material was obtained. Sulfur was determined by precipitation with BaCl₂ and weighing as BaSO₄. Na₂O 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 (K₂PtCl₄). The analysis and the ratios calculated therefrom establish conclusively that the substance under consideration is the mineral mirabilite (Na₂SO₄.10H₂O).

<table>
<thead>
<tr>
<th>TABLE 1</th>
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<tr>
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<tr>
<td>Na₂O</td>
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<tr>
<td>K₂O</td>
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<tr>
<td>CaO</td>
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<tr>
<td>SO₃</td>
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<tr>
<td>Cl</td>
</tr>
<tr>
<td>H₂O</td>
</tr>
<tr>
<td>Insoluble</td>
</tr>
</tbody>
</table>

|         | 99.50 | 100.00 | 100.00 |

1. Results of analysis. 2. Same, after removing insoluble matter and recalculating to 100%. 3. Theory for Na₂SO₄.10H₂O. 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 Miller² 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.³

The sample is, however, somewhat nearer a fault which crosses
the lode obliquely striking E and W and having 30° or less to the N
and it is conceivable that a certain amount of water may circulate
along this fault. These faults or crossings also contain more sul-
vides so that the water near them may well contain more sulfates.

The interesting thing about this occurrence of mirabilite is that
while it seems to have deposited from water so high in lime, it is
yet so free from lime. To explain this we may note that calcium
sulfate is much less soluble than sodium sulfate, and still less so
in the presence of calcium chloride. For instance at 0° C. 0.241
gram of gypsum is dissolved by 100 grams of water, and at 18°,
0.259 gram; whereas in a solution containing 15.9070 calcium
chloride at 25°, only 0.092 gram of gypsum is dissolved in 100
cubic centimeters. Calcium sulfate is more soluble in sodium
chloride solutions, because sodium sulfate is formed, and this is
enormously more soluble.

Unfortunately I did not observe the temperature of the mine
and rock at the time we took the sample, but the normal tempera-
ture cannot be far from 15° C. (61° F.). At that temperature we
find the following peculiar behavior of sodium sulfate: 37.43
grams of sodium sulfate or 105.79 grams of sodium sulfate +7 aq.
can exist away from the air, but by exposure to air (or the inocula-
tion with crystals) it is converted to the sodium sulfate with
10 aq., of which only 35.96 grams (corresponding to 13.20 grams of
anhydrous sodium sulfate) are soluble. This solubility decreases
markedly with the drop in temperature, so that at 10° but 9 grams
and at 0° but 5.02 are dissolved. Therefore both exposure to
air and cooling would tend to promote crystallization of mirabilite
more than gypsum. A study of the occurrence of this efflores-
cence with reference to the season and its relation to upcast and
downcast currents in the mine circulation would show if tempera-
ture were the more important factor. The rock of the upper
levels is down to 6° C. (43° F.) and the air temperature of the down-
cast shaft generally below 15° C. (60° F.).

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