



XXXIV. Further observations on the ultimate analysis of organic compounds

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proved mode, I will take the following case, as it will serve to contrast the two processes.

We have a mixture of the sulphates of potass and soda whose united weights equal 53; on dissolving them in water and precipitating by chloride of barium, the quantity of sulphuric acid present was found to be 25. Then $53 - 25 = 28$, the weight of the mixed bases. Then letting, as mentioned above,

the weight of sulphate $53 = h; a = 1.84955$ } as before;
 of mixed bases $28 = h'; b = 2.28209$ }
 then

$$(2.28209 \times 28 = 63.89852) = (h' b)$$

$$(63.89852 - 53 = 10.89852) = (h' b - h)$$

$$(2.28209 - 1.84955 = 0.43254) = (a - b)$$

$\left(\frac{h - h' b}{a - b}\right) = \frac{10.89852}{.43254} = 25.19 = x$, quantity of potass and
 $(h' - x) = 28 - 25.19 = y$, quantity of soda.

This mode it is obvious is equally applicable to mixtures of barytes and strontia or lead, lime and magnesia, &c., although it is evident that it will only give exact results when the atomic weights of the mixed bases differ considerably from each other; the greater this difference is, the more exact are the results. Still, however, it is much to be doubted whether the analytic chemist would not prefer the results of experiment to those of calculation, excepting in those cases where the mixed bases, as potass and soda, scarcely admit of quantitative estimation by direct experiment.

22, Wilmington Square, Jan. 3, 1838.

XXXIV. *Further Observations on the ultimate Analysis of Organic Compounds.* By ROBERT RIGG, M.R.I.*

IN my short paper on ultimate analysis which has already appeared in the *Philosophical Magazine*, p. 31, I described the method which I adopt in the examination of solid bodies only; I therefore now propose to submit to the analytical chemist my equally simple method of analysing liquids. Premising that the apparatus of tubes, &c., together with the black oxide of copper, are such as have been heretofore described, I observe, in the first place, that the liquid to be analysed is accurately weighed in a small tube, whose length is from one to two inches, and whose diameter is such that it easily slides within the analysing tube. Round a slender wire

* Communicated by the Author.

from six to eight inches long is folded a little dry amianthus covering about one inch of its length; this amianthus is *then rolled in black oxide of copper*, and is with the wire put into the small tube which contains the liquid to be analysed. The whole is then placed within the analysing tube, which is filled up with black oxide of copper and amianthus, and proceeded with as in the analysis of solids.

The flame of the lamp being first applied to the part of the analysing tube which is most remote from the liquid, the oxide and the wire become ignited in this part; and as they gradually conduct the heat to the other extremity of the tube, the vapour of the liquid is by slow degrees given off, and in its passage through the ignited oxide is decomposed. When the experiment is nearly finished the flame of the lamp is extended to that part of the tube where the liquid under analysis was placed, and thus every portion of the vapour of the compound is brought into contact with the oxide in a state of ignition. This constitutes the analytical process: the methods of measuring and calculating the gaseous products are the same as in the analysis of solids. I may add, that no dependence whatever can be placed upon an experiment wherein the compound under analysis has been subjected to a quick process. It will be superfluous also for me to say, that in the analysis of volatile liquids everything must be refrigerated.

In this way I have analysed æther, alcohol, spirit of different kinds, acetic acid, sap of plants*, the liquid separated by the drying of plants, &c., and the following are among the results which I have obtained.

	Sp. gr. at 60°.	Carbon.	Hydrogen.	Water.	
Æther...	725	66·8	10·9	22·3	100
Do.....	740	64·4	10·5	25·1	100
Do.....	758	61·7	10·1	28·2	100
Alcohol	804	53·6	8·7	37·7	100
Do.....	819	50·6	8·3	41·1	100
Do.....	825	50·0	8·2	41·8	100
Spirit ...	839	46·6	7·6	45·8	100
Do.....	920	27·6	4·5	67·9	100

From these I think we are warranted in drawing the conclusion, that the following will be the constitution of

	Sp. gr. at 60°.	Carbon.	Hydrogen.	Water.	
Æther.....	700	70·6	11·5	17·9	100
Do.	720	67·6	11·1	21·3	100
Alcohol ...	796	55·1	8·9	36·0	100

* On evaporating to dryness the sap of plants at or near the boiling temperature, the dry matter which is left does not contain more than from two to four tenths of the compound of carbon, hydrogen, and nitrogen which the sap at first contained.

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The liquid which I obtained by gentle distillation from the roots of the hyacinth *when young* I found to be constituted as under :*

Carbon	•250
Hydrogen.....	35
Nitrogen	•158
Water	99•557

100•

It had a specific gravity of 1001•6, that of water being 1000. The dry solid matter of the same young roots examined in the mass was constituted of

Carbon	40•8
Hydrogen	1•4
Nitrogen	5•5
Residual	3•5
Water	48•8

100•

Thus showing an excess of hydrogen in these young roots ; but when the plant is full grown, I find the hydrogen predominating in the *spiral vessels only*†.

The valuable suggestions which I have received from the Rev. J. B. Reade of Peckham, have enabled me to prove that which appears to be a principle in vegetable physiology, viz. that the chemical composition of the roots of plants varies with the season and the stage of their growth, and that the constituent parts of the full-grown roots have their own peculiar chemical characters.

In the analysis both of liquids and solids by the method now proposed, it must be observed that the amianthus which is used for condensing the vapour of water condenses also carbonic acid gas, and this too in quantities proportionate to the quantity of water condensed in the amianthus. The quantity of carbonic acid gas so condensed varies also with the mode of conducting the experiment. Every analyst must find out this quantity for himself. By my mode of conducting experiments, the gas which remains in the analysing tube is equal to about $\frac{2}{10}$ of the interstices of the tube which are not filled up. This I ascertain by driving off the condensed water and collecting the gaseous products over mercury in the usual way.

A very satisfactory mode of proving the correctness of the analysis of any compound is to repeat the experiment, and

* My best analysis of this and similar liquids can only be considered as an approximation to their real constitution.

† See page 422 of the last volume of *Phil. Mag.*

suffer the gaseous products to pass off in their moist state, and in calculating the products of the analysis to allow for the increase in volume by moisture.

The results arising from my analysis of alcohol and æther do not favour the view which is very generally taken in the present day of the *vinous fermentation* and its products, to prove the inaccuracy of which, it is only necessary to make experiments and to examine them *in all their parts* with ordinary attention. Indeed the erroneusness of the commonly received theory is evidenced by the combination of carbonic acid gas with vinous liquors, with æther and water, and with alcohol and water, when a compound very different from sugar is the product.

The true theory which appears to run through every part of the composition and decomposition of vegetable matter can only be obtained by continuous and extensive observation. An outline of a part of the necessary course of experiment was laid before the Royal Society about two years ago. It must ever be borne in mind that the entire series of results presents itself in one continued chain, each link holding its necessary position and its just proportion. Isolated experiments, like broken links, lose their value, and bewilder and mislead the inquirer.

Walworth Road, Jan. 13, 1838.

XXXV. *Analysis of some Double Salts of Mercury.* By
R. H. BRETT, Esq., F.L.S., M.R.C.S., &c.*

THE combinations of iodide, bromide, and chloride of potassium with bicyanide of mercury were spoken of in a former paper. The iodo-cyanide of potassium and mercury had been described by Liebig and Dr. Apjohn; the bromo-cyanide of potassium, together with the combinations of the bromides of the other alkaline and earthy metals and bicyanide of mercury, by Caillot in the *Journal de Pharmacie*: the new salt which I then described, and of which I was not able to find any previous mention, was the chloro-cyanide of potassium and mercury. All these salts possess the same crystalline form and atomic constitution: they are therefore isomorphous. The salts about to be described are also isomorphous with those already noticed, and atomically considered differ only from those described by Caillot in the substitution of the elementary atom *chlorine* for *bromine*; they are double salts, in which one

* Communicated by the Author.