

equivalent on both sides, consequently the figures are asymmetrical in accordance with the type.

The prism 10 $\bar{1}$ 0 is but slightly developed on these crystals, and being the more soluble form was beautifully etched by hot 25% HCl, acting for ten seconds. (See photo 10.) The limitations of the narrow face are readily discernible on either side of the etch figure, which extends in a diagonal direction approximately the entire width of the face. The etching is a simple oval form, pointed at either end. The inclination of the figures to the prism edges approximates 30°, therefore revealing no planes of symmetry.

Base

The base 0001 being absent on the crystals used, small cleavage pieces were etched with dilute HCl. The figures are simple triangular pits turned asymmetrically to the crystal edges.

(To be concluded.)

MIRABILITE FROM THE ISLE ROYALE COPPER MINE, HOUGHTON, MICHIGAN.

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During the fall of 1916 the Mineralogical Laboratory of the University of Michigan received from Professor A. C. Lane of Tufts College a sample of a fibrous mineral which upon investigation proved to be the rather uncommon mineral mirabilite. The material was obtained by Dr. Lane and Mr. A. H. Wohlrab, assistant to the superintendent of the Isle Royale Copper Company, from the 26th level, Shaft No. 2 of the Isle Royale Mine. Subsequently Dr. Wohlrab furnished another sample but this was from the "old workings of the No. 1 Shaft." I am greatly indebted to these gentlemen for so kindly placing this material at my disposal.

The material consists of a mass of colorless interlocking fibers, clear and transparent for the most part, and frequently very much twisted and bent. A small amount of clayey matter is present as an admixture. Upon exposure to the air, the fibers soon crumble to a white powder.

A preliminary examination before the blowpipe showed the presence of much sodium, sulfur and water, with traces of potassium, chlorine, calcium and aluminium, the last two being contained in the clayey material referred to above. Quantitative analysis yielded the result of table 1.

The mineral was first dried in an air bath at 130°C. until it showed a constant weight. This served to drive off all water. The fact that the water content, and consequently the molecular ratio, is somewhat lower than the theoretical value is easily accounted for when it is considered that the original material taken for analysis had already been partially dehydrated by exposure to air. Upon solution in water an insoluble residue of earthy

material was obtained. Sulfur was determined by precipitation with BaCl_2 and weighing as BaSO_4 . Na_2O was determined by the difference in weight of the combined chlorides of sodium and potassium after the latter had been found as the chloro-platinate (K_2PtCl_6). The analysis and the ratios calculated therefrom establish conclusively that the substance under consideration is the mineral mirabilite ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$).

TABLE 1

	1	2	3	4	5
Na_2O	17.84	19.02	19.25	0.3067	} 0.3148
K_2O	0.72	0.77	.....	0.0081	
CaO	trace	.....	.....	.....
SO_3	23.81	25.37	24.86	0.3168	1.006
Cl	trace	.....	.....	.....
H_2O	51.4	54.84	55.89	3.0466	9.677
Insoluble	5.69	.....	.....	.....
	99.50	100.00	100.00		

1. Results of analysis. 2. Same, after removing insoluble matter and recalculating to 100%. 3. Theory for $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$. 4 and 5. Ratios shown by 2.

This is further confirmed by the determination of the optical constants. By using the immersion method a mean index of refraction of 1.437 ± 0.005 was obtained. This compares very favorably with the value given by Miller¹ of approximately 1.44 for β . The double refraction is very weak, low gray interference colors predominate and only the thicker sections show distinct colors. The optical character of the mineral is negative as is also its principal zone. The apparent optic angle ($2E$) is large.

It is thought that this is the first time mirabilite has been reported as occurring in Michigan. Except for its formation in large quantities in the salt lakes of the west, it is a mineral met with rather infrequently because of its great solubility and unstable character.

THE ORIGIN OF THE MIRABILITE FROM THE ISLE ROYALE MINE.

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The water of this mine, like that of all Michigan copper mines, runs very high in calcium chloride. The nearest samples analyzed to the place where the mirabilite was found give the following results, in parts per thousand.²

¹ *Trans. Cambridge Phil. Soc.*, 7, 215, 1842.

² *Mich. Geol. Biol. Survey, Publ.* 6, *Geol. Ser.* 4, II, 823.