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## CRYSTALLOGRAPHIC STUDIES OF FLUORITE

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The Bement Collection of Minerals, which was presented to the American Museum by the late J. Pierpont Morgan, Esq., in 1900, is particularly rich in crystallized fluorite. A recent intensive survey of this series indicated several occurrences as likely to provide appropriate matter for study from the point of view of new and rare form combinations as well as providing interesting examples of parallel growth phenomena.

### 1. FLUORITE FROM PHOENIXVILLE, PENNSYLVANIA

Material for the study of this occurrence was furnished by three specimens, numbered 3059, 3060 and 3061, obtained from the Wheatley Mine at Phoenixville, Pa. Like all of the best specimens from this famous locality, these represent old finds.

No. 3059, originally from the collection of J. D. Whitney, was probably collected by him prior to its sale to Mr. Bement at some time close to the middle of the last century. No. 3060, from the collection of the late Joseph Willcox of Philadelphia, was purchased by Mr. Bement at some time prior to 1891 when the remnant of the Willcox Collection (after sales to Bement and to the British Museum) was deposited in the U. S. National Museum. No. 3061 was obtained by Mr. Bement from the late Samuel Tyson, a collector of the town of King of Prussia, not far from Phoenixville. From certain indications on the original (Tyson) label, it is probable that this specimen like the others was obtained about the middle of the last century.

No adequate description of the fluorite crystals from Phoenixville has, to the knowledge of the writer, ever been published. J. Lawrence Smith,<sup>1</sup> writing in 1855, designated them as small, colorless and transparent, and stated that the cube is much modified by the truncations of angles and edges. The same author gives the results of an analysis in which he found fluorine 48.29% and calcium 50.81%, thus indicating a fluorite singularly free from impurities. The series of three crystals

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<sup>1</sup>Amer. Jour. Sci., 1855, (2) XX, p. 242.

that were studied by the present author were obtained from specimen No. 3060. They are clear, colorless, and measure about 1 mm. in diameter. On this specimen the fluorite crystals are thickly implanted on scalenohedral calcite in such a manner that the points of attachment represent very small relative areas. The crystals are cubic in habit, highly modified especially on the cube corners, and are sharp and brilliant. During the measurement with a Goldschmidt Two-circle Goniometer, it was noted, upon centering on a trapezohedral face with

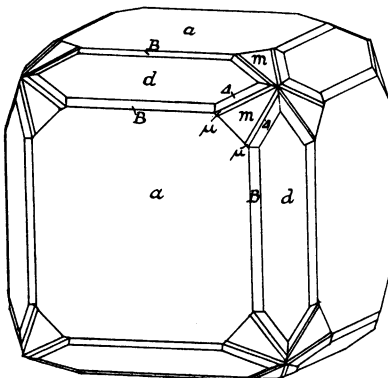


Figure 1

the combination of lenses giving the higher magnification, that, in addition to the reflection from the trapezohedral plane, four reflections from the two rare hexoctahedrons were also observed in the field as clearly defined images of the signal.

The following forms were observed:— $a(100)$ ,  $d(100)$ ,  $B(037)$ ,  $m(113)$ ,  $\Delta(3.5.11)$  and  $\mu(5.7.17)$ , the last named being new to the species. Figure 1 shows these crystals in ideal proportion.

$B(037)$ . This rare tetrahexahedron has been cited by several authors, notably by Von Calker,<sup>1</sup> who observed it as a corrosion form on fluorite from Zinnwald. In the present instance it was recorded from a number of planes on Crystal I, the average of ten readings giving  $\rho = 23^\circ 12.8'$  as compared with a calculated value for this angle of  $23^\circ 13'$ .

$\Delta(3.5.11)$ . This hexoctahedron is among the earliest forms recorded for fluorite. G. Rose<sup>2</sup> in 1828 described and figured a combination from

<sup>1</sup>Zeitschr. f. Kryst., 1887, VII, 45.

<sup>2</sup>G. Rose, 1828, Pogg. Ann., XII, Plate iv, fig. 6.

Weardale, Cumberland, on which the zone  $[113.011]$  is emphasized by (3.5.11) and (124) beveling the edges between (011) and (113) in proportions that strongly suggest the crystals under discussion.

$\mu(5.7.17)$ . This new hexoctahedron also lies in the zone (113.011) close to (3.5.11) but sharply defined from the latter form. On the three

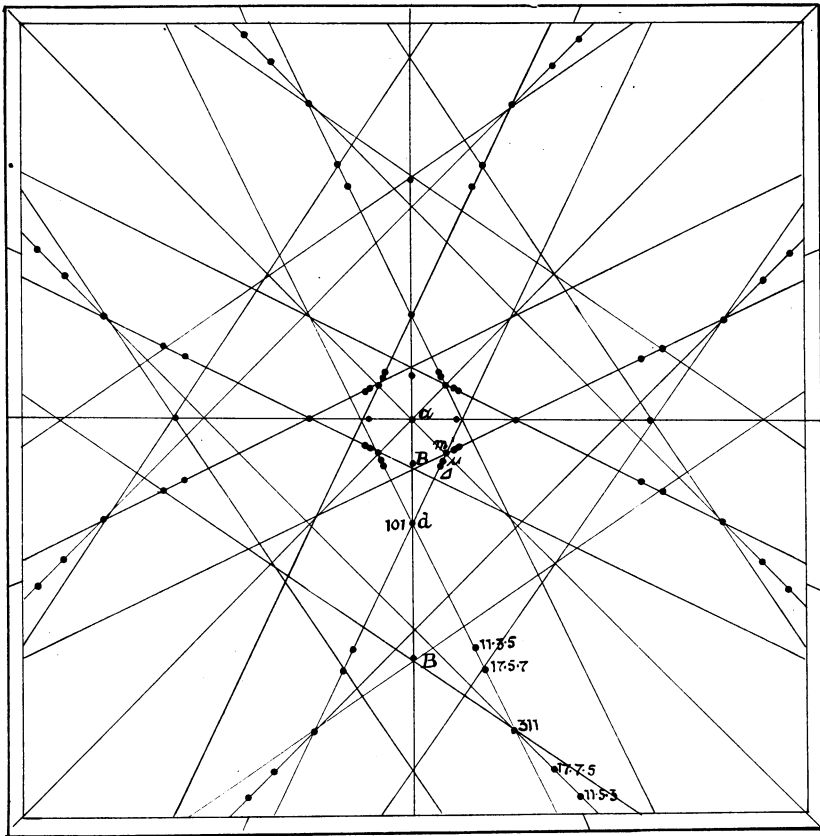


Figure 2

crystals selected for study, readings on no less than 47 faces of (5.7.17) were obtained, a most unusual circumstance when considered in connection with a new crystal form.

The zonal relations of the forms occurring on the fluorite from Phoenixville are shown in gnomonic projection in figure 2.

A single crystal measuring about 5 mm. in diameter and showing the habit of figure 1 was noted on specimen No. 3061 implanted on brownish dolomite.

Crystals of larger size and simpler in habit implanted on calcite and representing an earlier generation of fluorite formation were noted on specimen No. 3059. These are cubic in habit with a relatively small development of  $m(113)$ .

The forms  $\mu(7.5.17)$  and  $\Delta(5.3.11)$  were identified by the following series of measurements determined on a Goldschmidt Two-circle Goniometer.

	Form	Crystal I			Crystal II			Crystal III			Average			Calculated	
		$\phi$	$\rho$	N	$\phi$	$\rho$	N	$\phi$	$\rho$	N	$\phi$	$\rho$	N	$\phi$	$\rho$
$\mu$	7.5.17	35 35	26 50	7	35 40	26 49	4	35 7	26 56	4	35 29	26 51	15	35 32	26 50
	17.7.5	22 29	74 54	5	22 17	74 41	6	22 19	74 47	6	22 21	74 47	17	22 23	74 47
	17.5.7	16 21	68 21	5	16 30	68 36	6	16 22	68 35	4	16 25	68 31	15	16 23	68 26
$\Delta$	5.3.11	31 12	27 54	7	31 7	27 54	8	31 47	27 56	3	31 14	27 57	18	30 58	27 55
	11.5.3	24 20	76 3	4	24 17	75 56	6	24 8	76 3	6	24 14	76 1	16	24 27	76 3
	11.3.5	15 15	66 22	5	15 30	66 17	6	15 13	66 31	3	15 21	66 22	14	15 15	66 19

Table 1

## 2. PARALLEL GROUPING ON FLUORITE CRYSTALS

Two instances of grouping of fluorite crystals in parallel position were encountered in the course of the above mentioned survey. These seem noteworthy because of their rarity and because of the possible implications suggested by their habit.

A small specimen from Zinnwald, Czechoslovakia, numbered 2643, was obtained by Mr. Bement, early in the formation of his collection, from H. Hoseum of Basel, Switzerland.

The fluorite consists of light violet implanted octahedra, the largest crystal measuring 5 mm. in diameter. These are encrusted with minute purple tetrahedra in parallel grouping and so disposed as to form in lines perpendicular to the nearest octahedral edge. Figure 3 suggests the singular grouping of these small crystals which are obviously of a later generation than the octahedra on which they are implanted.

A specimen of light green fluorite, purchased by Mr. Bement between 1870 and 1875 from Dr. Krantz in Bonn, Germany, is octahedral-

dodecahedral in habit. The light green crystals, which average about 12 mm. in diameter, are frequently crowned by light violet red cubic crystals of a later generation in parallel position, as shown in figure 4. In some instances the second generation crystals show a slight beveling of the cubic edges by the dodecahedron.

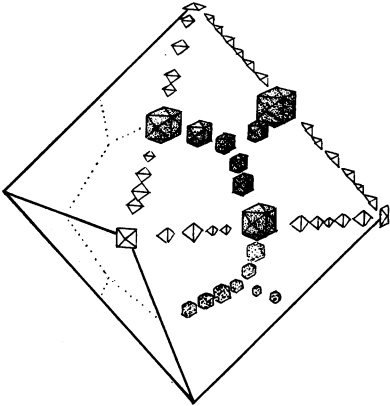


Figure 3

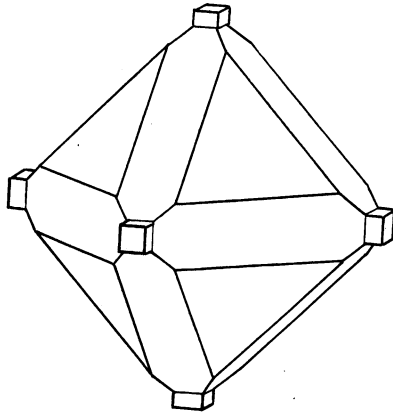


Figure 4

