PROBERTITE FROM RYAN, INYO COUNTY, CALIFORNIA

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The mineral probertite was described by A. S. Eakle[2] as a new hydrous borate of soda and lime from the borax mines near Kramer, California. The mineral was independently described by Waldemar T. Schaller[3] under the name kramerite. At this locality it is one of the minor minerals of the borax ore and is found as radiating rosettes of thin blades or needles in low grade kernite, borax, or in the clay lenses that occur sparingly in the massive body of salts. There is no doubt that kramerite is identical with probertite although the analysis of Eakle's is apparently in error and leads to a formula somewhat different from that obtained by Schaller.

Before the discovery of the borax deposits near Kramer, Kern County, the colemanite deposits at and about Ryan, Inyo County, California, were the chief source of this commodity. The producing mines were the Biddy McCarthy, the Widow, the Played-Out, and the Annie Oakley. Colemanite was the chief ore mineral although in the Lower Biddy McCarthy mine important amounts of ulexite are present and in the Widow mine, besides ulexite, a mineral locally known as "*boydite*" (a name used in a descriptive circular of the Death Valley Region by the Union Pacific Railroad) is abundant and is said to have been shipped in some quantity as a borax ore. This mineral has also been found in lesser amounts in the Upper Biddy McCarthy mine. Investigation of this material shows it to be identical with probertite.

The mineral from the two mines differ slightly in their appearance, that from the Widow mine being in long, satiny, divergent needles or laths, some of these needles being as long as 30 centimeters. The luster is satiny, rarely glassy, and the perfect cleavage of the mineral is usually quite evident. The width of the cleavage faces, however, rarely exceed one millimeter. It also occurs as fibrous, closely reticulated aggregates and with a silky to greasy luster. The mineral is rarely transparent and is usually translucent. Probertite is associated with a light buff or pinkish indurated marl and sometimes with a soft bentonitic clay. The marl is in small

[1] Published by permission of the Secretary of the Smithsonian Institution.

[2] Probertite, a new Borate: *Am. Mineral.*, **14,** 427–430, 1929.

[3] Borate Minerals from the Kramer District, Mohave Desert, California; *U. S. Geol. Surv., Prof. Paper* **158,** 137–170, 1930.

broken blocks suggesting a breccia and the probertite forms interstitial and vein-like masses suggesting a secondary origin. In some portions of the deposit the probertite is purer but finer bladed, forming a tough compactly reticulated aggregate.

The probertite from the Upper Biddy McCarthy mine was not found in place but a considerable quantity was piled near the edge of the dump. It is finer bladed than the Widow mineral, somewhat laminated and with flattened radial structure or compact with a greasy luster. At times specimens can be found with a botryoidal surface suggestive of the massive ulexite of the colemanite deposits. The mineral is admixed with slight amounts of gray clay and occasionally shows small pebble-like concretionary masses of carbonate of lime, such as make up "conglomerate" beds in the colemanite-bearing sedimentary series.

Abundant material was available for chemical investigation, the sample prepared was selected from a pure mass of coarsely bladed needles. Boric acid was determined by titration in the presence of mannite with standard sodium hydroxide. The remaining constituents were determined in the usual manner after boric oxide had been removed by repeated evaporations with methyl alcohol and hydrochloric acid. The results are given below:

ANALYSIS OF PROBERTITE, RYAN, CALIFORNIA
W. F. Foshag, Analyst

	I	II
Lime (CaO)	15.88	15.98
Magnesia (MgO)	0.06	
Iron and aluminum oxides (Fe_2O_3, Al_2O_3)	0.38	
Soda (Na_2O)	9.00	8.83
Boric Oxide (B_2O_3)	49.10	49.56
Water (H_2O)	25.64	25.63
Insoluble	0.20	
Total	100.26	

This analysis agrees satisfactorily with those of Schaller for probertite and with the theoretical composition for the compound $Na_2O \cdot 2CaO \cdot 5B_2O_3 \cdot 10H_2O$. (Column 2). It is thus a lower hydrate of the ulexite series. The pyrognostics are like those described by Schaller. The mineral is insoluble in water but easily soluble in dilute acids.

Since the Ryan mineral is coarser bladed and more compact the hardness is greater than that found by Schaller for the Kramer material. The coarse-bladed mineral from the Widow mine easily scratches calcite but does not mar the smooth crystal surface of fluorite. It is therefore about $3\frac{1}{2}$ in hardness. The specific gravity, measured by the Jolly balance, using a pure compact fragment of mineral is 2.135. The cleavage is perfect, parallel to *m* (110), the interfacial angle of the cleavage faces measured 87° (ϕ for the prism *m* (110) = 43°30′).

The mineral is biaxial, positive, and has a medium large optical angle (estimated 70°). Crystals lying on the pinacoid *a* show the emergence of an optic axis near the edge of the field and have parallel extinction. Crystals placed on end show the emergence of an optic axis in the field. The plane of the optic axes lies parallel to the pinacoid *b*. Crystals lying on the prism face show an inclined extinction, the maximum angle measured being 13°. The indices of refraction measured by the oil immersion method gave:

$$\alpha = 1.517, \qquad \beta = 1.525, \qquad \gamma = 1.544.$$

These are essentially the same as those found for the Kramer mineral by Schaller and C. S. Ross. The optical orientation is: $Y = b$, $Z \wedge c = 13°$.

There are embedded in the soft bentonitic clay many crystals of probertite but they are invariably deeply etched and corroded so that satisfactory crystal measurement is impossible. The form of the crystals is often distinct, however, and measurements were sufficiently good to identify the forms present. These are the prism *m* (110), the pinacoid *a* (100), rarely the domes *t* (101) and *e* (011). The habit found is similar to some on the kramer mineral. The crystals are usually small, seldom measuring more than 5 millimeters, the larger ones being so deeply corroded that their crystal form is no longer evident.

The central portion of the Widow ore body is made up of massive ulexite. The colemanite is best developed along the foot wall of the body but is also present to a lesser extent along the hanging wall. Probertite was found associated with the colemanite and its relationship to the ulexite could not be determined. The presence of an abundance of this lower hydrate presents an interesting problem while the higher hydrate, ulexite, is much more abundant and widespread in these deposits. Artificial probertite has been synthesized by Van't Hoff and also by Schaller by heating two parts of

ulexite and one of borax to a temperature of 60°C. or higher. It is doubtful, however, if any temperatures even approximating this was attained in the boron beds. From the relationship of the mineral to the marl fragments it is quite evident that the mineral has undergone some rearrangement or recrystallization. Its general similarity to the ulexite of similar deposits suggest that probertite is a recrystallization of ulexite, the formation of the lower hydrate being favored by the pressure of the superincumbent load of sediments and lavas or by the pressure induced by earth movements. The appreciable difference of volume (ulexite: Sp. Gr.=1.963; probertite: 2.141) would favor this change with increasing pressures.

NOTES AND NEWS

A NEW OCCURRENCE OF VIVIANITE IN VIRGINIA.

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During the latter part of June, 1930, while making a study of the Eocene formations in the vicinity of Fredericksburg, Virginia, fragmentary specimens of indurated greensands were collected from the Nanjemoy beds at Woodstock which contain radiating crystal aggregates of vivianite. Woodstock is an old homestead on the south bank of the Potomac River, 31 miles east of Fredericksburg, now known as Mathias Point, in King George County. At the time the collections were made nothing was known as to the nature of the mineral in question. The writer is indebted to Dr. C. S. Ross of the United States Geological Survey for its identification. No reference in the literature to such an occurrence in Virginia has been made so far as is known. Dana in his *System of Mineralogy* reports its occurrence in bog ore in Stafford County, and also as occurring 8 or 10 miles from Falmouth with gold and galena. He does not give any references so that apparently the occurrences which he cites have not been described.

The crystals of vivianite occur as acicular, radiating aggregates on the outer surfaces of the indurated greensand fragments. The individual crystals average 4 mm. in length, the maximum being 7 mm. Cleavage is well developed in the direction (010). In color the crystals vary from dark blue to bluish-green. Owing to the extreme scarcity of the crystals occurring at this locality, blow pipe tests have not been made of the specimens collected.