

doubt, has assisted in giving currency to the notion that hydrogen is a metal. Except for it, perhaps the crudity, hydrogenium, would not have been inflicted upon us. Of course it has occupied a conspicuous place in chemical literature; scores of papers, and at least two books, have been printed about it. The name ammonium amalgam expresses the supposed constitution of the substance; the radical ammonium is represented as dissolved in or united with mercury. The ammonium is, moreover, conceded to be a solid or a liquid, and to have a truly metallic character. Thus the latest and best authorities present the case. It is described, in nearly all treatises on chemistry, as if its constitution was as certainly ascertained as that of common salt. There have been from the beginning, however, those who doubted the prevailing ideas, and some (see Daniel's "Chemical Philosophy," p. 520, and Dr. Wetherill on Ammonium Amalgam, in *Silliman's Journal*, vol. x., p. 160) boldly objected to them, but the reasons they alleged had not sufficient weight. Ammonium amalgam has always been a pet with chemists; it has always been ready for the service of one theory or another. The ammonium theory, the radical theory, the nitrogen and hydrogenium theories, have each in their turn been of too much importance to permit any of their props to be withdrawn.

The author considers the so-called ammonium amalgam to be a mechanical or physical mixture of liquid mercury with the gases ammonia and hydrogen, and that its semi-solid consistence is due to the mixture having the nature of a froth. When sodium-amalgam is brought into a solution of sal-ammoniac (the ordinary method of preparing ammonium amalgam) the chlorine combines with the sodium, and the residue ($\text{NH}_3 + \text{H}$) of the sal-ammoniac is set free all over the surface of the mercury. The particles of the mixed gases adhere to the mercury, and by reason of the movement bringing to the surface fresh mercury, they become enfilmed and carried inward, until the mixture becomes a homogeneous froth. The principal considerations by which this view of the constitution of ammonium amalgam has been reached, are as follows:—

1. The volume of ammonium amalgam is inexplicable in any other way; it is utterly inconsistent with the well-established laws of combinations by volume. There is no case of a liquid or solid chemical compound, or amalgam, which has any analogy to it.

2. Mercury has a mirror-like surface, while ammonium amalgam has comparatively a whiter and more dead surface; it approaches in appearance to matt silver. Such changes are characteristic of froths.

3. If ammonium amalgam be subjected to varying pressure, its volume changes apparently in accordance with Mariotte's law of gaseous volume. To illustrate this important fact, a glass tube one-third inch in diameter, twenty inches long, and fitted with a plunger, was employed. Mercury containing a little sodium was poured into the tube to one-third of an inch in depth, and upon this was poured a strong solution of chloride of ammonium, occupying about two inches in length of the tube. The ammonium amalgam was completely formed in a few minutes, and occupied several inches of the tube. On adjusting and depressing the plunger, the volume of the amalgam progressively diminished till it closely approached the original volume of the amalgam. Also it was notable that the amalgam progressively gained fluidity and the mirror surface, till at the greatest pressure it appeared like mercury. On withdrawing the pressure the original volume and appearance of the compound were resumed, and on reducing the pressure below that of the air, the amalgam still expanded, until it rose above the surface of the liquid in the tube. If the great pressure be maintained, more ammonium amalgam will be formed, the mass expanding progressively, apparently in accordance with the fact that the absorption or adhesion of gases to liquids is favoured by pressure. By means of the simple apparatus used a pressure of ten atmospheres, or a good vacuum, is easily and at once attainable, and the experiments with it are very striking.

The so-called ammonium amalgam is therefore not an amalgam at all; ammonium is not proved to be a metal, and if it be admitted that the monatomic radical really exists in ammonium amalgam, it is neither a solid nor a liquid, but a gas.

The considerations regarding ammonium amalgam are evidently equally applicable to Loew's hydrogenium amalgam; both are only metallic froths. The expansion of palladium observed by Graham, on its absorption of hydrogen, is probably analogous to the case in question. In both cases the gases concerned are condensed by reason of their attraction to the metal; and if the

molecules of palladium were made free to move, as those of mercury, it is probable that Graham's hydrogenium alloy would become a palladic froth, more remarkable than the corresponding mercuric froth. Many have erroneously supposed that hydrogen was conspicuous in its capability of being absorbed by metals, and thus have more readily been infused with the hydrogenium theory. Oxygen has an eminence over hydrogen in that property, and yet no one has a theory of oxygenium. Iron absorbs carbonic oxide, but no one is bold enough to suggest that carbonic oxide is a metal.

DIARY

THURSDAY, JUNE 16.

ROYAL SOCIETY, at 8.30.—Papers to be read by Dr. Hofmann, F.R.S.; Dr. H. E. Armstrong, Dr. Alex. Rattray, Prof. Macalister, C. Tomlinson, F.R.S., W. Huggins, F.R.S., Sir Edward Sabine, P.R.S., the Earl of Rosse, F.R.S., Dr. Stenhouse, F.R.S., G. Busk, F.R.S., the Hon. J. W. Strutt, Mr. J. Broughton, Mr. A. Le Sueur, and W. H. L. Russell, F.R.S.

ROYAL SOCIETY OF ANTIQUARIES, at 8.30.—On Heydon Church, Yorkshire: Mr. G. E. Street.

LINNEAN SOCIETY, at 8.—On two Species of *Serapias* which occasionally present semi-Jabelliform lateral sepals: Mr. J. T. Moggridge.

CHEMICAL SOCIETY, at 8.

NUMISMATIC SOCIETY, at 7.—Anniversary Meeting.

SUNDAY, JUNE 19.

SUNDAY LECTURE SOCIETY, at 8.—On Volcanoes: Mr. D. Forbes.

MONDAY, JUNE 20.

LONDON INSTITUTION, at 4.—Botany: Prof. Bentley.

TUESDAY, JUNE 21.

STATISTICAL SOCIETY, at 8.—On Free Libraries: Mr. W. E. A. Axon.

ETHNOLOGICAL SOCIETY, at 8.30 (at the Royal United Service Institution, Whitehall Yard).—On the Aymara Indians of Bolivia and Peru: Mr. D. Forbes.

WEDNESDAY, JUNE 22.

GEOLOGICAL SOCIETY, at 8.

THURSDAY, JUNE 23.

ZOOLOGICAL SOCIETY, at 8.30.—On the Walrus: Dr. J. MURIE.—Catalogue of the Mammals of South China and Formosa: Mr. R. SWINHOE.—On a Collection of Birds from the Island of Trinidad: Dr. O. FINSCH.

BOOKS RECEIVED

ENGLISH.—On Diamagnetism and Magne-Crystalline Action: Prof. Tyndall (Longmans and Co.).—Notes on Light: Prof. Tyndall (Longmans and Co.).—Grave-mounds and their Contents: L. Jewitt (Groombridge and Sons).—Gymnastics for Ladies: Madame Brenner.—First Principles of Chemical Philosophy: J. P. Cooke, jun. (Macmillans).

FOREIGN.—(Through Williams and Norgate).—Annales de Chimie et de Physique: Chevreul et Dumas, Tome xx.—Zeitschrift für Ethnologie, 1870, Heft II.—Ueber die Entstehung der Welt: C. S. Cornelius.—Lehrbuch der Chemie: A. Genth.—Histoire des Poissons: Aug. Duméril. Tome II. et Atlas.—Charles Darwin et ses précurseurs français: A. de Quatrefages.

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