XI.—*On Mordenite, a New Mineral from the Trap of Nova Scotia.*

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The first known investigators of the mineralogy of Nova Scotia, Jackson and Alger, and Gesner, passing under the trap cliffs of the bay of Fundy, obtained such rich harvests of fine specimens of zeolitic and quartz minerals, that many a follower has trodden

* Ann. Ch. Pharm. xcv., 12. † Ibid, p. 17. ‡ Ibid, p. 17.

in their footsteps in hopes of like success. Whatever the relative good fortune in these cases, there is no doubt that year after year large quantities of beautiful objects have long been and are still carried away, to the enrichment of cabinets in different parts of the world. Beauty has been, no doubt, the desirable thing on most occasions, so that the chief attention of collectors has been given to such minerals (besides the quartz species) as stilbite, heulandite, analcime, apophyllite, and chabazite (especially in its often exquisitely red and pink-tinted variety, acadiolite, peculiar to this region), all of which certainly offer great attractions. Not only are these species attractive, but they present very decided differences in physical characters, so that they can be readily distinguished: whence it results that they have been long known and well described, as compared with another section of the zeolites, the fibrous species, which exhibit far less alluring forms, and resemble each other rather too closely for the unpractised eye to discern the differences which actually exist among them.

A few years ago these fibrous zeolites were all called here either Thomsonite or Needlestone. I showed* first (in 1858) that mesolite is an abundant mineral in Nova Scotia trap, and that it is often associated with faroëlite, another fibrous mineral. The former, I imagine, is what passed for thomsonite, which species has probably not yet been found here. I have never met with it, and Mr. Marsh, of Yale College, U.S., who has on several occasions collected largely in various localities, states† that he has never found it, and he "considers it doubtful if this species has yet been discovered in this region." The name needlestone I take to have been given to natrolite, which is the other form in which the old "mesotype" is here represented. As minerals of this district, which were probably confounded with mesolite and faroëlite and misnamed along with them, I may mention the radiated lamellar gyrolite of Anderson, which I detected‡ in apophyllite, and the centrallasite of like structure, which I described§ as a new species a few years ago.

The subject of my present paper affords further proof that the fibrous zeolites occurring in Nova Scotia are more numerous than they were thought to be, for I shall show that it is different from any species yet described. The mineral I first met with in 1858, some two or three miles east of Morden or French Cross, a small village

* Silliman's Journal [2], xxvi, 31.
† *Ibid.* Jan. 1863.
‡ Edin. New Phil. Journal, 1861.
§ *Ibid.* x, 84.

in King's county, on the shore of the bay of Fundy. It has, I have little doubt, been often found and rejected as a worthless incumbrance to the collector, on account of its wanting these marked features of lustre and colour displayed in large, or at least well-defined crystals, which are so generally the exclusive objects of his search. It occurs in rather small masses, varying from the size of a pigeon's to that of a bantam's egg, in the form of somewhat cylindrical, reniform, or flattened geodes and solid concretions, rather smooth externally, sometimes coated with a thin, yellowish crust, blotched with a green mineral, probably a silicate of iron, and sometimes exposing its own white, yellowish, or pinkish-coloured surface; often a small portion of the latter only is visible. It is hard enough to resist the weather better than the trap in which it is imbedded, so that it sometimes protrudes on old faces of rock, and is easily detached from its matrix with the chisel. Its interior often presents scarcely any appearance of crystalline structure, on the hurried glance generally taken on first exposing a fracture in collecting, as regards mordenite itself; and when other minerals are associated with it, these are, from the compactness of the geodes, in small or indistinct crystals. Even in the most compact specimens, however, a fibrous structure is seen on close examination, while in some cases this is so distinct that the mineral has probably been considered a compact variety of "thomsonite." To my eye, tolerably accustomed to the various forms of fibrous minerals met with in Nova Scotia trap, on some of which I had been working when I began to study it, the mineral looked unfamiliar in its general assemblage of characters; and I found on analysis that it differed essentially from any described species in the relative proportions of its elements, which are those of zeolites. This conclusion was arrived at from the examination of various specimens, in some of which it occurred with other minerals. Its associations are interesting, and afford material evidence as to its distinct nature. It is met with alone in solid concretions, also overlying a mineral in small, pale green, hemispherical, transluscent masses, looking like prehnite, but not agreeing in chemical characters with that species, so far as I could make out on the small amount of substance at my disposal; it occurs also underlying barytes, forming with it a solid mass, the heavy-spar occupying the entire centre; it also underlies apophyllite, which, in small well-defined crystals, lines the centre of a nearly solid geode. These charac-

ters were observed in the specimens from Morden, which served for analysis. Last summer I met with what I have no doubt is the same species at Peter's Point, or Margaretville, about eight miles to the west of Morden, occurring in several cases *per se*, and with flesh-coloured gyrolite in two specimens, one of which has but few of the small spherical concretions (about one-eighth of an inch in diameter) made up of the pearly plates characteristic of the latter species, while the other is thickly covered with them. It was in this neighbourhood that I detected gyrolite as a Nova Scotian mineral, in association with apophyllite, as described in the paper previously referred to.

Mordenite is a fibrous mineral, occurring in small concretions or geodes, as above described, of white, yellowish, or pinkish colour, and highly silky lustre, weathering dull; it cleaves readily in directions parallel with the fibres, is translucent on the edges; its hardness is a little above 5; it is rather brittle; its specific gravity is 2·08; before the blowpipe it fuses in a good heat without any inturmescence to a glassy bead; does not gelatinize, but affords slimy silica with hydrochloric acid.

In the following analyses, the mineral, not being perfectly decomposed by acids, was ignited for water, and the residue fused with carbonated alkali for the general analysis; the alkalies were extracted by acid in separate portions when determined; water was expelled with difficulty; the results are on substance dried over sulphuric acid.

	I.	II.	III.		IV.
Potassa.....	0·09	0·23			
Soda.....	2·25	2·34	2·53[b]	2·71[c]	1·92[c]
Lime.....	3·94	3·21	3·15	3·40	3·61
Alumina[a]	13·28	12·55	13·07	12·47	12·47
Silica.....	67·33	68·85	68·63	67·92	69·27
Water	12·88	13·32	12·70	13·50	12·73
	99·77	100·50	100·08	100·00	100·00

[a] With a very little Fe_2O_3. [b] KO not separated. [c] By loss.

Analysis I was on the mineral occurring alone; II, on the mineral with that resembling prehnite; III, on the mineral underlying apophyllite; in the second experiment the silica was proved to leave but a minute residue when boiled with carbonate of soda, consisting possibly of lime from the filter; IV was on the

mineral with barytes; in this case the silica obtained, on being re-fused with carbonate of soda, gave a mass soluble in water, showing the mineral analysed to be free from heavy-spar.

The analytical numbers are sufficiently concordant to show constant composition in the different specimens, and the mean of them, with the oxygen of the constituents, is this,

	Mean.		Oxygen.
Soda	2·35	=	·606
Lime	3·46	=	·988
Alumina.....	12·77	=	5·977
Silica	68·40	=	36·238
Water.....	13·02	=	11·572
	100·00		

The oxygen ratio for $RO.R_2O_3.SiO_3.HO$ is nearly 2 : 6 : 36 : 12, and taking (the half of) this as existing in the pure mineral, we arrive at the following simple formula expressive of the compositions of mordenite:—

$$RO.3SiO_3 + R_2O_3.3SiO_3 + 6HO;$$

and if $RO = \frac{1}{3}\,NaO + \frac{2}{3}\,CaO$, we get the following percentages:—

$\frac{1}{3}NaO$	=	10·33.....	2·54
$\frac{2}{3}CaO$	=	18·66.....	4·59
Al_2O_3	=	51·40.....	12·66
$6SiO_3$	=	271·80.....	66·92
$6HO$	=	54·00.....	13·29
		406·19	100·00

showing a good general agreement with the results of the various analyses of the mineral occurring alone and in three distinct associations. It follows then that mordenite has the characters of a definite species; and, on comparing it with minerals containing the same elements, it is found to be nearest to heulandite in chemical composition. The formula of this mineral* is $CaO.SiO_3 + Al_2O_3.3SiO_3 + 5HO$, requiring 9·2 per cent. lime, 16·8 alumina, 59·3 silica, and 14·7 water, the silica being higher than in any other zeolite; but it is much lower than in the subject of this paper, so that mordenite stands out as the most highly silicated of the aluminous non-magnesian hydrous silicates yet described.

* Damour, *Dana's Mineralogy* ii, 330.