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NOTES ON DAWSONITE, A NEW CARBONATE.

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In the present paper I wish to describe a new mineral, which on account of its peculiar composition seems to be of more than ordinary interest.

In 1862 Messrs. J. H. and G. Gladstone described, under the name of Hovite, a mineral which they suggested might be regarded as a double carbonate of *alumina* and lime.* On the ground, however, of a carbonate in which alumina or sesquioxide of iron enters being unknown to chemistry, and from the fact that the so-called Hovite occurs mixed with Collyrite, a hydrous silicate of alumina, Dana regards the alumina as belonging wholly to the admixed material, and considers the lime to be present in the state of *bicarbonate*. With regard to it he says: "Although the bicarbonate referred to is known only in solution, the most likely condition for finding it in the mineral kingdom is in one of the hydrous silicates of alumina, like collyrite, in which there is present much water, loosely held; the mineral therefore is most probably a carbonate of the formula above given ($\frac{1}{2}CaO + \frac{1}{2}HO$) $CO_2 + aq$; especially since a carbonate in which Al_2O_3 or Fe_2O_3 enters is, as the authors (the Messrs. Gladstone) admit, yet unknown to chemistry."

Now although the formation in the laboratory of a carbonate

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* Phil. Mag., IV. xxiii. 462, 1862.

† Mineralogy, 5th ed. p. 709.

of alumina has been denied by some chemists, we find Fresenius stating that* "carbonates of the alkalies throw down from solutions of alumina basic carbonate of alumina." Watts in his Dictionary of Chemistry writes carbonate of alumina with a query after it, and Valentin, of the Royal College of Chemistry, says that carbonate of soda, or carbonate of ammonia, precipitates from solutions of alumina "basic carbonate of uncertain composition."† Langlois, Wallace, and Muspratt have all regarded the precipitate formed by alkaline carbonates as consisting of hydrated carbonate of alumina, but each of them has assigned to it a different formula. H. Rose, on the other hand, states that the precipitate formed by carbonate of ammonia is a compound of trihydrate of alumina with carbonate of ammonia.‡ We cannot then, I think, confidently assert that a carbonate into which alumina enters is unknown to chemistry, but simply that it is one of those points upon which "doctors differ." I refer to it here, because it has a certain bearing upon the mineral which is the subject of this paper.

This mineral is a carbonate, the principal bases in which are alumina, lime, and soda; the carbonic acid being considerably in excess of the amount required to form neutral carbonates with the bases other than alumina. It occurs in the joints of a trachytic dyke near the western end of McGill College, and having been first collected by Principal Dawson, has, in honour of him, been called Dawsonite.

The rock constituting the dyke was examined by Dr. Hunt some years ago; but no special analysis of the Dawsonite was made, as sufficient material could not then be obtained. As the composition of the dyke is of interest in connection with that of the material filling its joints, I give Dr. Hunt's description and analyses. He says§: "The rock is divided by joints into irregular fragments, whose surfaces are often coated with thin bladed crystals of an aluminous mineral, apparently zeolitic. Small brilliant crystals of cubic iron pyrites, often highly modified, are disseminated through the mass. The rock has the hardness of feldspar, and a specific gravity of from 2.617 to

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* Man. Qual. Chem. Anal. ed. by S. W. Johnson, M.A., p. 111. New York, 1869.

† Text Book of Practical Chemistry. London, 1871 p. 175.

‡ Watt's Dict. of Chem. vol. I, p. 779.

§ Geology of Canada, 1863, pp. 659, 669.

2.632. It has a feebly shining lustre, and is slightly translucent on the edges, with a compact or finely granular texture, and an uneven sub-conchoidal fracture. Before the blow-pipe it fuses, with intumescence, into a white enamel. The rock in powder is attacked even by acetic acid, which removes 0.8 per cent. of carbonate of lime, besides 1.5 per cent. of alumina and oxyd of iron; the latter apparently derived from a carbonate. Nitric acid dissolves a little more lime, oxydises the pyrites, and takes up, besides alumina and alkalies, a considerable portion of manganese. This apparently exists in the form of sulphuret, since, while it is soluble in dilute nitric acid, the white portions of the rock afford no trace of manganese before the blow-pipe; although minute dark-colored grains, associated with the pyrites, were found to give an intense manganese reaction. From the residue after the action of the nitric acid, a solution of carbonate of soda removed a portion of silica; and the remainder, dried at 300°F. was free from iron and from manganese."

No. I. is Dr. Hunt's analysis of the portion insoluble in nitric acid; No. II. that of the matters dissolved by nitric acid from 100 parts of the rock:—

	I.		II.
Silica	63.25	....	1.43
Alumina....................	22.12	....	2.43
Peroxyd of iron............	....	....	2.40
Red oxyd of manganese...	....	....	1.31
Lime	0.56	....	0.60
Potash	5.92	....	0.40
Soda....................	6.29	....	0.98
Volatile....................	0.93	....	....
	99.07		

The bladed, aluminous mineral alluded to by Dr. Hunt is the Dawsonite of this paper, and will now be described.

Physical Characters.—Hardness 3. Specific gravity 2.40. Lustre vitreous. Colour white. Transparent—translucent.

As mentioned above, it is bladed, but the blades show a somewhat fibrous structure, which is best seen when fragments are examined under the microscope. With polarized light it exhibits beautiful bands of brilliant colours. As regards its crystalline form I am uncertain, though it is probably monoclinic, with the inclination of the principal axis about 75°.

Chemical and Blowpipe Characters.—Before the blowpipe colours the flame intensely yellow, becomes opaque, and often exfoliates or swells up into cauliflower-like forms. After ignition in the forceps, or in the closed tube, gives a strong alkaline reaction. Fragments which have not been ignited, when placed upon a piece of moistened turmeric paper, shew no alkaline reaction; but if the finely pulverised mineral is treated with water, the water is rendered slightly alkaline. In the closed tube gives off water and carbonic acid. With nitrate of cobalt gives a fine blue colour (alumina.) With hydrochloric or nitric acid dissolves in the cold completely, with evolution of carbonic acid; and this even when the mineral is in fragments and the acid exceedingly dilute. Addition of ammonia to the solution gives a copious precipitate of alumina. Acetic acid decomposes it, but does not appear to dissolve it completely; the solution, however, gives an abundant precipitate of alumina with ammonia.

Through the kindness of Dr. Dawson I have been enabled to obtain sufficient material for two analyses. The first was made some months ago, but so strange did the results appear, that I was unwilling to publish them before making a second analysis, in order to ascertain whether the mineral was at all constant in composition.

The first analysis gave me the following results:

	I.
Carbonic acid	29.88
Alumina*	32.84
Lime	5.95
Magnesia	traces.
Soda	20.20
Potash	0.38
Water	11.91
Silica	0.40
	101.56

The carbonic acid was determined with an ordinary single flask apparatus, and the water with a small chloride of calcium tube. Together they equal 41.79 per cent. Direct ignition of a separate portion of the mineral in a covered crucible gave a loss of 41.16 per cent.

For the second analysis, the material was obtained from at least twenty different specimens, and considering that the amount employed was small, the results are sufficiently close to those of

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* With traces of peroxide of iron.

No. I. to warrant the conclusion that the mineral is constant in composition. They are as follows:

II.

Carbonic acid	30.72
Alumina with traces of Fe_2O_3	32.68
Lime	5.65
Magnesia	0.45
Soda	20.17
Water	[10.32]
	100.00

In this analysis the total alkaline chlorides are calculated as soda, the amount of potash not having been determined.

In No. 1 the excess of carbonic acid above that required to form neutral carbonates with the bases other than alumina is 10.69; while in II. it is 11.46. This excess must either be in combination with the alumina, or else must go towards forming bicarbonates with a portion of the protoxide bases. If the alumina is not present as carbonate, we might then suppose it to exist as hydrate. There is, however, not sufficient water to form trihydrate, the compound known in nature as Gibbsite, and too much to form the monohydrate or diaspore. Native trihydrate, moreover, is only soluble in acids with difficulty, and diaspore is insoluble, unless after ignition.

The amount of water is about that which would be required to form dihydrate,—a hydrate which, as prepared in the laboratory, is soluble in acetic acid, though insoluble in the stronger acids. But hydrochloric, or nitric acid, readily dissolves all the alumina in the Dawsonite.

The crystalline character of the mineral, and the uniformity of its optical and chemical characters, forbid its being regarded as a mechanical mixture; and, for the present, we can only say that it may be a hydrous carbonate of alumina, lime and soda, or perhaps a compound consisting of a hydrate of alumina combined with carbonates of lime and soda.*

If we adopt the former view, and consider that alumina may exist in combination with carbonic acid, we need no longer consider Hovite as a bicarbonate of lime, but may adopt the suggestion of the Messrs. Gladstone, that it is a double carbonate of alumina and lime.

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* There is nearly enough carbonic acid to form neutral carbonate with the lime, and bicarbonate with the soda.