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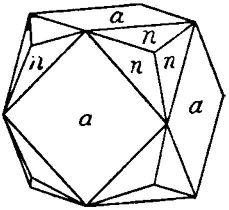
ART. XIII.—*On Bixbyite, a new Mineral, and Notes on the Associated Topaz*; by S. L. PENFIELD and H. W. FOOTE.

Bixbyite.—The mineral to be described in the present article was sent to us for identification by Mr. Maynard Bixby of Salt Lake City, Utah. Concerning its occurrence we are informed that the mineral is found very sparingly in one or two small areas on the edge of the desert about thirty-five miles southwest of Simpson, Utah. The crystals are implanted upon topaz and decomposed garnet and rhyolite and have evidently been formed by fumarole action.

The mineral crystallizes in the isometric system, usually in cubes, some of which measure over 5^{mm} on an edge. These are occasionally modified by the trapezohedron, 211, and on one small specimen the cubes and trapezohedrons are developed with almost ideal symmetry as shown in fig. 1. When measured on the goniometer the crystals gave fairly good reflections of the signal and $211 \wedge 112$ was found to be 33° 40′; calculated 33° 33½′. The mineral breaks with an irregular fracture, and on one or two specimens traces of octahedral cleavage were observed. The color is brilliant-black with metallic luster, and the streak is black. The hardness is 6 to 6·5. The specific gravity of the material used for the quantitative analysis was taken on a chemical balance and found to be 4·945. The mineral fuses before the blowpipe at about 4 and becomes magnetic. When very finely powdered, it dissolves with some difficulty in hydrochloric acid with evolution of chlorine.

1.



Method of Analysis.—The material for analysis was separated in a nearly pure condition by the thallium-silver nitrate mixture. The mineral was treated with strong hydrochloric acid in a flask connected with a condenser, and the chlorine liberated was distilled over into a solution of potassium iodide. Free iodine was then determined volumetrically with standard thiosulphate and iodine solutions, from which the amount of available oxygen was calculated. After filtering off a small amount of insoluble material, iron, aluminium and titanium were separated from manganese and magnesium by the basic acetate method. The three oxides were weighed together, iron was then determined by titration with permanganate solution and titanium was twice precipitated by boiling the nearly neutral dilute sulphate solution for two hours in the presence of sulphur dioxide. It was weighed as TiO_2. From the filtrate from the basic acetate precipitation, manganese was precipitated with excess of bromine water. The precipitate, after filtering, was dissolved in a solution of sulphur dioxide, precipitated as phosphate and weighed. Magnesium was precipitated from the first manganese filtrate as phosphate.

Following are the results of the analyses:

	I.	II.	Average.	Ratio.
SiO_2	1·24	1·19	1·21	
Al_2O_3	2·57	2·48	2·53	
Fe_2O_3	47·81	48·15	47·98	·300
TiO_2	1·62	1·78	1·70	·022
MnO	42·08	42·02	42·05	·592
MgO	0·12	0·09	0·10	·002
Avail. O	4·37	4·39	4·38	·274
	99·81	100·10	99·95	

The silica and alumina are regarded as impurities, as only a trace of them went into solution when the mineral was treated with hydrochloric acid. In preparing the mineral for analysis, a variation in specific gravity was observed, owing to the fact that some of the dark particles were buoyed up by impurities, but in order to obtain sufficient material for analysis, it was necessary to include some of the lighter portion. It is probable from the results of the analysis that some topaz was present, for the ratio of silica to alumina is about 1:1 and topaz is intimately associated with the bixbyite.

Leaving silica and alumina out of account, two formulas are possible. Considering the titanium as Ti_2O_3, the oxygen derived from the TiO_2, 0·16 per cent, plus the available oxygen, 4·38, total 4·54 per cent, is about sufficient to convert the MnO into Mn_2O_3, the amount required for 42·05 per cent, MnO being 4·74. The composition therefore can be expressed as R_2O_3 where $R = Fe$, Mn and a little Ti. The proportion of Fe to Mn is 1:0·99 or almost 1:1, so that disregarding Ti_2O_3, the composition is $FeMnO_3$. If the mineral is an isomorphous mixture of Fe_2O_3, Mn_2O_3 and Ti_2O_3 we should expect it to be rhombohedral and to belong to the hematite, corundum and menaccanite group, and also it is not probable that the Fe and Mn would be present in the proportion 1 : 1.

As the mineral is isometric, it seems more reasonable to regard it as a compound having essentially the composition $FeO.MnO_2$ and related to the isometric mineral perofskite, $CaO.TiO_2$. On this basis, the results of the analysis may be put in the following shape:

		Ratio.	
FeO	43·17	·600	=·602
MgO	0·10	·002	
MnO	42·05	·592	=·613
TiO_2	1·71	·021	
Avail. O and O from Fe_2O_3	9·18	·574	
SiO_2	1·21		
Al_2O_3	2·53		
	99·95		

The ratio of Fe+Mg : Ti+Mn is ·602 : ·613 or nearly 1 : 1, while the oxygen is almost sufficient to convert the MnO into MnO_2 as indicated by the ratio MnO : O = ·592 : ·574. As oxygen was determined perhaps as accurately as any other constituent, it seems possible that a small amount of manganese may be present as protoxide, replacing FeO. If enough manganese be taken as protoxide to make the ratio of RO to RO_2 exactly 1 : 1, the results become:

		Ratio.	
FeO	43·17	·600	·608
MgO	0·10	·002	
MnO	0·40	·006	
TiO_2	1·71	·021	·608
MnO_2	41·65	·587	
O	9·18		
SiO_2	1·21		
Al_2O_3	2·53		
	99·95		

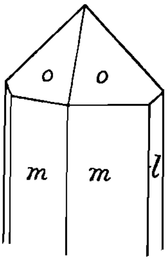
The oxygen necessary to convert 41·65 per cent of MnO to MnO_2 is 9·38, which is only slightly in excess of that actually found in the analysis. It seems therefore probable that the mineral is essentially $FeMnO_3 = FeO . MnO_2$, in which small quantities of MgO and MnO are isomorphous with FeO and a little TiO_2 with MnO_2. The mineral is therefore to be regarded as a ferrous salt of manganous acid H_2MnO_3, corresponding to braunite $MnMnO_3$, which is supposed to be the manganese salt of the same acid.

We take pleasure in naming this mineral after Mr. Bixby, who has generously supplied us with material for investigation, and has gone to a great deal of trouble and pains to secure the specimens.

Topaz.—On the topaz with which bixbyite is associated the following forms were observed:

a, 100	*m*, 110	*d*, 201	*y*, 041	*u*, 111
c, 001	*l*, 120	*f*, 021	*o*, 221	

2.



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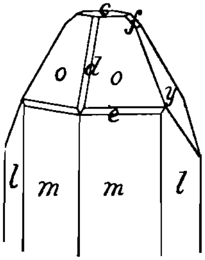

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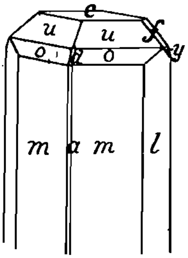

The prevailing types of the crystals are shown in figs. 2, 3, and 4. Some of the crystals are more than 4^{cm} long and are transparent and colorless; a few have a delicate wine color, and many are either opaque white or partially so. The opaque crystals, as shown by microscopic examination, are not pseudomorphs but consist of fresh unaltered topaz containing minute quartz crystals, which evidently have been included during crystallization.

Associated with the topaz crystals are rough trapezohedrons which apparently were once garnet, but which have suffered alteration. The garnet is wholly gone and the crystals consist of bixbyite with either quartz, topaz or both. The garnet was probably the manganese variety, spessartite, which has been observed by Cross[*] at Nathrop, Colo., associated with topaz in rhyolite, an occurrence similar to that in Utah.

ART. XIV.—*Note concerning the Composition of Ilmenite*;

by S. L. PENFIELD and H. W. FOOTE.

THE existence of a molecule $R^{II}O \,.\, R^{IV}O_2$ in bixbyite and perofskite brings to mind the views concerning the composition of ilmenite. One of these is, that the mineral is $RO \,.\, TiO_2$ (R=Fe and Mg), as advanced by Mosander[†] and adopted by Rammelsberg[‡] and Hamberg.[§] The other, that it is R_2O_3, or an isomorphous mixture of Fe_2O_3 and Ti_2O_3, as advanced by Rose[‖] and adopted by Groth.[¶]

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[*] This Journal, xxxi, p. 432, 1886.

[†] Pogg. Ann., xix, p. 219.

[‡] Pogg. Ann., civ, p. 497.

[§] Geol. Fören., i, Stockholm Förhandl., xii, p. 604.

[‖] Pogg. Ann., lxii p. 119.

[¶] Tabellarische Übersicht der Mineralien, 3 Aufl., Braunschw., 1889, p. 40.