

TWO CORRECTIONS TO MINERAL DATA<sup>1</sup>N. L. BOWEN, *Geophysical Laboratory, Carnegie Institution of Washington*

## RIVAITE AND REAUMURITE

Some time ago Professor A. B. Peck showed me some crystals in a partially devitrified glass and though their optical properties were readily determinable we were unable to identify the crystals with any known compound. Suspecting that they might be "rivaite," a supposed disilicate of sodium and calcium found at Vesuvius, I sent to Professor Zambonini for a specimen of that mineral in order that I might measure its constants. Professor Zambonini kindly sent a specimen which proved on examination to consist of minute needles of wollastonite embedded in glass of refractive index varying from about 1.51 to 1.52. The microscopic appearance was exactly that of a devitrified crown glass such as is frequently encountered in glass practice.<sup>2</sup>

In his recent bulletin giving his determinations of optical constants Larsen has included rivaite. He, too, notes its inhomogeneity, stating that it consists of "two minerals in approximately equal amounts. One of these minerals is clear and isotropic and has an index of refraction of  $1.513 \pm 0.003$ . The other occurs in prisms embedded in the isotropic part."<sup>3</sup> He then gives the properties of these prisms in detail and remarks that these properties are not very different from those of wollastonite.

In Table 1 it is shown that the differences are, indeed, within the limits of error of the measurement when the comparison is made with pure synthetic wollastonite.

TABLE 1

	$\gamma$	$\beta$	$\alpha$
Pure synthetic wollastonite . . . . .	1.631	1.629	1.616 <sup>4</sup>
Prisms in "rivaite" . . . . .	1.628	1.627	1.614 <sup>5</sup>

<sup>1</sup> Presented at the meeting of the Mineralogical Society of America, December 29, 1921.

<sup>2</sup> N. L. Bowen. The identification of "stones" in glass. *J. Am. Ceram. Soc.*, **1**, 594-605, 1918.

<sup>3</sup> E. S. Larsen, *U. S. Geol. Survey, Bull.* **679**, 127, 1921. In the index it is given as "Rivaite (doubtful)."

<sup>4</sup> Refractive indices as determined by F. E. Wright. *Am. Jour. Sci.*, **39**, 74, 1915.

<sup>5</sup> Refractive indices as determined by Larsen. *loc. cit.* The uniformly lower values found for "rivaite" may possibly represent a real difference, in which case they are to be referred to a very small amount of another compound, say  $\text{Na}_2\text{SiO}_3$ , in solid solution. If this is true the crystals vary towards a wollastonite-pectolite.

These prisms of "rivaite," according to previous observers, have positive elongation, but by careful rolling of the prisms in liquid a position can be found in which the elongation is negative though the birefringence is then excessively weak. The elongation is therefore  $\beta$  and the difficulty of finding a section with negative elongation is due only to the fact that  $\beta$  and  $\gamma$  are nearly identical, and the range of positions showing negative elongation is, therefore, very narrowly restricted. The similarity to wollastonite is complete.

The mineral rivaite should, therefore, not be accepted as an established species. The material called by that name is inhomogeneous and consists of prisms of wollastonite embedded in glass. It is evidently a piece of cobalt-bearing glass that has become involved with volcanic material and devitrified as a result of the heating it experienced.

Lacroix describes such devitrified glass from Mont Pelée and, comparing it with rivaite, comes to the conclusion that this Vesuvian material is also devitrified glass. But Lacroix considers that in both localities the glass as a whole has devitrified and given a mineral that has sensibly the same composition as the glass. This is certainly not true of the Vesuvian material. To the material from Mont Pelée, Lacroix gives the definite mineral name, reaumurite, but states that it is probably identical with rivaite. It seems quite possible that reaumurite is a mixture of glass and wollastonite differing only from rivaite in being of finer grain.<sup>6</sup> The given properties of reaumurite suggest, too, that it may vary more decisively toward wollastonite-pectolite, than does rivaite.

(Since the above was written, Professor Zambonini has kindly sent me a sample of a synthetic preparation made by him at the Geophysical Laboratory while visiting here some years ago. A glass was made by fusing  $\text{Na}_2\text{CO}_3$ ,  $\text{CaCO}_3$ , and  $\text{SiO}_2$  in the proper proportions to give the composition  $(\text{Na}_2, \text{Ca}) \text{Si}_2\text{O}_5$ . (The ratio  $\text{Na}_2\text{O} : \text{CaO}$  in this synthetic material is not stated by Professor Zambonini.) This glass was then devitrified at a low temperature. The product is not altogether homogeneous but appears to consist almost entirely of crystals of one kind. The composition of the crystals can not be far from the total composition of the mixture so that this synthetic material proves the possibility of the existence of crystals which at least approach the composition that has been

<sup>6</sup> *Bull. Soc. Min. France*, 38, 16-21, 1915

assigned to rivaite. The properties of these crystals are, however, altogether distinct from those of the crystals contained in the inhomogeneous material that has come to Larsen and to me as rivaite. The synthetic crystals have parallel extinction, positive elongation and  $\gamma$  about 1.58. These properties correspond very well with those of the crystals originally sent me by Professor Peck. The possibility that a glass, when subjected to volcanic heat, might be devitrified in such a way as to give these crystals must therefore be accepted, but the material called rivaite, as now available, does not correspond with them. Even though some of the specimens of rivaite or reaumurite should be definitely shown to contain crystals corresponding with Zambonini's synthetic crystals, it is doubtful whether material formed in the manner of these specimens can be appropriately set up as a mineral species.)

#### MONTICELLITE

Our knowledge of the optical constants of natural monticellite is based entirely on the crystals from Magnet Cove. Of these the optic axial angle  $2V$  as determined by Penfield and Forbes<sup>7</sup> is  $75^{\circ} 02'$ , but all text-books give  $37^{\circ} 31'$ , which is really the value of  $V$ . The Magnet Cove monticellite therefore has a large, instead of a small, optic axial angle. We have not sufficient data to be sure of the variation of optical constants with composition, but we have certain indications bearing on the question. Artificial monticellite of the theoretical composition is positive, with  $2V$  nearly  $90^{\circ}$ .<sup>8</sup> The Magnet Cove mineral is negative, with  $2V$  as given above, and contains 4.75 per cent FeO and 1.62 per cent MnO. All monticellites intermediate between these two in composition will probably be intermediate in properties, since the actual range is quite small. A monticellite with from 1.5 to 2 per cent FeO would probably have  $2V$  about  $90^{\circ}$  and therefore lie on the border between positive and negative monticellites. The optic axial angle of all of them would be large and of most of them very large. With these data in mind it seems probable that the "mineral A," associated with the merwinite of Larsen and Foshag,<sup>9</sup> is monticellite.

<sup>7</sup> *Am. Jour. Sci.* 1, 135, 1896.

<sup>8</sup> See Merwin in Ferguson and Merwin, The ternary system CaO-MgO-SiO<sub>2</sub>, *Am. Jour. Sci.* 48, 92, 1919.

<sup>9</sup> *Am. Min.* 6, 144, 1921.