liquid boiling at 156° having a similar composition.

Dr. ARMSTRONG suggested that the action of sulphuric acid should be tried, for a mixture of hydrocarbons,  $C_{10}H_{16}$  and  $C_{10}H_{18}$ , might crystallise from alcohol unaltered and distil at a constant temperature under diminished pressure.

In consequence of the lateness of the hour the two following papers were taken as read, and the Society adjourned to January 16, 1879.

"On the Formation of Baric Periodate," by S. SUGIURA and C. F. CROSS. In a previous paper the authors showed that by passing iodine vapour and dry air over heated oxide of barium, baric periodate was formed. This substance they find to be identical with that produced when barium iodate is heated, or when the iodide is heated in a current of dry air, in both of which cases baric periodate,  $Ba_5I_2O_{12}$ , is formed. This substance is therefore the most stable combination of the three elements. If barium carbonate be heated with iodine in a tube exhausted of air no combination takes place. On the admission of dry air the formation of periodate at once commences. The formation of periodate is therefore referable not to the direct replacement of oxygen by iodine and the subsequent oxidation of iodide, but to the oxidation of the iodine itself and the subsequent union of the oxidised molecule with barium oxide.

"On Erbium and Yttrium," by T. S. HUMPIDGE and W. BURNEY. This paper, which is dated from Hofwyl, commences with an interesting abstract of the results obtained by various chemists who have investigated the composition of gadolinite with especial reference to the occurrence of the rare metals. The authors instituted the present series of experiments with the special object of isolating the metals, of determining their specific heats, and of discovering a better and more complete method of separation. They were unsuccessful in finding a method superior to the one proposed by Bunsen, which depends on the relative solubilities of the baric nitrates. They also failed to obtain the metals in coherent masses, black powders or small metallic scales being alone obtained. These scales slowly decomposed water at ordinary temperatures; more rapidly on warming. They burned with a brilliant white light in a Bunsen flame. By a long series of crystallisations some erbia was obtained, from which the atomic weight of 171.61 was obtained. No yttria sufficiently pure was obtained to make a similarly accurate determination of its combining weight. At the end of the paper they give two analyses of gadolinite, one from Ytterby containing  $P_2O_5$  1.28 per cent,  $Yt_2O_3$  35.16 per cent,  $Er_2O_3$  4.109 per cent; the other from Hitteroë. The authors are still investigating the subject, and promise another communication.

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## CHEMICAL NOTICES FROM FOREIGN SOURCES.

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

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*Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences.* No. 23, December 2, 1878.

Experimental Researches on Meteoritic Ferrocyanides.—Stanislas Meunier.—Mixtures of iron and nickel chlorides reduced by hydrogen at a red heat yield well-defined alloys, sometimes admirably crystalline, and closely analogous to the meteoritic alloys of iron and nickel.

**Novel Phenomenon of Static Electricity.**—G. Govi.—The author referring to the recent paper of M. Duter declares that it would be needless to enter here into the details of his own earlier experiments, which he, however, immediately proceeds to describe.

**Effects of the Vapour of Carbon Disulphide.**—L. Poincaré.—From numerous and prolonged experiments upon animals the author finds that the structural lesions occasioned by the gradual action of the vapours of this compound are so serious that the use of vulcanised caoutchouc should be restrained to the preparation of articles of real utility.

**Repulsion Resulting from Radiation.**—W. Crookes.

**On Cholalic Acid.**—A. Destrem.—The author has studied the constitution of this acid, obtained by the decomposition of the biliary acids, and has examined some of its derivatives.

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*Biedermann's Central-blatt.*  
Heft 11.

**Emission of Oxygen by Certain Crassulaceæ.**—Prof. A. Mayer.—Leaves of various Crassulaceæ which have been kept in the dark have always an acid reaction, which, on exposure to the sun, passes into neutrality or faint alkalinity. Leaves of these plants possessing a strongly acid reaction yield more oxygen on prolonged insolation than such as have merely a slight acid reaction.

**Agricultural and Chemical Experiments on Various Kinds of Tobacco.**—Dr. Ricciardi, Prof. Cantoni, and E. Rotondi.—Experiments on the effect of different manures and methods of cultivation upon the yield and quality.

**On Starch.**—MM. Musculus and Gruber.—Taken from the *Comptes Rendus*, 1878, pp. 1459 and 1460.

**Value of Different Wheats.**—Prof. Werner.—The nature of this paper can be inferred from its title.

**Reductive Sugar of Commerce with Reference to Polarisation.**—H. Morin.—The author objects to Gunning's suggestion to apply the coefficient 0.38.

**On Steeping Barley.**—O. Ney and Prof. Thausing.—A polemical paper.

**Optical Behaviour of Different Wines, and Recognition of Wines "Gallised" with Grape Sugar.**—Prof. C. Neubauer.—The author bases his process for the recognition of such wines on the fact that they cause the plane of polarised light to deviate to the right, whilst pure natural wine is either optically inactive or occasions a deviation to the left.

**The Use of Ice in the Management of Dairies.**—N. J. Fjord.—The author maintains that the more strongly milk is cooled the greater is the yield of butter.

**French Opinion on Start's Method of Creaming.**—Prof. A. F. Pourian.—The author questions the advantages of the use of ice as above.

**Detection of the Adulterations of Butter.**—The process of Messrs. Angell and Hehner for the detection of extraneous fatty matters has given satisfactory results in the hands of various chemists.

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*Moniteur Scientifique, Quesneville.*  
December, 1878.

**Universal Exhibition of 1878.**—E. and A. Kopp contribute an interesting report on the progress of the arts of dyeing and printing.

**Dyeing at the Exhibition of 1878.**—Marius Moyret.—The author declares that in this department the display has been feeble, containing nothing extraordinary, and being not better but worse than that of 1867. Many of the most important firms have abstained from exhibiting at all, and others have manifested great discretion in not

showing too much. They can only evince greater caution in future by abstaining altogether.

**Singular Method of Stimulating the Vegetation of Seeds which Germinate with Difficulty.**—Weak solutions of caustic potassa or soda are exceedingly efficacious according to Böttger. If a handful of coffee beans are agitated for a few hours with a weak solution of potashlye germination begins often after two or three hours.

**Crystallisations of Metallic Oxides in Glass.**—Dr. P. Ebell.—The combinations of silica with the alkalies, earths, &c., are at their melting-points energetic solvents for metals, oxides, and salts. Substances dissolved in igneous flux take different forms on cooling according to circumstances. If the refrigeration is rapid the solidified body is homogeneous and amorphous; if slow the dissolved substances separate either in an amorphous condition (as copper in hæmatinon), or in the state of crystals (copper in aventurin, alumina, magnetic oxide of iron, chromic oxide, &c.). Ordinary glasses are metallic oxides and salts dissolving in melting silicates and cooled in the state of solution. It is the same with transparent glasses coloured with gold, silver, and copper. Opaque glasses, such as hæmatinon, aventurin (cupric or chromic), mat glass, &c., are products of fusion, in which a precipitation takes place during the act of cooling. The theory that the metals are absorbed as such by melted glass is corroborated by the fact that at such temperatures metals like gold cannot be conceived as existing save in the reguline state.

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*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*

No. 59, November, 1878.

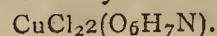
**Report Presented by Th. du Moncel on Edison's Electric Pen.**—This paper is not capable of useful abstraction without the accompanying illustrations.

**Influence of Complementary Colours in Decoration.**—M. Rosenstiehl.—The author considers the following propositions as demonstrated as far as concerns the conditions of the harmony of colours. In mono-chrome decorations, derived from a single pure colour, the gradations of one and the same colour furnish among themselves harmonious arrangements, realising what M. Chevreul calls the "harmony of analogues." When a colouration is derived from two pure colours the most pleasant assortment is that of two complementaries and their derivatives. The resulting harmony is what Chevreul calls the "harmony of contrasts."

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*Bulletin de la Société Chimique de Paris;*  
No. 11, December 5, 1878.

**Action of Benzoic Acid upon Leucin.**—A. Destrem.—By causing these two compounds to act upon each other in sealed tubes at 200° the author obtains leucini-mid and a new substance closely analogous to the superior homologue of hippuric acid.

**Combinations of Certain Metallic Salts with the Compound Ammonias.**—A. Destrem.—The author, on adding phenylamin to an alcoholic solution of cupric chloride, obtains a brown crystalline precipitate,—



This is only one of a series of compounds which he is engaged in examining.

**Transformation of Dibromated Ethylen into an Aceton Containing Four Atoms of Carbon by Means of Hypobromous Acid.**—E. Demole.—When dibromic ethylen is submitted to oxidation there is formed a transitory compound,  $\text{C}_2\text{HBr}$ . At a lower temperature this body is polymerised, taking up  $\text{HBr}$ . At a higher temperature it takes up at once oxygen and bromic hydride, forming bromide of bromacetyl, and in presence of hypo-

bromous acid it yields a secondary hexabromic butylic alcohol.

Action of the Chlor-oxy-carbonate of Ethyl upon Certain Oxygenated Haloidic Derivatives of the Fatty Series.—O'Neill F. Kelly.—A lengthy paper, not capable of useful abstraction.

Note on the Memoirs of M. Lescœur and M. Wolff.—M. Reboul.—The author points out certain errors in the papers in question.

*Gazzetta Chimica Italiana.*

Anno viii., 1878. Fasc. vi. and vii.

Constitution of the Cuminic Compounds, and on Cymen.—E. Paterno.—The author argues for the existence of isopropyl in cuminic compounds.

A Regulator of the Heat of Gas-stoves Used in Chemical Laboratories.—L. Cresti.—Requires the accompanying illustrations.

On Meta-nitro-cinnamic Acid.—R. Schiff.—On treating cinnamic acid with concentrated nitric acid two nitro-cinnamic acids are produced, one of which the author examines.

On Two Mono-bromo-pyromucic Acids.—R. Schiff and G. Tassinari.—An account of the preparation and properties of the ortho- and meta-mono-bromo-pyromucic acids, both of which have the composition  $C_5H_3O_3Br$ .

On Benzylated Cresol.—E. Paterno and G. Mazzara.—This compound is obtained by mixing 50 grms. paracresol with a like weight of benzylic chloride and a little zinc turnings. On heating gently an energetic reaction is set up; hydrochloric acid is abundantly liberated, and a reddish brown liquid is obtained. The product of several such operations, freed from the zinc by decantation, is submitted to a first distillation at the ordinary pressure in a current of carbonic acid to separate it from unchanged chloride of benzyl and cresol. By fractionated distillation  $C_{14}H_{14}O$  is obtained as a transparent liquid of a slightly yellow colour.

Certain Derivatives of Arachic Acid.—G. Tassinari.—The derivatives in question are the arachic-acetic and arachic-valeric acids, both anhydrous, the chloride of arachyl, nitro-arachic and amido-arachic acids.

Certain Derivatives of Santonin.—S. Cannizzaro and L. Valente.—These derivatives are hydrosantonin acid, metasantonin chloride, methylic metasantonate, parasantonide, parasantonin acid, methylic and ethylic parasantonates, and hydrosantonide.

On Two Other Isomers of Santonin.—S. Cannizzaro and Carnelutti.—These compounds are metasantonin, melting at  $160.5^\circ$ , and an isomer which melts at  $136^\circ$ .

Crystalline Form of Certain Derivatives of Santonin.—Giovanni Struver.—Not suitable for abstraction.

Crystallographic and Chemical Notes on Benzylic Santonate and on Tribenzylamin and its Principal Salts.—Dr. R. Panebianco.—This paper, consisting essentially of tables of angles as measured and calculated, is incapable of useful abstraction.

NOTES AND QUERIES.

Sugar Manufacturing.—Will any of your readers inform me which is the best book on sugar and its manufacture from the cane? and also which is the best book on practical chemistry?—Vic. S.

Oils.—Can any of your correspondents inform me of any good treatise on the different kind of oils, and the best way of testing the quality? Any information will be gladly received.—R. J.

Coal-Tar Distillation.—(Reply to R. J.)—I think R. J. will find what he requires in a manualette published by Van Voorst at half-a-crown, entitled "Destructive Distillation," by E. J. Mills. Though a small book, it treats briefly on the whole of the industries interested in destructive distillation, and also gives a few pages of bibliography of the subject. I think it has only been published about twelve months.—W. B. J.

TO CORRESPONDENTS.

ERRATUM.—In the report of the Chemical Society, p. 283, col. 2, line 30 from top, for G. W. Slatter read G. W. Hatler.  
J. F. Armstrong.—Will this correspondent kindly give the information for the benefit of the readers of the readers of the CHEMICAL NEWS.

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An Examination in Practical Chemistry in connection with the Institute of Chemistry will be held during the last week of January next. Examiner, Dr. W. J. Russell, F.R.S. Candidates can obtain further information on application to the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London W.C.

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NOTICE.

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We, the undersigned, Owners of Letters Patent for the manufacture of a new green colouring matter called MALACHITE GREEN, No. 828 of the year 1878, beg to call the attention of the public to the fact that endeavours to infringe our Patent rights have been made by some Continental manufacturers.

In consequence hereof we hereby give notice that proceedings will forthwith be taken by us against any person found to be infringing our said Patent rights, whether by making or by purchasing, selling, or importing or being concerned in importing, or in any way using within the United Kingdom Malachite Green other than that manufactured or imported by us or by our Licensees, Messrs. Meister, Lucius, and Brüning, under our or their respective trade-marks and labels.

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IN the High Court of Justice Chancery Division

Vice-Chancellor Malins at Chambers. In the Matter of the COMPANIES ACTS 1862 and 1867 and in the Matter of the BRIGHTON CO-OPERATIVE STORES LIMITED The CREDITORS of the above-named Company are required on or before the 31st day of January 1879 to send in their names and addresses and the particulars of their debts or claims and the names and addresses of their solicitors (if any) to John Ball Ball of No. 1 Gresham Buildings Basinghall Street in the City of London the Official Liquidator of the said Company and if so required by notice in writing from the said Official Liquidator are by their solicitors to come in and prove their said debts or claims at the Chambers of the Vice-Chancellor Sir Richard Malins at No. 3 Stone Buildings Lincoln's Inn in the county of Middlesex at such time as shall be specified in such notice or in default thereof they will be excluded from the benefit of any distribution made before such debts are proved Tuesday the 11th day of February 1879 at 12 o'clock at noon at the said Chambers is appointed for hearing and adjudicating upon the debts and claims Dated this 19th day of December 1878

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