ART. LI.—*On the Occurrence of Pollucite, Mangano-Columbite and Microlite at Rumford, Maine*; by H. W. FOOTE.

DURING the spring of 1885, Mr. E. M. Bailey of Andover, Maine, sent to Prof. S. L. Penfield for identification some specimens from Black Mountain, Rumford, Me. Among these, one which had the appearance of ordinary white quartz or beryl proved to be the very rare and interesting mineral pollucite. The following summer, the locality was visited by Professor Penfield accompanied by Mr. Bailey and a supply of pollucite and its associated minerals was obtained.

The minerals occur in a ledge of coarse pegmatite which has been worked without success for gem tourmalines, but the locality is of unusual mineralogical interest and the work has been continued to some extent for specimens. In addition to quartz, feldspar and muscovite, which are crystallized on a large scale, there were found pink, green and white tourmalines in imbedded crystals, pink lepidolite, both granular and in crystals, with hexagonal outline, spodumene occasionally in crystals but usually only in cleavage masses, amblygonite rather abundant and in cleavage masses only, beryl not very common, cassiterite rather abundant as irregular masses and rarely in small but distinct crystals, black columbite, pollucite and, very rarely, mangano-columbite and microlite.

Pollucite.

Pollucite has previously been found in the United States at Hebron, Me., where it was discovered by Mr. Loren B. Mer-

rill while mining for gem tourmalines. A full description of this occurrence together with an analysis and a discussion of the chemical composition of the mineral has been given by Prof. H. L. Wells.* The material at Hebron was all found as loose pieces in two cavities, while at Rumford, which is about thirty miles north of Hebron, it is found intimately associated with quartz, albite, muscovite, tourmaline, lepidolite and spodumene. The specimens are not very attractive in appearance as neither the pollucite nor the associated minerals, with the exception of tourmaline, occur well crystallized. The irregular masses of pollucite are sometimes quite large, so that, for example, for a distance of ten centimeters there will be continuous pollucite. Small particles of the mineral are colorless and perfectly transparent, but the masses look as if they had been crushed and the appearance is therefore white. The quartz at the locality is mostly smoky so that it is readily told from the pollucite at a glance, but some of it is quite white, and then it is almost impossible without physical or chemical tests to distinguish the two minerals apart. A great deal of credit is due to Mr. Bailey for having observed that the pollucite was something different from quartz, which needed investigation.

Although occurring in masses of considerable size, the pollucite is not very abundant, but it is hoped, now that the mineral has been identified, that it will be more carefully looked for and saved. It is possible and even quite probable that pollucite is not at all a rare mineral at the tourmaline and lepidolite localities in Maine, but has been overlooked as it resembles quartz so closely and does not occur in characteristic crystals.

Material for a chemical analysis was separated in a very pure condition by means of the potassium mercuric iodide solution. That which was used for the analysis ranged in specific gravity between 3.029 and 2.938, a difference of 0.091. Wells gives 2.986 and 2.976 for the mineral from Hebron. The method of analysis was as follows:

The substance was digested with strong hydrochloric acid for several hours until completely decomposed. The silica and alumina were then determined in the usual manner. The filtrate from the alumina precipitation was evaporated to dryness and ammonium salts driven off with extreme caution. The chlorides of the alkalis were dissolved in very little hydrochloric acid and enough lead chloride added to combine with all the caesium to form the salt Cs_2PbCl_6 .† Chlorine was then passed into the hot solution which was

* This Jour. III. xli, p. 213, 1891.

† Ibid., xlvii, p. 186, 1893.

gradually cooled, finally with ice. This operation removed nearly all the caesium, which was filtered on a Gooch crucible, washed with hydrochloric acid saturated with chlorine, dried at 100° and weighed as Cs_2PbCl_6 . The filtrate was evaporated to dryness, the residue taken up in water, the lead removed with hydrogen sulphide and the potassium and remaining caesium precipitated and weighed as platinum chlorides. The platinum was then determined, from which the potassium and caesium were calculated. Lithium and sodium were freed from platinum and separated with amyl alcohol. Only a trace of rubidium could be detected by the spectroscope.

Water was determined by strong ignition of the substance over a powerful blast lamp.

Following are the results of the analyses, together with the analysis of the mineral from Hebron, by Wells:

	I.	II.	Average.	Ratio.		Hebron.
SiO_2	43.75	43.54	43.64	.727	9.00	43.51
Al_2O_3	16.77	16.90	16.84	.165	2.03	16.30
Cs_2O	36.25	36.03	36.14	.128	} .168	36.10
K_2O	0.33	0.42	.037	.004		.48
Na_2O	2.06	2.11	2.09	.033		1.68
Li_2O	0.03	0.13	0.08	.003		.05
H_2O	1.57	1.59	1.58	.082	1.01	1.50
						$\text{CaO}=0.22$
	100.76	100.72	100.74			99.84

The results of the analyses are remarkably close to those obtained by Professor Wells and the ratio which is nearly 9:2:2:1 gives the formula $\text{H}_2\text{Cs}_4\text{Al}_4(\text{SiO}_3)_9$ as deduced by him.

In a recent article, "On the Constitution of the Silicates,"* Clarke has discussed the constitution of pollucite and considered two formulæ, one, $\text{H}_2\text{Cs}_2\text{Al}_2\text{Si}_5\text{O}_{18}$, deduced from the analysis of the mineral from Elba by Rammelsberg, the other that of Wells. The latter had shown, however, very conclusively that his formula was correct and that it agreed better with the results of the earlier analysis than did that of Rammelsberg, and this new analysis fully substantiates his view.

Many thanks are due Professor Wells for his many helpful suggestions as to methods of analysis.

* Bull U. S. Geolog. Survey, No. 125, p. 31, 1895.

Mangano-Columbite.

This mineral is found in imbedded crystals which are seldom over 10^{mm} long. The color is a dark reddish brown, very closely resembling that of rutile. The available material was not sufficient for a quantitative analysis, but a qualitative examination showed the the presence of manganese, tantalum and niobium. A specific gravity determination on 0.3242^{gr} of material taken very carefully on a chemical balance gave 6.44, which would indicate a chemical composition about midway between a niobate and tantalate and near that of the mangano-columbite from Branchville, analyzed by Comstock.*

The crystals show a considerable variation in habit, being usually prismatic in the direction of the *c* axis, fig. 1, sometimes lengthened parallel to *a*, fig. 2, while occasionally they are about equally developed in all directions. They show a very good cleavage parallel to *b*, 010. The forms which were observed are similar to those found on columbite and are as follows:

<i>a</i> , 100	<i>m</i> , 110	<i>f</i> , 102	<i>u</i> , 133
<i>b</i> , 010	<i>g</i> , 130	<i>e</i> , 021	<i>π</i> , 121
<i>d</i> , 730	<i>k</i> , 103	<i>o</i> , 111	<i>n</i> , 163

They gave a few excellent reflections which served to establish the lengths of the crystallographic axes. The values are given below, together with the axes for columbite as determined by E. S. Dana.†

Mangano-Columbite.	Columbite.
$m \wedge m, 110 \wedge 1\bar{1}0 = 79^\circ 47'$	$79^\circ 17'$
$f \wedge f, 102 \wedge 102 = 55 \quad 40$	$56 \quad 28$
$a : b : c = 0.8359 : 1 : 0.8817$	$0.8285 : 1 : 0.8898$

The variation in the ratios is undoubtedly due to a change of both acid and base, the measurement by Dana having been

* This Journal, xix p. 131, 1880.

† Zeitschr. Kryst. xii, p. 266, 1886.

made on columbite from Standish, Me., having a specific gravity of 5.65, and which according to the analysis of Allen* contains only a little tantalum and manganese.

Several forms gave rather unsatisfactory reflections. Some of the measured and calculated angles are as follows:

	Calculated.	Measured.	Calculated for Columbite.
$f \wedge f'$, $102 \wedge \bar{1}02 =$	$55^\circ 40'$	$55^\circ 40'*$	$56^\circ 28'$
$k \wedge k'$, $103 \wedge \bar{1}03 =$	$38 \ 47$	$38 \ 52$	$39 \ 23$
$d \wedge d''$, $730 \wedge \bar{7}30 =$	$39 \ 25$	$39 \ 56$	$39 \ 6$
$m \wedge m'''$, $110 \wedge \bar{1}10 =$	$79 \ 47$	$79 \ 47*$	$79 \ 17$
$g \wedge g''$, $130 \wedge \bar{1}30 =$	$136 \ 31$	$136 \ 51$	$136 \ 10$
$g \wedge g'$, $130 \wedge \bar{1}30 =$	$43 \ 29$	$44 \ 5$	$43 \ 50$
$e \wedge e'$, $021 \wedge 0\bar{2}1 =$	$120 \ 57$		$121 \ 20$
$m \wedge o$, $110 \wedge 111 =$	$36 \ 0\frac{1}{4}$	$35 \ 55$	$35 \ 38$
$o \wedge o'$, $111 \wedge \bar{1}11 =$	$76 \ 44$		$77 \ 29$
$o \wedge o'''$, $111 \wedge \bar{1}11 =$	$62 \ 30\frac{1}{2}$		$62 \ 27\frac{1}{2}$
$\pi \wedge \pi'$, $121 \wedge \bar{1}21 =$	$55 \ 0$	$55 \ 3$	$55 \ 30$
$\pi \wedge \pi'''$, $121 \wedge \bar{1}21 =$	$101 \ 2$		$100 \ 59$
$n \wedge n'$, $163 \wedge \bar{1}63 =$	$19 \ 42$		$19 \ 54$
$n \wedge n'''$, $163 \wedge \bar{1}63 =$	$118 \ 0$		$118 \ 20$
$u \wedge u'''$, $133 \wedge \bar{1}33 =$	$79 \ 32$		

One variation from columbite shown by the habit of these crystals is that the form f , which is the predominating one at the termination of all of the crystals, is of rare occurrence and has previously been observed only with slight development on columbite.

Microlite.

Very beautiful crystals of microlite averaging 2^{mm} in diameter of a honey-yellow color and high luster are found sparingly at the locality. The prevailing form is the octahedron, modified by the dodecahedron and sometimes by the icositetrahedron, 113. The habit is then very much like that of the pyrochlore figured on page 762 of the sixth edition of Dana's Mineralogy. The specific gravity, taken by Professor Penfield on 0.2642 gr. of material was found to be 5.17, which is somewhat low for microlite and due probably to the presence of a little more niobium than usual. A qualitative analysis indicated the presence of calcium and of tantalum in considerable excess over niobium.

In closing, I wish to express my thanks to Professor Penfield for his kind assistance during the entire investigation and to Mr. Bailey for a generous supply of the rare and interesting minerals from this locality.

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* Zeitschr. Kryst., xii, p. 272, 1886.