ART. XIX.—*Some Interesting Beryl Crystals and their Associations*; by W. E. FORD.

THE beryl crystals commonly found in pegmatite veins are prismatic in habit, consisting of a simple combination of the prism of the first order, m , with the base, c , and as a rule are only semi-transparent, and of a green color. It is the chief purpose of this article to describe several striking exceptions to

this general rule, and to point out some interesting similarities in crystal habit, color and association shown by a series of beryl crystals from a number of different localities, all of which are noted for the occurrence of variously colored tourmalines of the lithia variety and of gem quality.

The pegmatite deposits of San Diego Co., California, which have become famous on account of their beautiful tourmalines, have lately furnished some beryl crystals of an unusual habit and uncommon color. Figure 1 is of a crystal from the deposit at Mesa Grande, while figures 2 and 3 are of crystals from the locality of Pala. The short prism which they show, especially in figures 1 and 2, together with the large and

prominent development of the pyramid of the second order s . ($11\bar{2}1$), give them a habit of crystallization very different from that usually shown by beryl. The crystal represented by figure 2 also shows smaller replacements by faces of the pyramid of the first order p ($10\bar{1}1$) with an occasional face of the dihexagonal pyramid v ($21\bar{3}1$). It is further complicated by several reëntrant angles caused by a repetition of the faces due to parallel growth. The figures are drawn to show as nearly as possible the development of the faces in their true proportions, figure 1 being about natural size while figures 2 and 3 are one half natural size. The crystals are transparent and of a beautiful light rose-pink color: their extraordinary color combined with their unusual habit of crystallization

make them especially noteworthy. Figure 1 is of a crystal loaned for study by Mr. Ernest Schernikow of New York and which has since come into the possession of the Brush Collection, while the crystals represented by figures 2 and 3 are in the Tiffany Gem Collection in the American Museum of Natural History, New York.

Figures 4, 5 and 6 are of beryl crystals showing interesting similarities in habit and association with those just described, but from other localities. Figure 4 represents an incomplete crystal found at Mt. Mica, Paris, Maine, now in the mineral collection of the American Museum of Natural History in New York. It shows a short development of the prism m with prominent faces of the second order pyramid s ; also small replacements of another pyramid of the second order o ($11\bar{2}2$), of the pyramid of the first order p , and of the dihexagonal pyramid v ($21\bar{3}1$). The crystal is transparent and colorless like pure quartz, and attached to it are plates of lepidolite. Figure 5 is likewise of a colorless crystal from Mt. Mica belonging to the Brush Collection, nearly complete, quite symmetrical in development and about 15^{mm} in diameter. It is characterized by small faces of the prism m and a large development of the pyramid s , while o and v were observed as

small truncations. Figure 6 is of a crystal in the Brush Collection from the famous tourmaline locality of Haddam Neck which corresponds to these other crystals in having the pyramid of the second order unusually prominent, although on this crystal the prism faces are large and well developed. This crystal is transparent and has a very pale pink color. Several other light-colored crystals from Haddam Neck showing a development of faces similar to that of figure 6 are in the mineral collection of the American Museum of Natural History. One very large one, donated to the Museum by Mr. Ernest Schernikow, measures 18 inches in length by 1 foot in diameter. It is doubly terminated, but so attached that only a portion of its faces are developed.

Pink beryls were formerly found at Goshen, Massachusetts, associated with tourmalines of light to dark green color, and were given the name of goshenite by Shepard.* Specimens of beryl from this locality in the Yale College Collection show only the forms of the prism *m* and the base *c*. Transparent, colorless and pink beryls are also found in the Island of Elba associated with variously colored gem varieties of tourmaline. A specimen of pink beryl in the Brush Collection from Elba shows a short prismatic development terminated only by the base. Vom Rath† describes the Elba beryls as being usually transparent and frequently of a light pink color, and although light green and blue crystals occur there as well, they are

* A Treatise on Mineralogy, third edition, 1852, p. 229.

† Z. d. d. Ges. xxii, 661.

often only semi-transparent. These crystals are described as having generally a prismatic habit, but he mentions several instances where they are markedly tabular in development.

It is interesting to note the striking similarity in habit, color and association of beryl crystals from these different localities. Many of them are of an unusual crystal habit for beryl, frequently being short prismatic, at times even tabular parallel to the base, and occasionally are highly modified. They are also of unusual color, some of them colorless, others of a light tone of pink, quite distinct from the green or blue-green shades commonly shown by beryl. All of them also were found in pegmatite deposits associated with variously colored green and pink tourmalines of gem quality. Such coincidences of association of beryl crystal of unusual habit and color with tourmaline crystals of light colors and gem quality are interesting and suggestive. To the writer's knowledge, the ordinary green beryl, showing a simple combination of prism and base commonly found in pegmatite veins, occurs rarely at the localities which furnish gem tourmalines. It would seem not at all improbable that the conditions favorable to the formation of tourmalines of gem quality were likewise favorable to the formation of these beryl crystals of unusual color and habit.

The factors which control such matters as mineral occurrence and association are undoubtedly extremely complex, being both physical and chemical in their nature. It would seem probable however, if this association which has been noted is anything but accidental in character, that some chemical similarities might be found to exist between these types of tourmaline and beryl. It has been noted that gem tourmalines are usually characterized by containing about twice as much of the alkali oxides as the ordinary varieties, Li_2O being practically only found in the gem material. The occurrence of small amounts of alkalies, usually Na_2O and Cs_2O , have been frequently noted also in beryl. It was thought therefore that any chemical similarity between the gem tourmalines and the pink or colorless beryls would be in the presence in each of unusual amounts of the alkali oxides. Quantitative tests for alkalies were therefore made on two different beryls, the first being pink material from Mesa Grande, the same as that of the crystal illustrated in figure 1, while the second was a pale pink opaque crystal in the Brush Collection from Haddam Neck. Both of them showed considerable amounts of alkalies, the Mesa Grande material yielding about 3.00 per cent and that from Haddam Neck about 5.00 per cent of mixed alkali oxides. From both of them strong tests for caesium were obtained by use of the spectroscope. In this

connection an analysis* by H. L. Wells of a clear and colorless beryl found associated with gem tourmalines at Hebron, Maine, might be quoted, which yielded Na_2O , 1.13; Li_2O , 1.60, and Cs_2O , 3.60. These few instances would seem to indicate that these unusually colored beryls are liable to contain several per cent of alkalis, caesium being characteristically present. Their association with those tourmaline crystals, which likewise contain unusual amounts of alkalis, can hardly be considered entirely accidental, and consequently in this fact of chemical similarity we probably find one of the conditions which influence the association of this type of beryl crystals with the gem tourmalines.

Figure 7 is of a transparent green crystal (aquamarine) in the Brush Collection from the Mack Mine, San Diego Co., California, and is introduced here chiefly for the sake of contrasting it with the tabular type from the same general locality shown in figure 2, the two crystals representing the opposite extremes of development. The crystal is represented in the figure in its true proportions, except that its length parallel to the vertical axis should be four times as great as is shown. The length of the crystal is approximately fifteen times as great as its diameter, the actual dimensions being $60 \times 4^{\text{mm}}$. The faces on the crystal are the prism of the first order m , the dihexagonal prism i ($21\bar{1}0$), the pyramid of the second order s and the pyramid of the first order p , with the basal plane c , and are developed with almost ideal symmetry.

There are also in the Brush Collection two perfectly transparent and yellow colored beryl crystals from Ramona, San Diego Co., which show remarkable etchings: These are in the form of depressions arranged singly in line, figure 9, or in groups, figure 10, in the positions which would naturally be occupied by faces of the prism m . The prism m , however, does not appear on the crystals, the groups of pits corresponding in position to adjacent m faces being separated from each other by a dihexagonal prism. Measurements of a series of the faces forming the pits were made on a two-circle goniometer and the averages of the results obtained were used to plot the positions of the faces on a gnomonic projection, figure 8, the plane of projection being taken as parallel to m ($10\bar{1}0$). From this projection figures 9 and 10 were made, which show the character and arrangement of the etched pits drawn in orthographic projection upon a plane parallel to m . The faces were all

* Dana's Sys. Min., p. 407.

urements due to the vicinal character of the faces, exact symbols cannot be assigned to these forms. In some places the pits form a single line down the length of the crystal, not encroaching at all on the faces of the dihexagonal prism at the sides, as shown in figure 9. More generally they are in two or more parallel and adjacent lines and interlock with each other in a very complicated manner, as shown in figure 10. The pits average 2^{mm} by 1.5^{mm} in size. The crystals show a tendency to taper at the ends on account of the etching and rounding of the prism faces.

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