

PLATE 7



( $\times 1/3$ )

MILKY QUARTZ, NEAR OURAY, COLORADO.

Florence P. Manchester Memorial Collection, Fall River, Mass.

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## THE IDENTITY OF FLAGSTAFFITE AND TERPIN HYDRATE

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The writer recently described<sup>1</sup> a new organic mineral from Arizona and in discussing its paragenesis suggested that it had been formed, thru oxidation or hydration, from the natural resins of the buried logs in which it was found. At that time, however, a search among the synthetic terpenes and related compounds failed to bring to light anything that corresponded exactly to the writer's analysis and crystallographic measurements. Later Dr. Francis D. Dodge, of Brooklyn, suggested<sup>2</sup> that the mineral might be identical with terpin hydrate, a well known synthetic product of the laboratory, but unknown as a natural substance.

Careful comparative tests have therefore been made with the limited amount of flagstaffite available, with the result that both crystallographically and chemically the two substances have been found to be identical. Dr. Dodge called the writer's attention to the fact that if the published *b* axis of terpin hydrate was made equivalent to the writer's *a* axis, or vice versa, the crystals yielded the same goniometric values. This is illustrated in the table below, the measurements of Maskelyne being taken for comparison, after converting them into two-circle angles and changing the orientation to suit that adopted by the writer for flagstaffite.<sup>3</sup>

<sup>1</sup> F. N. Guild. Flagstaffite, A New Mineral from Arizona. *Am. Min.*, 5, 169, 1920.

<sup>2</sup> Personal communication to the Editor.

<sup>3</sup> Maskelyne, *Z. Kryst. Min.*, 5, 644; Groth, *Chem. Kryst.*, III, 658.

TABLE 1

<i>Terpin Hydrate, Maskelyne</i>			<i>Flagstaffite, Guild</i>		
Letter	$\varphi$	$\rho$	Letter	$\varphi$	$\rho$
q	90° 00'	25° 39'	o	90° 00'	25° 40'
b	90 00	90 00	a	90 00	90 00
m	38 56	90 00	m	38 58	90 00
o	38 56	37 24	p	38 58	37 26

The writer's formula for flagstaffite derived from chemical analysis and molecular weight determination was given as  $C_{12}H_{24}O_3$ . The accepted formula for terpin hydrate is  $C_{10}H_{22}O_3$ , ( $C_{10}H_{20}O_2 + H_2O$ ) and this should now be taken as the corrected formula for flagstaffite. In view of the new data now available the original analysis may be handled as suggested below:

	Per Cent.	Ratio	Ratio $\times 10/5.52$
C	66.21	5.52	10.0
H	11.55	11.45	20.7
O	22.24	1.39	2.5

This analysis, then, could well correspond to terpin hydrate partially dehydrated by standing for a time over sulfuric acid.

Further work on melting points shows that when parallel tests are made on the two substances, giving each the same treatment, identical results are obtained. On either substance variable results may be obtained, mainly depending upon the time of heating. This is due to the fact that terpin hydrate loses water before melting and the mixture fuses at lower temperatures. If the substances are heated very slowly they soften slightly above 100° and finally melt completely in the neighborhood of 116°. The anhydrous terpin from flagstaffite was found to melt at 105°. This corresponds to the synthetic terpin.

The theoretical molecular weight of terpin hydrate is 190, while 210 was found on the natural substance recrystallized from alcohol. No explanation for this divergence has been found, but it is after all not sufficient to negative the conclusion from the other data. Many qualitative tests were applied to the two products and in every case they appeared identical.

Crystals of flagstaffite, recrystallized from alcohol, were found to be optically positive and  $\rho > v$ . This also corresponds to the published data on terpin hydrate.

Terpin hydrate is easily prepared in the laboratory by allowing turpentine oil to stand for a long time in the air, in contact with

water (alho it may be prepared more quickly by adding nitric acid and alcohol to this mixture). It is, then, strange that this substance should not have been found earlier in nature. The discovery of flagstaffite in buried logs is therefore of double interest since it adds a new mineral species and brings to light a natural product that formerly was supposed to be only the product of the synthetic laboratory.

These investigations emphasize also the value of crystallographic measurement in chemical research. While the chemical data described above are somewhat conflicting, the crystallographic data on the two substances are in perfect harmony. Correspondence of crystal form (if the crystals are measurable with reasonable accuracy), is an excellent criterion of the identity of chemical substances, applicable in many branches of chemical work.

## THE UNIONVILLE, PENNSYLVANIA, CORUNDUM MINES

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Conspicuous among the minerals of the larger collections of the eastern United States are the brilliant "fawn-colored" crystals of diaspore from Unionville, Chester Co., Pa. The locality is, furthermore, a classic one for corundum, which has been mined in considerable quantities; and due to the zeal of the early Chester County mineralogists, it was the type locality for some five mineral species (all since reduced to the status of varieties): Euphyllite, pattersonite, lesleyite, unionite and corundellite.

The mines have been abandoned since the end of the last century, but the dumps, residual ledges, and boulders still yield a number of interesting corundum-associates and serpentine minerals.

Corundum is still to be found, chiefly in weathered boulders which appear innocent enough on the outer surface, but on investigation show cleavable crystals imbedded among scales of margarite. A few years ago the writer found a boulder of black tourmaline which was penetrated by long grayish-white corundum crystals, associated with pearly euphyllite. On the same visit,