



## LI. Some observations on the aqueous solution of carbonate of magnesia with excess of carbonic acid, and on the salt which it affords by spontaneous decomposition

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is of the order  $m^2$ , or at least such portion of it as is supposed to be included in this expression; and as  $\frac{d^2 R}{d e d c}$  and  $\frac{d R}{d c}$  are each of the order  $m^2$ , this term is of the order  $m^6$ , which after a fresh integration remains of the order  $m^4$ .

Hence we may conclude with safety, without having recourse to any peculiar system of constants, or to any precarious induction, that however far the approximation be carried, the variation of the semi-axis major in the Lunar Theory contains no term of long period multiplied by a power of  $m$  inferior to the fourth.

Sept. 21, 1840.

LI. *Some Observations on the aqueous Solution of Carbonate of Magnesia with excess of Carbonic Acid, and on the Salt which it affords by spontaneous Decomposition.* By JOHN DAVY, M.D., F.R.S.\*

I HAVE been induced to institute some experiments on the solution of carbonate of magnesia in water strongly impregnated with carbonic acid gas, in consequence of the high repute, on very questionable grounds, which it has lately acquired as a medicine.

The solution I have used is that prepared and sold by Mr. Dinneford of New Bond-street, with the designation of Dinneford's Solution of Magnesia, and with the following recommendation on the label: "The great advantages of this elegant preparation are, that being in a fluid state and possessing all the properties of magnesia in general use, it is not likely to form dangerous concretions in the bowels; it corrects acidity and heart-burn effectually, without injuring the coats of the stomach, as carbonates of potash and soda are known to do; it prevents the food of infants turning sour, and in all cases it acts as a pleasing aperient, particularly adapted for females."

Such a recommendation I should not have thought it right to notice, were it an ordinary quack eulogy, and unsupported by certificates given by respectable medical men; and moreover were I not assured that great faith is placed by many persons in the asserted virtues of the preparation, and that the use of it is rapidly extending.

The first trials I subjected the medicine to, were made with a view to test the permanence of the solution; as by ex-

\* Communicated by Sir David Brewster.

posure to the air in an open vessel, exposure to a temperature of 100° Fahrenheit, in a vessel loosely corked, and to the action of the air-pump under an exhausted receiver.

The result in each instance was very similar; carbonic acid gas escaped, or was expelled, and a salt was deposited in the form of minute prismatic crystals.

This separation of the magnesia in a solid form, on the disengagement of the excess of carbonic acid, was no more than might have been expected from the known nature of the compound, and the artificial manner in which it is formed by the condensation of the gaseous acid; and must be considered as quite incompatible with the declaration of its "fluid state" in the stomach and bowels, and sufficient ground to call in question the propriety of placing confidence in the preparation as a medicine, in preference to common carbonate of magnesia or calcined magnesia, than either of which it is so much more costly an article.

The prismatic salt deposited on the escape of the excess of carbonic acid, has been examined by several chemists; resting chiefly on the results of the experiments of Berzelius, and the late Dr. Henry, it has been considered as a hydrated carbonate of magnesia, composed of one proportion of magnesia, one of carbonic acid, and three of water.

From the experiments which I have made on it, it appears to be composed as follows; viz.

29·61	Magnesia.
32·22	Carbonic acid.
10·27	Water expelled at 212° Fahrenheit.
27·90	Water expelled by a higher temperature, as by ignition.
<hr/>	
100·00	

or of one proportion and half of magnesia, and carbonic acid, one of water expelled at 212°, and three proportions of water expelled by a higher temperature. Compared with the common carbonate of magnesia, from the results which I have obtained operating on the latter, this appears to differ chiefly from the former in possessing half a proportion more of magnesia, and one proportion less of water, being composed of

41·52	Magnesia.
33·31	Carbonic acid.
17·47	Water expelled at 212°.
7·70	Water expelled at a higher temperature.
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100·00	

These results accord tolerably with those of other inquirers

who have examined this compound; the variation or want of perfect accordance, probably chiefly depends on the degree of dryness of the preparation examined, or on the quantity of water retained in the powder admitting of expulsion at  $212^{\circ}$ , which water being hygrometrical, at least in part, must vary with the degree of dryness of the atmosphere to which it is exposed.

The method by which these two compounds of magnesia and carbonic acid were analysed was a simple one, admitting of considerable accuracy.

The quantity of water expelled at a temperature of  $212^{\circ}$  was determined by exposure of an hour or more to the heat of a steam-bath; the quantity of carbonic acid, by acting on the compounds, very carefully weighed, by muriatic acid, saturated with carbonic acid, over mercury in a graduated tube; and the quantities of magnesia and of water expelled at a higher temperature than  $212^{\circ}$  by the action of a red heat, continued for two or three hours, till no further loss of weight was produced by a continuance of the high temperature. In estimating the proportion of carbonic acid, the calculation was made on the ground that 100 cubic inches of this gas weigh  $47.262$  grains.

A few words relative to the properties of the first-mentioned carbonate. Its tendency to crystallize is remarkable: however obtained, even when rapidly separated by the expulsion of the excess of carbonic acid by heat, it has been deposited in a crystalline form. This form is not obvious to the naked eye; but when the powder is examined by the microscope, each particle is found to be a distinct prismatic crystal. And the persistence of this form is no less remarkable; it is not destroyed by decomposition; the powder after ignition, after the expulsion of the whole of the water and carbonic acid, under the microscope shows no alteration; each particle is still prismatic, and when moistened with water is transparent.

It is asserted that this carbonate readily loses the water with which it is combined. In a dry atmosphere it loses a portion of the water, which perhaps may be considered as hygrometrical, and at the same time loses its transparency; but I find, as has been already remarked, that a temperature of  $212^{\circ}$  expels only one portion, and that a high temperature is requisite to expel the three remaining proportions, and which are probably the strictly chemically combined water.

It is also said that this compound is altered by the action of cold water, and by that of boiling water; that in one

instance a solution of bicarbonate of magnesia is formed, and an insoluble carbonate containing a smaller proportion of carbonic acid; and in the other, that the same insoluble subcarbonate is produced, but without the solution of bicarbonate, the proportion of carbonic acid required for this being expelled in the form of gas. The results of the trials I have made have not confirmed either of these conclusions. It has appeared to me to dissolve both in hot and in cold water, without undergoing any decomposition. I have not been able to obtain an insoluble subcarbonate of magnesia by acting on the prismatic salt by cold water, or carbonic acid gas from it by boiling water,—for instance, boiling it in distilled water in a retort connected with a mercurial pneumatic apparatus. It is true, that when this carbonate is thrown into hot water, there is a disengagement of air, but the air is common air mechanically entangled, not carbonic acid gas which had been chemically combined.

Both the hot solution and the cold, on evaporation, yielded the prismatic compound. 1000 grains of water at the temperature of 60° appear capable of holding in solution about four grains; thus 326·6 grains of the solution of carbonate, after the excess of carbonic acid gas had been expelled by the air-pump, afforded on spontaneous evaporation 1·5 grain of crystalline salt.

Whether this slight degree of solubility can be useful, considering the qualities of the compound as a medicine, or whether the crystalline spicular prismatic form which it assumes on separation of the excess of carbonic acid by which the carbonate was brought into solution can be injurious to the coats of the stomach, as a mechanical irritant, it is far from easy to determine; the probability is, reasoning analogically, that neither the one nor the other circumstance, medicinally considered, is of much consequence.

Fort Pitt, Chatham, Oct. 1, 1840.

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LII. *An Abstract of Professor Daniell's Papers on the Electrolysis of Secondary Compounds, in the Philosophical Transactions for 1839 and 1840.*

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IT has been long known that when a saline solution is subjected to the action of a galvanic current, both the water and the salt that it contains are resolved into their constituents; oxygen and the acid being evolved at the zincode, whilst hydrogen and the base appear at the platinode. The primary object of these researches was the determination of the relative proportions of these decompositions, and their relation