BERYLLONITE AND OTHER PHOSPHATES FROM NEWRY, MAINE

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The Dunton tourmaline mine in the town of Newry, Maine, was operated about twenty years ago in a search for gem tourmaline. The locality is described briefly by Bastin[1] and was widely known because of the large tourmalines found there with green center and pink border zone, tightly frozen in the pegmatite ledge-matter. Little gem tourmaline was found and the mine was soon abandoned.

This ledge and others near it was reopened in the summers of 1926 and 1927 under the superintendence of W. D. Nevel of Andover, Maine, in search for pollucite in commercial quantities.[2] The search was successful but mining has now ceased. Mr. Nevel saved with great care all unusual minerals found in opening these ledges and from him a very full suite has been secured for the Harvard Mineralogical Museum. On a later occasion it is hoped to give a full account of the paragenesis of this lithium pegmatite. In this paper it is intended to describe only three rare phosphates found there of which analyses have been made for the author by Dr. E. V. Shannon.

BERYLLONITE. Beryllonite was first described by E. S. Dana and H. L. Wells[3] from Stoneham, Maine. Their material consisted of isolated crystals found by Sumner Andrews in the talus slope of a cliff together with other typical pegmatite minerals. Only one or two specimens showed the new mineral attached to any other substance and one of these, a smoky quartz crystal with a beryllonite crystal partly imbedded in it, is in the Harvard Mineralogical Museum. This ledge was never found in place and the whole pegmatite body appeared to have been undermined and disintegrated during the erosion of the valley. No other occurrence of this mineral has since been found. It was therefore with peculiar interest that the author, assisted by the optical data obtained by Mr. Berman, recognized beryllonite among some specimens sent in by Mr. Nevel for identification. A large suite of specimens has

[1] Geology of the Pegmatites and Associated Rock of Maine, *U. S. Geological Survey, Bull.* **445**, 76, 1911.

[2] The Importance of Pollucite. E. E. Fairbanks, *Am. Mineral.*, **13**, 21, 1928.

[3] Description of the New Mineral Beryllonite, *Am. J. Sc.*, **37**, 23, 1888.

now been examined and the description that follows is based upon them. The crystals are all more or less altered, the change ranging from a thin surface deposit of fibrous herderite, described on a later page, to the complete destruction of the beryllonite substance leaving a cavernous pseudomorph. The substance when fresh is snow white and shows perfect basal cleavage and less perfect orthopinacoidal cleavage. The alteration attack develops a fibration parallel to the vertical axis. No crystallographic measurements are possible on the coated crystals. They are thick, tabular parallel to the base, like the type beryllonite crystals, and there are some evidences of prismatic twinning. The largest crystal is far larger than any of Dana's crystals, reaching dimensions of 8×5 cm. in cross section and 4 cm. parallel to the vertical axis, while several are nearly as large in cross section and much thinner. The crystals are rarely attached to the walls of cavities; more commonly they are imbedded in albite of the platy clevelandite type, with rather vague outlines. It is the oldest of the phosphates to form, being coated with herderite, the product of its alteration, and in one specimen cut by a later crystal of eosphorite. Green tourmaline is in several specimens imbedded in the beryllonite and is apparently older.

Mr. Berman determined the specific gravity of the Newry beryllonite with the pycnometer to be 2.806. As this was much lower than the figure given by Dana, 2.845, three crystals from Stoneham were reexamined and gave values ranging from 2.791 to 2.808, an average of 2.798. It would appear that the true specific gravity of beryllonite is very near 2.80 and no explanation of the discrepancy between Berman's values and that of Dana was discovered.

The optical characters, practically identical with those given in Larsen's Tables, are as follows:

Biaxial negative 2V medium
$\beta=1.558$ $\gamma=1.562$

Material for analysis was purified by Mr. Berman and proved under the microscope to be homogenous except for numerous fluid inclusions similar to those present in the Stoneham beryllonite.

The analysis by Dr. Shannon is as follows:

	Percentages	Molecular ratios
BeO	19.12	.762 } .769 = 2 × .384
CaO	0.40	.007 }
MgO	trace	
Na_2O	23.28	.375 }
K_2O	0.92	.010 } .387 = 1 × .387
Li_2O	0.07	.002 }
P_2O_5	55.40	.390 .390 = 1 × .390
Al_2O_3	0.21	
Fe_2O_3	0.07	
Ignition	0.52	
Insoluble	0.16	
	100.15	

These results give with great exactness the same formula as did the type material, Na Be PO_4. It is worthy of note that small amounts of sodium are replaced by potassium and lithium. It is possible that the small amount of CaO found is derived from a slight admixture of herderite but the quantity is inconsiderable.

Herderite. Crystals of herderite have been found in a number of Maine lithium pegmatites and it is a far more common mineral than beryllonite, the only other known beryllium phosphate. At Newry, however, herderite occurs, not in crystals but in a radial fibrous form yielding botryoidal or spheroidal aggregates which are quite new to the species. It was first noted as tiny colorless spheres attached to the tips of albite crystals of acicular habit. These have exactly the translucency and gray color of chalcedony. Later it was found in considerable abundance lining small cavities with a botryoidal coating. Similar fibrous masses coat the beryllonite crystals and form walls dividing the interior of hollow pseudomorphs of that mineral. It is evidently here the product of alteration of beryllonite.

Its fibrous form makes the determination of the optical characters very difficult. Mr. Berman obtained the following data which may be compared to those given in Larsen's Tables or in Dana, System, 761, 1892.

Biaxial negative. 2V large. Axial plane across the elongation, therefore $\gamma = b$

$\alpha = 1.604$ $\beta = 1.616$ $\gamma = 1.627$

Analysis by Dr. Shannon of a carefully purified sample with specific gravity 2.851, yielded the following results.

	Percentages	Molecular ratios
CaO	32.24	.577
MnO	0.16	.002 } .598=2×1.03
MgO	0.76	.019
BeO	16.50	.657 .657=2×1.13
P_2O_5	39.74	.280 .280=1× .97
H_2O	7.97	.442
F	0.87	.046 } .488=2× .84
Al_2O_3	0.50	
CO_2	none	
Cl	none	
Insoluble	2.02	
	100.76	

The molecular ratio derived from this analysis yields the formula $Ca(OH)_2Be\ PO_4$. This differs from typical hydroherderite in having two molecules of hydroxyl instead of one. The abnormally high content of water is, however, believed to be related to the fibrous form of the mineral, a form favorable to the adsorption of water in many minerals. It is deemed better to accept this explanation rather than seek to establish the mineral as a new species.

Eosphorite. Eosphorite, a hydrous manganese aluminum phosphate was first found at Branchville, Connecticut,[4] and has been found in Maine at Poland, Buckfield and Mount Mica,[5] always in very small amount. At Newry it is, except for lithiophilite, the most abundant phosphate found. It is always in free crystals implanted on quartz in open cavities or forming fan-shaped groups on albite. The crystals are of simple form, showing the unit pyramid and the two pinacoids $a(100)$ and $b(010)$. They show prismatic development with an almost square cross section. In color they vary from opaque blackish brown to transparent hair brown. The optical characters, determined by Mr. Berman are as follows:

Biaxial negative 2V 50° about, $\rho < \nu$ easily perceptible.

$\alpha = b = 1.638$, colorless.
$\beta = a = 1.660$, light yellow.
$\gamma = c = 1.667$, brown.

[4] Brush and Dana, *Am. J. Sc.*, **16**, 35, 1878.
[5] Landes, K. K. *Am. Mineral.*, **10**, 386, 1925.

Material for analysis was obtained by hand picking and crushing the crystals which were then purified in a heavy solution. The specific gravity is 3.067.

The analysis by Dr. Shannon is given in the following table.

	Percentages	Molecular ratios	
Al_2O_3	20.51	.201	.204=1×.204
Fe_2O_3	0.56	.003	
MnO	27.65	.390	.477=2×.238
FeO	3.74	.052	
MgO	0.36	.009	
CaO	0.84	.015	
BeO	0.27	.011	
P_2O_5	30.38	.214	.214=1×.214
H_2O	15.59	.866	.875=4×.219
F	0.18	.009	
Insoluble	0.45		
	100.53		

The molecular ratio yields with exactness the usual formula of eosphorite, $2MnO \cdot Al_2O_3 \cdot P_2O_5 \cdot 4H_2O$. In this occurrence of the mineral the amount of iron replacing manganese (childrenite molecule) is very small, the only analysis showing less iron being that of eosphorite from Buckfield.