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A VIEW OF THE PROGRESS OF DISCOVERY

IN NATURAL PHILOSOPHY, CHEMISTRY, MINERALOGY, GEOLOGY, BOTANY, ZOOLOGY, COMPARATIVE ANATOMY, PRACTICAL MECHANICS, GEOGRAPHY, NAVIGATION, STATISTICS, ANTIQUITIES, AND THE FINE AND USEFUL ARTS.

CONDUCTED BY

DAVID BREWSTER, LL.D.

F.R.S. LOND. SEC. R. S. EDIN. F.S.S.A.

HONORARY MEMBER OF THE ROYAL IRISH ACADEMY; MEMBER OF THE ROYAL SWEDISH ACADEMY OF SCIENCES; AND OF THE ROYAL SOCIETY OF SCIENCES OF DENMARK, &c. &c.

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ment or diminish the amplitude of its excursions, as Bichat had supposed. He supposed, however contrary to the result of experiment, that the tympanum unstretched itself for strong impressions, and stretched itself to receive weak impressions.

3. That the vibrations of that membrane communicate themselves, without any alteration to the labyrinth, by means of the small bones, in the same manner as the vibrations of the upper table of an instrument are communicated to the lower table.

4. That the small bones modify also the excursions of the vibrating parts of the organs contained in the labyrinth.

5. That the cavity of the tympanum (*Caisse du Tambour*) serves probably to keep up near the apertures of the labyrinth, and the internal face of the membrane of the tympanum, an aërial medium, whose physical properties are constant.

ART. XXII.—*Analysis of Euchroite.* By EDWARD TURNER, M. D. F. R. S. E. &c. Lecturer on Chemistry, and Fellow of the Royal College of Physicians, Edinburgh.

A SMALL fragment of the new mineral species, Euchroite,* having been presented to me for analysis by Mr Haidinger, I proceeded to a chemical investigation of it in the following manner.

When heated in a clean glass tube *per se*, its water of crystallization was disengaged, and this occurred at a temperature far short of redness. If the heat is gradually applied, it suffers no decrepitation whatever, retaining its form completely; its brilliant colour, however, is afterwards found to have changed to a dull green, and it crumbles into powder under the gentlest pressure. It undergoes no farther change on glass, its point of perfect fusion being above that of difficultly fusible glass. Urged by the blow-pipe on a piece of clean platinum, without exposure to the reducing flame,

* See Mr Haidinger's Description of Euchroite, p. 133 of the preceding Number.

it fuses completely, and crystallizes on cooling into a greenish brown mass. Heated before the blow-pipe on charcoal, it fuses readily, and at the same moment deflagrates; the odour of arsenic is then also perceptible, and white vapours rise. On continuing the blast, a distinct copper corn is left. If the reduction is performed in a glass tube, both a metallic crust of arsenic and minute crystals of arsenious acid condense on the cold parts of the glass, which are easily and completely driven off by heat.

It dissolves readily in concentrated and diluted nitric acid without effervescence, or formation of nitrous acid fumes, even on the application of heat. The addition of water neither caused precipitation, nor disturbed the transparency of the solution. Ammonia occasioned a greenish blue precipitate, which was wholly redissolved by an excess of the alkali, forming the blue solution characteristic of the peroxide of copper. The nitrate of silver caused no precipitate, nor did the muriatic and sulphuric acids. The absence of iron was proved by the tests of ammonia, ferrocyanate of potash, infusion of galls, and sulpho-cyanic acid. Acetate of lead caused a white precipitate, soluble in an excess of nitric acid. A stream of sulphuretted hydrogen, the sulphuret of copper which first fell being separated, gave rise to the formation of orpiment.

It appears from these observations, that Euchroite contains nothing but arseniate of copper, and water of crystallization. To determine the amount of the latter, 2.995 grains were heated at the flame of a spirit-lamp, in a clean glass tube, till all the water was expelled. The loss amounted to 0.73 grains, or 18.69 per cent. In another experiment, 2.565 grains lost 0.485 of a grain or 18.9 per cent. Taking the mean of these experiments, Euchroite contains 18.8 per cent. of water of crystallization. The water, as it condensed in the cold parts of the tube, was carefully tested by delicate litmus-paper, which was not reddened in the least; and I am satisfied, that all the water can be separated, by heating cautiously, without the loss of any acid.

8.35 grains of the anhydrous mineral were dissolved in dilute nitric acid, and then a concentrated solution of pure

potash, which had been prepared by means of alcohol, was added in such excess as to separate all the arsenic acid from the oxide of copper. After due ebullition and washing, the latter was collected on a filtre, ignited, and weighed. By this process, 4.925 grains of the peroxide of copper were obtained.

The alkaline solution was rendered acidulous by nitric acid, and then evaporated to dryness to obtain a perfectly neutral solution, and to separate a minute quantity of silica which had been dissolved by the potash. The arsenic acid was then precipitated by a neutral solution of the nitrate of lead. This operation was performed at a boiling temperature, and with as slight an excess of the precipitant as possible, to prevent the nitrate from combining with the insoluble arseniate of lead;—an inconvenience complained of by Berzelius in the case of phosphoric acid, and which I have repeatedly felt myself, when precipitating arsenic acid by the acetate of lead. A very pure arseniate of lead was thus procured; but on evaporating the clear solution by a gentle heat to dryness, and re-dissolving the soluble parts, an additional portion of the arseniate was obtained,—showing that all the salt had not fallen in the first instance. The arseniate of lead, after being heated to redness, weighed 9.955 grains, equal to 3.399 grains of arsenic acid, on the assumption that arseniate of lead contains 34.14 per cent. of acid.

The anhydrous Euchroite consists, therefore, of

Peroxide of Copper,	4.925	58.97
Arsenic acid,	3.399	40.7
	8.324	99.67

The crystallised mineral is composed of

Peroxide of Copper,	47.85
Arsenic acid,	33.02
Water,	18.8
	99.67

Did phosphoric acid exist in Euchroite, it would of course be present in the arseniate of lead. On decomposing a por-

tion of that salt by sulphuric acid, and neutralising the clear solution with potash, nitrate of silver was added. The brick-red arseniate of silver subsided without any admixture of the yellow phosphate. Another portion of the arseniate of lead was heated before the blow-pipe, on charcoal. Decomposition readily ensued, with evolution of copious arsenical vapours. Numerous globules of metallic lead were procured, but not the slightest trace of the characteristic phosphuret of lead could be detected. Phosphoric acid cannot, therefore, enter into the composition of Euchroite.

I shall only remark, with respect to the atomic constitution of Euchroite, that the proportion established by analysis is not satisfactory in theory. Supposing an atom of the peroxide of copper to be eighty, and an atom of arsenic acid sixty-two, (the estimate of Dr Thomson,) we shall require almost four per cent. more acid than is given by analysis, to establish a due proportion; and, even then, the water of crystallization would not agree. The proportions of Berzelius are still more discordant. But we are not warranted, I conceive, in assuming, on speculative grounds, so great an error in an analysis, unless it bear internal evidence of inaccuracy. The quantity operated on was, indeed, of necessity, small, and, therefore, the unavoidable errors of analysis would have considerable influence on the result; but as they were rendered trifling by careful manipulation, and the employment of an exceedingly delicate balance, the whole error could hardly amount to one per cent.

It is pleasing to see an analytical result square neatly with the doctrine of proportions; and when it does so happen, it is no small confirmation of the accuracy with which the analyst has operated. So general, indeed, are the laws of combination, that an analysis may sometimes be regarded as incorrect which does not correspond with theoretical considerations. Such an inference, however, is by no means admissible wherever arsenic acid is concerned; for our knowledge of its atomic constitution is far less precise than that of most other substances. To justify this observation, I need only mention, that the two celebrated analysts, Professors Thomson and Berzelius, who are deservedly held as our first authorities on this as on many

subjects, have both abandoned the opinions they formerly maintained, and that the conclusions at which they have eventually arrived are strikingly discrepant.

The Euchroite not only differs in mineralogical characters from the other native arseniates, but is also distinct in chemical composition. The proportion of oxide to acid is very similar to that of Count Bournon's third species, as analysed by Mr Chenevix; * only this mineral appears to contain no water of crystallization. A new analysis of the Cornwall arseniates is at present a desideratum; for, notwithstanding the known accuracy of Mr Chenevix, that chemist seems to have disregarded the probable existence of phosphoric acid in some of his arseniates. As I expect soon to possess, through the kindness of Mr Allan and Mr Haidinger, a whole series of the Cornwall arseniates, I hope in no long time to enter on the investigation of them.

ART. XXIII.—*Description of Fraunhofer's Large Achromatic Telescopes.* With a Plate.

THE great discovery of a method of making flint glass in large pieces, and perfectly pure and free from striæ, which was made by the late M. Guinand, and of which we have given a full account in this number, (see p. 348,) may be considered as forming an era in the history of the achromatic telescope.

By means of this glass, M. Fraunhofer, the director of the Optical Institute or Manufactory at Benedictbauern, near Munich, has constructed achromatic telescopes far superior to any that have hitherto been made; and we can assure our readers, of what many of them will deem incredible, that this eminent artist can now make achromatic object glasses with an aperture of *eighteen inches*. But it is not merely in the optical part of the instrument that M. Fraunhofer has been successful. His various improvements on the apparatus which accompanies the telescope, and his ingenious micrometers for measuring angles of all kinds in the heavens, have received the

* *Phil. Trans.* 1801, p. 199.