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Field Columbian Museum.
Publication 129.
Geological Series. Vol. III, No. 7.

NOTES ON VARIOUS MINERALS IN THE MUSEUM COLLECTION

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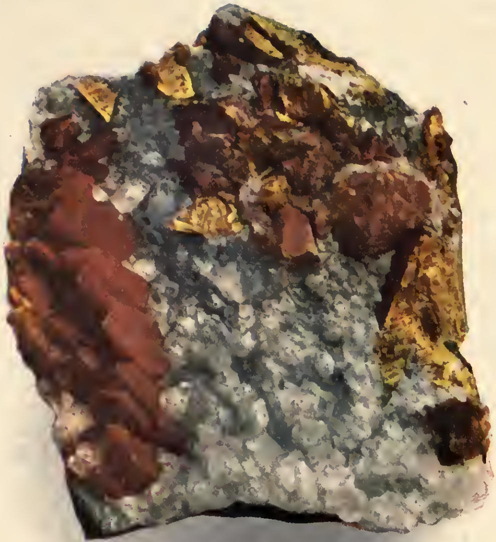
Chicago, U. S. A.
December 1, 1908.



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NOTES ON VARIOUS MINERALS IN THE MUSEUM COLLECTION

BY OLIVER CUMMINGS FARRINGTON AND EDWIN WARD TILLOTSON, JR.

ANGLESITE

TINTIC DISTRICT, UTAH

PLATES XLV AND XLVI

An especially fine series of crystallized anglesite, received from Maynard Bixby, all from the Tintic District, Utah, and chiefly from Eureka, afforded material for a study of the crystal habits of the mineral. The specimens were the choicest of many that had been collected by Mr. Bixby, and are probably, therefore, the best representation of the anglesite of the locality that has yet been obtained.

The crystals occur almost wholly in cavities in galena, the cavities as a rule having a diameter of from 1 to 4 inches. The galena shows a coarse, granular structure as a rule. The crystals of anglesite occurring in these cavities are for the most part colorless, but some are white and several show a tinge of yellow, in some cases a deep canary yellow; others exhibit smoky or gray shades. As a rule the crystals are nearly transparent, some completely so, but others show cloudings which may be so abundant as to make the crystals practically opaque. As is usual with anglesite, the lustre is highly adamantine in some specimens, but in others more nearly vitreous. The crystals vary in size from minute, lining druses, to one having a length of 4.5 centimeters (1¾ inches). For the most part a length of about 8 millimeters may be considered descriptive of the size. The crystal planes as a rule are well developed and afford fairly good measurements with the reflecting goniometer. Not infrequently, however, the surfaces are more or less uneven so that only broken reflections are obtained. The planes of the different forms are as a rule uniform in lustre and character of surface, with the exception of the macropinacoid, *a* (100), which is nearly always characterized by being striated in the direction of the vertical axis. It can usually be recognized by the naked eye by this peculiarity and thus the orientation of the crystal is much facilitated. These striations are probably the result of oscillation of the plane *a* (100) with prismatic planes, and in some crystals, as shown in Fig. 3, Pl. XLVI, this is obviously the case.

As is usual with anglesite, the crystals exhibit a variety of habits, no single habit predominating. The habits noted may be described as tabular, prismatic, and pyramidal. Of these perhaps the most striking and unusual to anglesite is the tabular one. It is produced by a pronounced development of the basal planes uniting with a short unit prism. Figs. 2 and 3, Pl. XLV, showing crystals taken from specimens having the Museum Numbers M 9579 and 7293, illustrate the habit. Crystals of this type may be simple or highly modified. In some the prism becomes longer in the direction of the vertical axis, as shown in Fig. 3, Pl. XLV. Crystals of this type are usually attached by one of the planes of the unit prism so that their orientation is not always obvious at a glance.

Prismatic habits are common and, as is usual with anglesite, the habit may be produced by elongation in the direction of either of the axes. Crystals elongated in the direction of the vertical axis are illustrated in Fig. 4, Pl. XLV (Mus. No. M 9590) and Fig. 1, Pl. XLVI (Mus. No. M 9586). Of these No. M 9590 is from the Bullion Beck mine. It exhibits the peculiarity of having the prism *m* (110) at one end of the crystal and the prism δ (230) at the other. As illustrated in the figures, the crystals of the vertically elongated prismatic habit may have pointed or blunt terminations. The blunt termination is produced by broad development of the basal plane and gives an especially characteristic form (Fig. 1, Pl. XLVI). Crystals elongated in the direction of the brachy-axis are illustrated by Fig. 2, Pl. XLVI (Mus. No. M 9587). Crystals of this type are inclined to stoutness. They are semi-transparent and have the planes well developed. The finest crystal of the whole collection exhibits this habit, the elongation in the direction of the brachy-axis being, however, less than shown in the figure of the type. This crystal has a length of 2 centimeters in the direction of the vertical axis and 1.5 centimeters in the direction of the macro-axis. It is perfectly transparent and colorless. Another superb crystal of this habit has a well-marked canary yellow color. It is about three-fourths the size of the one previously mentioned.

Fig. 3, Pl. XLVI (Mus. No. M 9582) shows a crystal form in which the elongation occurs in the direction of the macro-axis. Crystals of this type are as a rule small, having a maximum length of about 1.5

centimeters, and possess a yellow tinge. They may be described as having a wedge-shaped form, this being chiefly produced by the development of the prism M (410).

Another prismatic habit is characterized by a normally developed unit prism combined with extended basal and macropinacoids. Several pyramids also usually round the edge between the basal plane and prism. These crystals are as a rule transparent and colorless and rather small in size, their length in the direction of the vertical axis being about 4 millimeters, and in the direction of the macro-axis, about 7 millimeters. Fig. 1, Pl. XLV (Mus. No. M 9573) illustrates this habit.

The only remaining habit to be noted is a pyramidal one. Crystals of this habit are as a rule of simple development and are composed principally of the pyramid *y* (122) with minute basal planes and macro or brachydomes. One crystal of this type also shows small planes of the unit prism. These crystals have average lengths in the direction of the vertical axis of from 5 to 10 millimeters. On one specimen (Mus. No. M 9569) represented in Fig. 4, Pl. XLVI, the crystals have a milk-white color, while those of another specimen (Mus. No. M 9576) represented in Fig. 5, Pl. XVLI, are more nearly transparent and dark colored. The occurrence of the macrodome on one and brachydome on the other is also notable. One specimen (Mus. No. M 9677) exhibits a single large crystal possessing a pyramidal habit, but owing to the rounded nature of the planes the symbol could not be determined. The crystal is 4.5 centimeters in length, partially opaque, and of a dark yellow color. Another habit of occasional occurrence is produced by a combination of a pyramid and prism in about equal proportions. Crystals of this type (Mus. No. M 9581) are illustrated in Fig. 6, Pl. XLVI. They are not as a rule doubly terminated, but are so occasionally. Generally they are small, about .7 of a centimeter being an average length. These crystals are also as a rule transparent and colorless.

A total list of the forms observed on the Eureka anglesites is as follows:

a (100)	*δ* (230)	*r* (112)
b (010)	*n* (120)	*z* (111)
c (001)	*o* (011)	*τ* (221)
m (110)	*d* (102)	*p* (324)
M (410)	*l* (104)	*y* (122)
		μ (124)

BARITE

CARTERSVILLE, GEORGIA

FIGS. 1-3, PLATE XLVII

A fine suite of barite crystals from the above locality was presented to the Museum in the fall of 1902 by Prof. S. W. McCallie, the present State Geologist of Georgia. The specimens have the Museum Nos. M 7172–7235. While the occurrence of barite at the Cartersville locality has been described before, its crystallographic characters do not seem to have been given in detail. It seemed, therefore, desirable to make a crystallographic study of this suite.

The manner of occurrence of the barite has been fully described by Hayes* who states that it accompanies bodies of ocher occurring in the Cambrian quartzite of the region, the ocher being mined extensively for economic purposes. Numerous passages and cavities penetrating the quartzite and ocher are lined, Hayes states, in the case of the smaller cavities with a crust of small quartz crystals, while the larger ones frequently contain beautiful crystals of barite, which according to Hayes, "were probably deposited after the conditions favorable for the solution of silica and the deposition of ocher had passed." Hayes also says, "Groups of acicular crystals of this mineral several inches in length are not uncommon. It also occurs in white granular veins. The barite is called 'flowers of ocher' by the miners. It remains in the residual soil which covers the quartzite outcrops and affords the best means of tracing the ocher deposits. It is found at numerous points on the low quartzite ridge north and south of the Etowah river; and prospecting at these points has never failed to reveal more or less extensive deposits of ocher."

The crystals in possession of the Museum form, as a rule, interpenetrating groups or clusters, some of which are nearly a foot in length. The individuals of the group are often largely made up of aggregates having the macro-axis in common. These combine so as to produce a polysynthetic individual with serrated edges. The crystals are transparent to translucent except where the ocher enters into their substance in quantity, in which case it renders them opaque. The color of the transparent crystals is a delicate greenish-blue; but the crystals that are opaque partake to a greater or less degree of the yellowish-brown color of the ocher.

* Geological Relations of the Iron Ores in the Cartersville District, Georgia, Trans. Amer. Inst. Mining Engineers, 1900, Vol. XXX, p. 418.

The habit of the simple crystals is uniformly tabular with respect to *c* (100). They are usually also slightly lengthened in the direction of the macro-axis. The planes are bright and sharply outlined and give good signals with the reflecting goniometer. In length, in the direction of the brachy-axis, the individuals vary from 1 to 2.5 centimeters. Their average thickness is about 5 millimeters. They are rarely highly modified. They are usually made up chiefly of three pinacoids and the unit prism, pyramid and brachydome. Striations parallel with the edge *m a* usually characterize the prismatic zone except for planes of *m*, *a* and *b*, which are smooth and bright. Fig. 1, Pl. XLVII shows the usual type. The development of the prism is, however, not as a rule as well-defined as indicated in the figure, the zone from *a* to *m* being often considerably rounded and showing no well-marked planes. There may also occur a rounding of this sort between *m* and *b*. Such rounding is, in fact, quite characteristic. Some crystals are somewhat more highly modified than the above. These show as a rule several pyramids and an increased number of prisms. Figure 2, Plate XLVII (Mus. No. M 7197) illustrates such a crystal. This crystal was about 1 sq. cm, in area and 2 mm. thick.

Perhaps the most interesting type presented by these barites is that already mentioned in which numbers of smaller crystals combine to produce a crystal of different habit. The most common form of these is illustrated in Fig. 3, Pl. XLVII. Here small primary crystals, chiefly made up of the basal plane and unit prism, have grown together in parallel position to form a crystal of tabular habit which shows essentially the planes *c* (001), *a* (100), and *o* (011). Here, therefore, the crystallizing force controlled the arrangement and situation of the individual crystals as well as that of the molecules in the crystals themselves. The crystal here illustrated is not doubly terminated in the direction of the *a* axis, but in all other directions is fully developed. The size of these large polysynthetic crystals is from 3 to 6 centimeters in the direction of the *a* axis, and in the direction of the *c* axis about one-fourth of this. Groups of diverging crystals which have no apparent regularity, also occur among the specimens.

The total forms observed on the Cartersville barites and some of the measurements obtained are as follows:

c (001)	χ (130)	*f* (113)
a (100)	λ (210)	*q* (114)
m (110)	*o* (011)	*y* (122)
n (120)	*z* (111)	

					Observed	Calculated
$m \wedge m'''$	=	(110)	$\wedge$	$(1\bar{1}0)$	=	78° 25′	78° 22′
$\lambda \wedge \lambda'''$	=	(210)	$\wedge$	$(2\bar{1}0)$	=	44° 27′	44° 21′
$b \wedge n$	=	(010)	$\wedge$	(120)	=	31° 23′	31° 31′
$b \wedge \chi$	=	(010)	$\wedge$	(130)	=	22° 17′	22° 14′
$o \wedge o$	=	(011)	$\wedge$	$(01\bar{1})$	=	74° 27′	74° 34′
$c \wedge z$	=	(001)	$\wedge$	(111)	=	64° 50′	64° 19′
$c \wedge f$	=	(001)	$\wedge$	(113)	=	34° 40′	34° 43′
$c \wedge q$	=	(001)	$\wedge$	(114)	=	27° 34′	27° 28′
$c \wedge y$	=	(001)	$\wedge$	(122)	=	57° 10′	57° 1′
$o \wedge y$	=	(011)	$\wedge$	(122)	=	26° 15′	26° 1′

BERTRANDITE

ALBANY, MAINE

FIGS. 4–5, PLATE XLVII

In the summer of 1902, Mr. C. C. Spratt, at that time a resident of North Bridgton, Maine, submitted to one of the authors some hand specimens showing small, colorless crystals, which proved on examination of their blowpipe characters to be bertrandite. Mr. Spratt kindly indicated the locality from which the specimens were obtained and this was later visited by one of the authors. The locality is an area of coarse pegmatite in the northern part of the town of Albany, Maine. The pegmatite exhibits the usual coarse crystals of quartz, feldspar, tourmaline, mica, and beryl and has been worked to some extent to obtain the two latter minerals for economic purposes. The bertrandite was nowhere found to be abundant, but by close searching could occasionally be obtained. It occurs in single or grouped crystals implanted upon quartz or lining cavities one or two inches in diameter. In one of these cavities a considerably corroded piece of colorless beryl was found suggesting that the bertrandite may have been derived from alteration of the beryl. The crystals of bertrandite obtained (Mus. No. M 6969) are for the most part colorless to pale white and transparent to translucent. Some are covered with a rusty coating which readily dissolves in hydrochloric acid. The crystals all show a tabular habit produced by extensive development of the basal planes. In habit they thus resemble the crystals of Mt. Pisek and Mt. Antero rather than those described by Penfield * from Stoneham, although the latter locality is near Albany. The largest crystal of

* Am. Jour. Sci., 1889, 3, 37, p. 214.

the Albany material in the Museum is 10 mm. long, 10 mm. wide and 2 mm. thick. Some crystals seen must have been even larger than this but they were broken in excavating. The crystals in cavities are as a rule smaller than those attached to quartz, their average size being 3 x 3 x 1 mm. The attachment of all the crystals is always along an edge parallel with the vertical axis. They thus rarely show more than half the faces belonging to the prismatic zone. Their outline tends to be rectangular or hexagonal, according as the lateral pinacoids or the prisms predominate. The orientation adopted for the crystals for measurement was determined by the basal plane and by a pinacoidal cleavage normal to this which was regarded as that of the brachypinacoid, *b* (010). The distinctive characters of the base are its pearly luster and striations || to *a* (100). In addition to the cleavage || to *b* (010), a prismatic cleavage giving angles of nearly 60° was occasionally observed. The faces of the crystals on casual inspection appear bright and would seem to be well suited for measurement, but on closer examination their surfaces are found as is usual with bertrandite to be uneven and to give elongated reflections. This is especially true in the prismatic zone, where nearly all the measurements give variations between 2° and 3°. By taking the mean of these, however, values were obtained which served for identifying the faces. The crystals are not highly modified, only six forms being observed, as follows:

c (001)	*a* (100)	*f* (130)
b (010)	*m* (110)	**l* (203)

Of these *l* (203) is new to bertrandite, its determination being based on the measurement $c \wedge l = (001) \wedge (203) = 33° 56'$. The calculated angle for this form, using the axial ratios of Penfield* is 34° 59′ or using those of Urba† is 34° 48′. While the agreement of measured and calculated values for this form is not as close as could be desired it is all that can be expected when the imperfections of the planes are considered. The measurements upon which the determinations of the prisms were based are as follows, these being shown with the values calculated from both Penfield's and Urba's ratios:

		Observed	*Calculated* Penfield	*Calculated* Urba
$m \wedge m'''$	$= (110) \wedge (1\bar{1}0)$	= 58° 52′	59° 16′	59° 21′
$f \wedge f'$	$= (130) \wedge (\bar{1}30)$	= 61° 12′	60° 44′	60° 39′
Cleavage ∧ cleavage	= (110) ∧ (010)	= 60° 16′	60° 22′	60° 19′

* Am. Jour. Sci., 1889, 3, 37, p. 215. † Zs. Zr. 1889, 15, p. 194.

There is little variation in the development of the crystals, the principal differences being in the development of the macropinacoid *a* (100). When this is extended, as shown in Fig. 4, Pl. XLVII, the crystals have a generally rectangular outline; when it is developed about equally with the prisms, the crystals have an apparently hexagonal outline if, as is usually the case, only half of the crystal is present. Again the unit prism *m* (110) may be wanting entirely. If so, the crystal is usually elongated in the direction of the macro-axis and attached by the brachypinacoid *b* (010) so that the appearance illustrated in Fig. 5, Pl. XLVII is obtained. This drawing is made with *b* (010) in front in order to show the characteristic appearance. The form *l* (203), as illustrated in the figures, occurs at only one end of the vertical axis. The absence of a corresponding plane indicates hemimorphism in the direction of the vertical axis such as was noted by Penfield.* The edge opposite to *l* (203) produced by the junction of *c* ($00\bar{1}$) and *a* (100) and that upon which a plane corresponding to *l* would normally appear if the crystal were holomorphic, is never sharp, but grades irregularly toward the center of the crystal by successive overlying lamellae, all of which have irregular edges. Such indications of lamellar structure suggest twinning similar to that noted by Penfield on crystals from Mt. Antero,† but study of cross-sections of the crystals in polarized light gives no evidence to support such a view. Extinction in polarized light occurs parallel to the pinacoidal cleavage of the crystals, thus affording additional proof of the orthorhombic crystallization of the mineral. On slight heating the crystals become strongly electric so that they pick up pieces of paper. Before the blowpipe they exfoliate slightly and when heated in the closed tube decrepitate. The other blowpipe characters observed were similar to those which have been mentioned by previous observers.

CALAMINE

LEADVILLE, COLORADO

Among specimens received by the Museum from the World's Columbian Exposition, a series of ores from the Maid of Erin mine, Leadville, Colorado, contained an ocherous substance thickly coated with long, slender crystals. These crystals proved on examination by means of a blow-pipe to be calamine. The occurrence seems not to have been hitherto described, although Pratt has given an

* Loc. cit. † Loc. cit.

account of calamine,* of a habit quite similar to the above and also from a Maid of Erin mine. The occurrence described by Pratt is, however, in Clear Creek Co., Colorado, while the locality here represented is in Lake Co. As the crystals prove upon examination to exhibit a development somewhat different from that described by Pratt, there seems little doubt that they represent a separate occurrence. Inquiry by the writer of the company now operating the mine from which the Leadville calamine was stated to have come, elicited the information that some of the workmen thought that such crystals had been obtained in earlier operations at the mine but none was being found at the present time. The company also forwarded a specimen quite similar to the one above mentioned, with the information that it had been found at the El Paso mine adjoining.

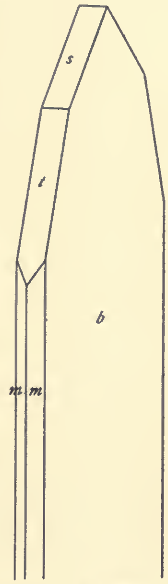

FIG. 1. Calamine.

Like the Clear Creek Co. calamine, the Leadville crystals are tabular with respect to *b* (010) and considerably striated in the prismatic zone. They are, however, differently terminated. Most commonly the termination is the unit macrodome *s* (101). Occasionally, however, the steeper dome *t* (301) is to be seen and the unit brachydome probably also occurs although this could not be verified. The usual appearance of the crystals is illustrated in the accompanying Fig. 1. Occasionally there is a larger development of the prism, giving a stouter form. The crystals tend to form groups which are partly radiated and partly joined by the brachy-pinacoid. No doubly terminated crystals were found, so that no opportunity was afforded for a study of the hemimorphic characters of this mineral. Gentle heating causes the crystals to become strongly electric. The character of the electricity developed by such heating was tested in the following manner: Numerous crystals were suspended by silk threads and after heating, glass rods electrified by silk or sealing wax excited by flannel were brought near. In every case the positively electrified substance, i. e., the glass, attracted the terminated end of the crystal and the negatively electrified, the broken end. The average length of the crystals is about 10 mm. They are transparent to translucent and colorless to white. The faces best suited for measurement are the macrodomes, an especially sharp

* Am. Jour. Sci., 1894, 3, 48, p. 213.

measurement of *t* (301) on *s* (101) having been secured on one crystal. The striations in the prismatic zone make measurements there unsatisfactory although results of sufficient accuracy for the identification of the planes were secured. The following are some of the measurements obtained:

			Measured	Calculated
$t \wedge s$	=	$(301) \wedge (101)$	= 29° 53′	29° 57′
$s \wedge s'$	=	$(101) \wedge (\bar{1}01)$	= 62° 54′	62° 46′
$m \wedge m'''$	=	$(110) \wedge (1\bar{1}0)$	= 75° 35′	76° 9′
$m \wedge b$	=	$(110) \wedge (010)$	= 52° 20′	51° 55′

CALCITE

JOPLIN DISTRICT, MISSOURI

PLATE XLVIII AND FIG. 2, PLATE XLIX

A number of crystallized specimens of calcite from the Joplin District, Missouri, received for the most part from Maynard Bixby, present features hitherto undescribed. Most of the specimens are twin crystals. The specimen bearing the Museum No. M 8695 and shown in Fig. 2, Pl. XLVIII, is from the Cuban mine, Joplin. The twinning plane is *e* $(01\bar{1}2)$ and the crystal shows its greatest elongation in the direction of this plane. The length in this direction is 11 cm. (4½ inches), while at right angles to this plane it is only about half as long (5 cm.). The form of the twin is roughly prismatic, the sides of the prism being planes of the unit rhombohedron *r* $(10\bar{1}1)$ and the scalenohedron 𝔅: $(51\bar{6}1)$.* At one end the crystal was attached, and here it shows only the cleavage rhombohedrons, but at the other end occur a re-entrant angle and a number of modifying forms. The latter forms are the rare scalenohedrons enumerated below. All are about equally developed. The substance of the twin is white and opaque in the interior and yellowish and nearly transparent on the exterior. The boundary between these two portions is rather distinctly marked, the thickness of the exterior portion being about 5 mm. The planes of the crystal have brilliant, flat surfaces as a rule, but the larger ones are more or less undulating both as to surfaces and edges. Measure-

*Goldschmidt's letter. One of the authors has elsewhere (Pub. Field Col. Mus. Geol. Ser. Vol. I., p. 239) given reasons for combining the use of Dana's and Goldschmidt's letters. The two kinds of letters can be distinguished by remembering that Goldschmidt's letters are followed by dots.

ments were made by contact. The forms determined and measurements obtained are as follows:

$r(10\bar{1}1)+R$	𝔅:(51$\bar{6}$1)+4R$\frac{3}{2}$	$\Delta(23\bar{5}2)-\frac{1}{2}R5$
$\mu(54\bar{9}1)+R9$	$G:(72\bar{9}5)+R\frac{9}{5}$	
$J:(52\bar{7}3)+R\frac{7}{3}$	$z(12\bar{3}5)-\frac{1}{5}R3$	

								Observed	Calculated
Δ	∧	Δ′	=	$(23\bar{5}2)$	∧	$(\bar{2}5\bar{3}2)$	=	40°	42° 14′
r	∧	Δ	=	(1011)	∧	$(23\bar{5}2)$	=	36°	35° 45′
μ	∧	μ′	=	$(54\bar{9}1)$	∧	$(\bar{5}9\bar{4}1)$	=	66°	66° 43′
𝔅:	∧	𝔅:‴′	=	$(51\bar{6}1)$	∧	$(\bar{1}\bar{5}61)$	=	136°	133° 19′
r	∧	𝔅:	=	$(10\bar{1}1)$	∧	$(51\bar{6}1)$	=	36°	35° 54′
z	∧	z′	=	$(12\bar{3}5)$	∧	$(\bar{1}3\bar{2}5)$	=	37°	35° 16
G:	∧	G:ᵛ	=	$(72\bar{9}5)$	∧	$(9\bar{2}\bar{7}5)$	=	21°	20° 44′
r″	∧	G:	=	$(0\bar{1}11)$	∧	$(\bar{7}9\bar{2}5)$	=	92°30′	92° 31′
r	∧	μ	=	$(10\bar{1}1)$	∧	$(54\bar{9}1)$	=	44°	44° 11′
r″	∧	J:.	=	$(0\bar{1}11)$	∧	$(52\bar{7}3)$	=	98°	99° 14′

A calcite twin bearing the Museum No. M 8692 is shown in Fig. 1, Pl. XLVIII. This is from the Crystal Palace mine, Central City, Missouri. The twinning plane is *c* (0001). The dominant forms are the rare rhombohedron *υ*·$(05\bar{5}3)$ and *e* $(01\bar{1}2)$. These produce an approximately spheroidal twin, but only about half the spheroid is present in this specimen. The halving is due to the manner of growth from the attachment. The twin is complete in a polar direction, but incomplete equatorially. The length of the polar diameter is 5.5 cm. The substance of the twin is wine-yellow, and transparent. All of the planes, however, with the exception of those of the rhombohedron *e* $(01\bar{1}2)$, are coated with a thin, firmly adhering layer of iron oxide, chocolate brown in color. The planes of *e* are striated, as represented in the drawing, and as also represented there unite with those of *υ*· by a curved edge. The common forms *v* and M modify the dominant forms. The twin is thus made up of three rhombohedrons, two of which are negative and one positive, and the scalenohedron *v*. Of the rhombohedrons, *υ*· $(05\bar{5}3)$ seems to have been first noted by Thürling*, who, however, gave it no letter. Whitlock,† who observed it on calcite from West Paterson, N. J., gave it the letter here employed.

The measurements which were made on the specimen were by contact, but the planes were so well marked that there seems

* Neues Jb. Beil. Bd., 1886, 4, p. 380.
† Am. Jour. Sci., 1907, (4), 24, p. 427.

little doubt of their accuracy. The forms and measurements are as follows:

$e(01\bar{1}2) - \frac{1}{2}R$ $\quad \upsilon.\ (05\bar{5}3) - \frac{5}{3}R$ $\quad M(40\bar{4}1) + 4R$ $\quad v(21\bar{3}1) + R3$

			Observed	Calculated
$e \wedge e'$ =	$(01\bar{1}2) \wedge (\bar{1}012)$	=	46°	45° 3′
$\upsilon. \wedge \upsilon.'$ =	$(05\bar{5}3) \wedge (\bar{5}053)$	=	95°	95° 26′
$M \wedge \upsilon.$ =	$(40\bar{4}1) \wedge (05\bar{5}3)$	=	57°	57° 12′
$v \wedge v'$ =	$(21\bar{3}1) \wedge (\bar{2}3\bar{1}1)$	=	73°	75° 22′
M ∧ M of twin =	$(40\bar{4}1) \wedge (40\bar{4}1)$	=	29° 10′	28° 26′

The specimen bearing Museum No. M 8696, and shown in Fig. 2, Pl. XLIX, exhibits a habit resembling that described by Sterrett* as presented by twins from the Maybell mine, North Empire, Kansas. The Museum specimen is from the Blackberry mine, Joplin. It lacks the amethystine color characteristic of the Maybell mine twins, being colorless and transparent except for small internal reflections and inclusions. Neither is the Blackberry mine twin characterized by large size as are the majority of the Maybell mine twins. The greatest length of the specimen here described is along the twinning plane in the direction of the edge *e f*, and is 8 cm. Normal to this in the same plane the length is 4 cm., and normal to the plane the length is 2 cm.

Like the Maybell mine twins this twin exhibits a prismatic form produced by prominence of the planes *e* and *t*. One end of the prism terminates in a re-entrant angle with modifying planes, while the other end was attached and exhibits the cleavage rhombohedrons of the two individuals, forming a salient angle. Aside from this occurrence of the unit rhombohedron it does not appear on the twin although on the Maybell mine twins it is prominent. Two scalenohedrons occur on the re-entrant angle of the twin, neither of which is represented in the Maybell mine twins. These are *E* $(41\bar{5}6)$ and a form new to calcite, ν: $(11.4.\bar{15}.3)$.† Two rhombohedrons, which are the common forms, *f* and M, round the edge between *e* and E. The rhombohedron *e* as will be noted by the figure, is the dominant form of the twin and is also the twinning plane. The common scalenohedron *v* which does not occur at all on the Maybell mine twins, occurs in this twin along the edge on which the individuals meet.

The planes of the crystal are for the most part brilliant and have sharp edges. The scalenohedron *E* however, is striated. Owing to

* Am. Jour. Sci., 1904. 41, 8, p. 73-76.

† The authors are indebted to Dr. Palache for designating this letter.

the size of the crystal, measurements were for the most part made by contact rather than by reflection.

The following is a list of forms and angles found, the new form being marked by an asterisk:

e $(01\bar{1}2)+\frac{1}{2}R$	*t* $(21\bar{3}4)+\frac{1}{4}R\ 3$	*E*$(41\bar{5}6)+\frac{1}{2}\ R\frac{5}{3}$
f $(02\bar{2}1)+2R$	*v* $(21\bar{3}1)+R\ 3$	**ν*:$(11.\ 4.\ \overline{15}.\ 3)+\frac{7}{3}\ R\ \frac{15}{7}$
M $(40\bar{4}1)+4R$		

			Observed	Calculated
Cleavage ∧ *e'*	= $(10\bar{1}1) \wedge (\bar{1}012)$	=	71°	70° 51′
e ∧ *f*	= $(01\bar{1}2) \wedge (02\bar{2}1)$	=	37° 30′	36° 52′
e ∧ M	= $(01\bar{1}2) \wedge (04\bar{4}1)$	=	77° 30′	77° 58′
e ∧ *t*	= $(01\bar{1}2) \wedge (21\bar{3}4)$	=	21°	20° 58′
e ∧ *v*	= $(01\bar{1}2) \wedge (21\bar{3}1)$	=	67°	66° 24′
E ∧ *E*ᵛ	= $(41\bar{5}6) \wedge (5\bar{1}\bar{4}6)$	=	15°	13° 4′
E ∧ M	= $(41\bar{5}6) \wedge (40\bar{4}1)$	=	38° 30′	39° 44′
e' ∧ *E*	= $(\bar{1}012) \wedge (41\bar{5}6)$	=	118°	117° 6′
M ∧ *ν*:	= $(40\bar{4}1) \wedge (11.\ 4.\ \overline{15}.\ 3)$	=	15°	14° 35′
e ∧ *ν*:	= $(01\bar{1}2) \wedge (11.\ 4.\ \overline{15}.\ 3)$	=	77°	77° 21′
t ∧ *ν*:	= $(21\bar{3}4) \wedge (11.\ 4.\ \overline{15}.\ 3)$	=	72° 30′	72° 52′
ν: ∧ *ν*:ᵛ	= $(11.\ 4.\ \overline{15}.\ 3) \wedge (15.\ \bar{4}.\ \overline{11}.\ 3)$	=	30°	29° 5′

A number of groups of calcite crystals from the Joplin District, exhibited by a private collector, Mr. John C. Moore, at the Louisiana Purchase Exposition, were of especial interest on account of the large size of the crystals and the perfection of their planes. A number of these were obtained by the Museum (Mus. Nos. M 7874-7884). Examination of the crystals with the contact goniometer shows them to be made up of common forms, such as are already known to charac-

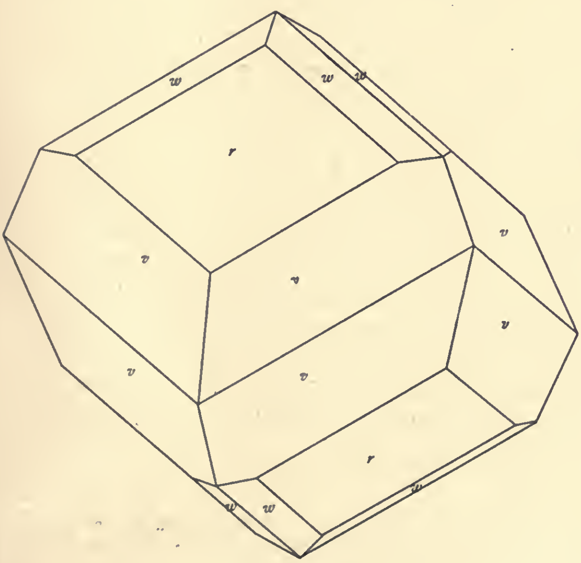

FIG. 2. Calcite.

terize the Joplin calcites, as described by one of the authors.* The average development of the forms is shown in the accompanying figure, Fig. 2. The planes of the different forms show readily recognizable peculiarities. Thus the planes of v $(21\bar{3}1)$ usually have brilliant, more or less undulating surfaces, those of r $(10\bar{1}1)$ are roughened like ground glass, and those of w $(31\bar{4}5)$ are smooth. The substance of the crystals is semi-transparent and amethystine in color. Needles and flakes of marcasite are included in large numbers through the substance. Fragments of the calcite phosphoresce with a warm yellow light when moderately heated, although Headden† found only the yellow Joplin calcite phosphorescent. The largest crystals measure a foot in length and weigh 20-30 lbs.

CALCITE

BELLEVUE, OHIO

FIG. 1, PLATE XLIX

A crystal of calcite (Mus. No. M 10372) kindly presented to the Museum by Mr. S. A. Kurtz, Principal of the Bellevue High School, shows some unusual features. The crystal is of the "dog-tooth" form and would appear on casual glance to be a polar half of a scalenohedron. It is 2.5 cm. in length and composed of colorless, transparent calcite. Mr. Kurtz states that such crystals occur at a depth of about twenty feet from the surface in a hard, blue layer of the Niagara limestone at Bellevue. An examination of the crystal with the reflecting goniometer shows that its fundamental forms are not scalenohedrons but pyramids of the second order. The dominant one of these is γ $(8.8.\overline{16}.3)$. This, it is of interest to note, was found by Penfield and Ford to be a dominant form on silicious calcite from the Bad Lands, Nebraska,‡ and Union Springs, New York.§ Rogers also found it a dominant form on calcite from Shullsburg, Wisconsin.|| The next pyramid of the Bellevue specimen cuts the vertical axis at one half the height of γ, its symbol being α $(44\bar{8}3)$. Above this occurs the pyramid π $(11\bar{2}3)$ cutting the vertical axis at one fourth the height of α. The pyramids are thus in Dana's symbols, $\frac{16}{3}$-2, $\frac{8}{3}$-2 and $\frac{2}{3}$-2.

* Farrington, Pub. Field Col. Mus., 1900, Geol. Ser. Vol. I, pp. 232-241.

† Am. Jour. Sci., 1906, 4, 21, p. 301.

‡ Am. Jour. Sci., 1900, 4, 9, p. 353.

§ Am. Jour. Sci., 1900, 4, 10, p. 237. The Union Springs occurrence was further studied by Whitlock (Bull. 98, New York State Museum) and the conclusion reached that the pyramidal habit was produced by crystallization from a highly siliceous solution.

|| Am. Jour. Sci., 1901, 4, 12, p. 42.

Combined with the pyramids are two scalenohedrons, one of which has the symbol 20. 11. $\bar{31}$. 11 ($+\frac{9}{11}$ R $\frac{51}{9}$) and the other occurs between this form and *a*. Although the latter is a well-defined plane no satisfactory reflections could be obtained from it for determining its symbol. Inasmuch, however, as its zonal relations are plainly shown on the crystal, it is represented in the drawing, Fig. 1, Pl. XLIX.

The form 20. 11. $\bar{3}$1. 11 is new to calcite, and through the kindly advice of Dr. Charles Palache, the letter μ: was adopted for it. The form is so close to the common scalenohedron *v* (21$\bar{3}$1) that it would seem probable that the latter symbol was the correct one, but the measurements obtained allow no other conclusion than the symbol above chosen.

The following are some of the measurements obtained:

						Observed	*Calculated*
$a \wedge a'$	=	(44$\bar{8}$3)	$\wedge$	($\bar{4}$8$\bar{4}$3)	=	54° 27′	54° 30′
$a \wedge a^{v}$	=	(44$\bar{8}$3)	$\wedge$	(8$\bar{4}\bar{4}$3)	=	54° 40′	54° 30′
$\gamma \wedge \gamma'$	=	(8. 8. $\bar{16}$. 3)	$\wedge$	($\bar{8}$. 16. $\bar{8}$. 3)	=	58° 28′	58° 28′
$\gamma \wedge \gamma^{v}$	=	(8. 8. $\bar{16}$. 3)	$\wedge$	(16. $\bar{8}$. $\bar{8}$. 3)	=	58° 24′	58° 28′
$\gamma \wedge r$	=	(8. 8. $\bar{16}$. 3)	$\wedge$	(01$\bar{1}\bar{1}$)	=	63° 40′	63° 24′
$a \wedge \pi$	=	(44$\bar{8}$3)	$\wedge$	(11$\bar{2}$3)	=	36° 31′	36° 38′
$\pi \wedge \pi'''$	=	(11$\bar{2}$3)	$\wedge$	($\bar{1}\bar{1}$23)	=	59° 7′	59° 20′
$a \wedge r$	=	(44$\bar{8}$3)	$\wedge$	(10$\bar{1}$1)	=	32° 41′	32° 32′
$a^{v} \wedge r$	=	(8$\bar{4}\bar{4}$3)	$\wedge$	(10$\bar{1}$1)	=	32° 24′	32° 32′
$\mu: \wedge \mu:'$		(20. 11. $\bar{31}$. 11)	$\wedge$	($\bar{20}$. 31. $\bar{11}$. 11)	=	72° 44′	72° 9′
$\mu: \wedge \mu:^{v}$		(20. 11. $\bar{31}$. 11)	$\wedge$	(31. $\bar{11}$. $\bar{20}$. 11)	=	37° 27′	37° 47′

EPSOMITE

WILCOX STATION, WYOMING

Crystals of epsomite from the above locality were described by one of the authors in a previous publication.* It may be here noted that the figure there given should be turned at right angles to its position in the text in order to be correctly placed. Some time afterwards the late Prof. W. C. Knight, to whom the acquisition of the first crystals was due, kindly furnished about a dozen additional individuals which were somewhat more modified than those first described.

The habit of these crystals is stout, prismatic. The largest crystal was 31 mm. (1 ¼ in.) long in the direction of the vertical axis and

* Pub. Field Col. Mus., Geol. Ser., Vol. I, p. 228.

23 mm. (⅞ in.) long in the direction of the macro-axis. All the crystals are bounded by the planes *m* (110), *b* (010), *z* (111), and *z'* ($\bar{1}$11), although occasionally one of the sphenoids is absent. Some of the measurements taken with the reflecting goniometer on which these determinations were based are as follows:

			Observed	*Calculated*
$b \wedge m$	= (010) ∧ (110)	=	45° 35'	46° 17'
$m \wedge m'''$	= (110) ∧ (1$\bar{1}$0)	=	89° 20'	89° 26'
$z \wedge z'$	= (111) ∧ ($\bar{1}$11)	=	53° 12'	53° 12'
$z \wedge z'''$	= (111) ∧ (1$\bar{1}$1)	=	52° 38'	52° 38'

Recognition of the clinopinacoid *b* (010) is made easy by the prominent cleavage in that direction. In the development of the crystals the prism *m* (110), and one of the sphenoids *z* (111) are most prominent, although the clinopinacoid has in some of the crystals a width half as great as the prismatic faces. Occasionally, too, both of the sphenoids are found to be equally developed. An average development of the faces is shown in the accompanying figure (Fig. 3.)

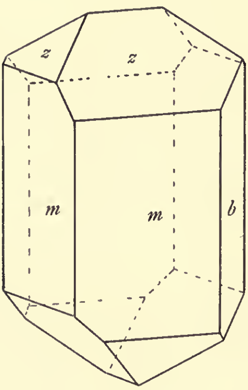

FIG. 3. Epsomite.

The crystals are simple individuals with the exception of two, each of which contains another individual implanted upon it, but not in any definite crystallographic direction. The crystals are all doubly terminated, but the planes are frequently imperfect and cavities are numerous. When first received the crystals were colorless and transparent, but in the Museum laboratory they have deliquesced.

LEADHILLITE

SHULTZ, ARIZONA

FIG. 1, PLATE L

A specimen of leadhillite from Shultz, Arizona, obtained from Maynard Bixby (Mus. No. M 9604), in the form of a single, large, cuboidal crystal with fragments of other leadhillite crystals attached, seems sufficiently unlike other occurrences of the mineral to warrant description. The sides of the apparent cube of this specimen have a length of 2½ centimeters. One of its surfaces is yellowish-green, translucent and of resinous luster, but the remaining surfaces are coated with a white, opaque mineral evidently derived from alteration of the underlying substance. This coating is about 1 millimeter in thickness. The blowpipe characters of the principal mineral agree with those of leadhillite, and those of the coating mineral with cerussite. Alteration of leadhillite to cerussite was also observed by Penfield on crystals from this locality.* While the large crystal under consideration had an apparently cubical form, measurements of the angles with the reflecting goniometer, secured by attaching cover glasses to the planes, gave 87° 5′, 87° 30′ and 87° 48′. These results suggested the presence of a rhombohedron, especially as an apparently rhombohedral form of leadhillite, known as susannite, has been observed. Moreover, a well-marked cleavage truncating the solid angle in a manner corresponding to the basal cleavage of the rhombohedron occurs on the crystal. The angles of this cleavage upon the planes of the crystal are as follows: 51° 20′, 51° 57′, 52° 45′. These angles closely resemble those given for the rhombohedron of susannite by Dana,† his value for $c \wedge r$ being 128° 3′ and for $r \wedge r'$, 94°. It is thus apparent that the interfacial angles of the crystal would admit of its interpretation as a rhombohedron. On examining the cleavage plates with the polarizing microscope, however, well-marked biaxial characters appear. Interference figures perpendicular to the acute bisectrix are exhibited, with dispersion $\rho < v$ and a negative optical character. It is thus obvious that the crystal should be interpreted as monoclinic and must therefore probably be regarded as made up of a negative pyramid and an orthodome. The pyramid and dome most nearly corresponding with the angles given above are *t* (112) and *f* ($\bar{1}01$), the measured and calculated angles for these forms comparing as follows:

			Observed	*Calculated*
c (cleavage) $\wedge f$	= (001) $\wedge$ ($\bar{1}01$)	=	51° 57′	51° 51′
c " $\wedge t$	= (001) $\wedge$ (112)	=	52° 45′	51° 51′
$t \wedge t'$	= (112) $\wedge$ ($1\bar{1}2$)	=	87° 5′	85° 6′

Fig. 1, Pl. L, shows the form thus produced. The habit seems not to have been hitherto observed in leadhillite except in so far as it may resemble the rhombohedral habit of susannite. The specific gravity of the mineral was found to be 6.42.

* Dana, System of Mineralogy, 1892, p. 922.

† Syst. Min., 1854, p. 373.

LINARITE

EUREKA, UTAH

FIGS. 2 AND 3. PLATE L

Several specimens of linarite from Eureka, Utah, were obtained from Maynard Bixby. Of these one specimen, Mus. No. M 9616, was especially remarkable for its size and perfection. The linarite occurs in this specimen as a single crystal attached to a siliceous matrix. On casual inspection the crystal has the appearance of a nearly square prism terminated by two dome planes. Measurement, however, shows that the crystal is, as is usual with linarite, elongated in the direction of the ortho-axis, the two apparent domes being the unit prism. The length of the crystal in the direction of the ortho-axis is 12 millimeters, and its width 6 millimeters. A re-entrant angle suggested that the crystal was probably twinned upon the basal plane, but as it was deemed undesirable to remove the crystal from its matrix, no careful study of this feature could be made. The color of the crystal is the deep azure-blue characteristic of linarite, and is so deep as to make the crystal as a whole practically opaque. On another specimen, Mus. No. M 9617, several smaller crystals occurred which permitted removal for measurement with the reflecting goniometer. The habit and attachment of some of these were the same as those of the large crystal, while others showed a more nearly tabular habit. The crystal selected for goniometric measurement exhibted the same habit as the large crystal and was 6 millimeters long by 3 millimeters wide. Its orientation was determined by well-marked cleavage parallel to the orthopinacoid. On this crystal in the zone of orthodomes two forms new to linarite were determined. These were δ (10.0.9) and ϕ ($\bar{9}$.0.10). Of these ϕ, ($\bar{9}$.0.10) was the better developed. The occurrence of the domes and base nearly at right angles to *a* (100) gives the crystal a characteristically hexagonal appearance when viewed in the direction of the ortho-axis. In the pyramidal zone a new form *f* ($\bar{5}23$) was observed. Its determination was based on its occurrence in the zone *mgr* and the angle $f \wedge m' = (\bar{5}23) \wedge (\bar{1}10) = 52° 45'$. It will be noted that this pyramid occurs in the same zone with the unit dome *s* ($\bar{1}01$), and if this dome had been present in the crystal, as is frequently the case with linarite, a measurement would have been obtained of it in that zone. As a matter of fact, however, the dome which actually occurs was outside the zone *mgr*. This affords additional proof of the correctness of its determination as ϕ ($\bar{9}$.0.10), although its position, so near that of the unit dome common to linarite, would suggest the possibility of its being confused with the latter. It may also be noted that the measurement from *a* (100) ∧ *c* (001), is nearly the same as from *a* (100) ∧ ϕ ($\bar{9}$.0.10). This would suggest twinning on the orthopinacoid, but on careful study of the crystal no evidence of twinning could be observed. The interpretation given above seems, therefore, to be the most reasonable one. The pyramid *f* ($\bar{5}$23) exhibits somewhat rounded faces; the dome *u* ($\bar{2}$01) is also characterized by somewhat undulating surfaces. No special characters were noted regarding the other planes. The appearance of the crystal as a whole is shown in Fig. 2, Pl. L. In Fig. 3, Pl. L a projection of these forms upon the clinopinacoid is shown. This exhibits to good advantage the characteristic zones of the crystal and its nearly square appearance when seen in the direction of the ortho-axis. The following is a list of the forms observed, together with some of the measured and calculated angles. The new forms are marked with an asterisk.

c (001)	*ϕ ($\bar{9}$. 0. 10)
a (100)	*x* ($\bar{3}$02)
m (110)	*u* ($\bar{2}$01)
r (011)	*g* ($\bar{2}$11)
*δ (10. 0. 9)	**f* ($\bar{5}$23)

				Observed	Calculated
c ∧ *x*	=	(001) ∧ ($\bar{3}$02)	=	39° 59′	40° 3½′
c ∧ *u*	=	(001) ∧ ($\bar{2}$01)	=	50° 14′	50° 6′
c ∧ *a*	=	(001) ∧ (100)	=	77° 27′	77° 22′ 40″
c ∧ *δ*	=	(001) ∧ (10. 0. 9)	=	24° 32′	25° 8′
c ∧ ϕ	=	(001) ∧ ($\bar{9}$. 0. 10)	=	25° 15′	25° 23′
r ∧ *m*	=	(011) ∧ (110)	=	50° 48′	51° 9′
r ∧ *a*	=	(011) ∧ (100)	=	80° 28′	80° 13′
g ∧ *m′*	=	($\bar{2}$11) ∧ ($\bar{1}$10)	=	42° 50′	42° 53′
g ∧ *a′*	=	($\bar{2}$11) ∧ ($\bar{1}$00)	=	59° 11′	59° 27′
f ∧ *m′*	=	($\bar{5}$23) ∧ ($\bar{1}$10)	=	52° 45′	52° 40′

MIMETITE

EUREKA, UTAH

FIGS. 4 AND 5, PLATE L

On several specimens from Eureka, Utah, obtained from Maynard Bixby, mimetite occurs in acicular form. In one of these specimens (Mus. No. M 8384), the crystals are in the form of minute white needles occurring in great abundance coating pyramidal crystals of anglesite. On another specimen (Mus. No. M 8385), the crystals are larger, reaching a length of 1 cm. with a thickness of .75 mm. These crystals are transparent and colorless. Many of them show a termination in which it is possible to recognize definite crystal planes, and examination with the reflecting goniometer permits identification of the unit prism *m* ($10\bar{1}0$), the unit pyramid *x* ($10\bar{1}1$) and the basal plane *c* (0001). Fig. 4, Pl. L, shows the characteristic development. In another specimen (Mus. No, M 9383), the mimetite exhibits the same habit, but the crystals are somewhat shorter and have a wine-yellow color. These crystals have an average diameter of .6 mm. and reach a length of 5 mm. The forms of which they are composed are similar to those previously mentioned, but the basal plane is more extensively developed as shown in Fig. 5, Pl. L. No doubly terminated crystals were found. Neither the colorless nor the yellow crystals exhibit noticeable absorption or pleochroism in polarized light in the direction of the vertical axis. On heating, the yellow crystals change to a smoky color.

OCTAHEDRITE

JEQUITINHONHA RIVER, BRAZIL

FIGS. 2-4, PLATE LI

Several crystals of octahedrite were presented to one of the authors by Olaf E. Ray, Esq., an official of the Chicago Brazilian Diamond Company. These crystals were obtained from washings of the diamond-bearing sand of the Jequitinhonha River, near Diamantina, Brazil. The crystals have the typical pyramidal character of octahedrite and range from 5 to 8 mm. in length. Their color is the typical brownish-black of the mineral showing greenish-yellow by transmitted light. Aside from striations the planes are splendent. The edges are somewhat rounded from stream rolling, but otherwise the crystals are well developed and give excellent signals with the reflecting goniometer. Probably the most remarkable feature exhibited by the crystals is their apparently hemimorphic development. This development is shown in Figs. 3 and 4, Pl. LI. Thus the crystal shown in Fig. 3, Pl. LI, exhibits at one end a small basal plane with several modifying pyramids, while at the opposite end the basal plane alone occurs. Again, the crystal shown in Fig. 4, Pl. LI, shows one end considerably modified by pyramids, while the other possesses no modifying planes whatever. Such crystals might be expected to show pyro-electricity but careful tests for this property made with the kindly assistance of Prof. R. A. Millikan, of the University of Chicago, gave no indications of its presence. The apparent hemimorphism is perhaps therefore to be regarded as due to distortion only. Other interesting illustrations of distortion or merohedrism are shown by the crystals. Thus on the crystal shown in Fig. 3, Pl. LI, but a single plane of the pyramid *v* (117) occurs, while the other forms are present in normal number. The crystal shown in Fig. 4, Pl. LI, exhibits two planes of the pyramid *v* (117) and two planes of the pyramid *r* (115). In addition occur two planes only of the ditetragonal pyramid s_1 (5.1.19). On the crystal shown in Fig. 2, Pl. LI, a single plane of the pyramid of the second order G (104) occurs and a pyramid new to octahedrite, M (338) is present as two planes, while the development of the other pyramids is normal in character. No differentiation of the planes in luster or etching figures can be noted except that the pyramid of the second order G (104) shows numerous pittings. In addition the dominant pyramid *p* (111) is always characterized by striations parallel to the base. The total forms observed with angles follow, the one marked with an asterisk being new. The letter G has been given to the form 104, this form having been listed by Hintze* but not lettered:

c (001)	*r* (115)	s_1 (5. 1. 19)
G (104)	*v* (117)	
p (111)	*M (338)	

				Observed	Calculated
$p \wedge p''$	=	(111)	$\wedge$ $(\bar{1}\bar{1}1)$	=	136° 32′	136° 36′
$r \wedge r''$	=	(115)	$\wedge$ $(\bar{1}\bar{1}5)$	=	53° 14′	53° 22′
$v \wedge v''$	=	(117)	$\wedge$ $(\bar{1}\bar{1}7)$	=	39° 44′	39° 30′
$c \wedge G$	=	(001)	$\wedge$ (104)	=	23° 48′	23° 58′
$c \wedge M$	=	(001)	$\wedge$ (338)	=	43° 51′	43° 18′
$s_1 \wedge s_1'$	=	(5. 1. 19)	$\wedge$ (1. 5. 19)	=	27° 33′	27° 38′
$p \wedge s_1$	=	(111)	$\wedge$ (5. 1. 19)	=	48° 5′	48° 12′
$r \wedge s_1$	=	(115)	$\wedge$ (5. 1. 19)	=	14° 46′	14° 41′
$v''' \wedge s_1$	=	$(1\bar{1}7)$	$\wedge$ (5. 1. 19)	=	21° 28′	21° 32′

* Handbuch der Mineralogie, 1906, Bd. I, p. 1563.

OLIVENITE

TINTIC DISTRICT, UTAH

PLATE LII

Crystals of olivenite from this locality have been previously described by Washington,* but a large suite of specimens received from Maynard Bixby affords some new characters which seem worthy of description. The olivenite in these specimens occurs both as well-defined crystals and in the fibrous form known as wood-copper. For the most part the crystals present the dark olive-green color characteristic of olivenite, although there are some variations from this, as will be noted. None of the crystals is highly modified, nor are they of large size. For the most part they exhibit a prismatic habit and occur encrusting cavities in a cupriferous gangue. The largest crystals noted (Mus. No. M 9414) are represented by Fig. 1, Pl. LII. These crystals are scattered in radiated fashion over a siliceous matrix and reach in some cases a length of 1 cm. They are usually attached by the macropinacoid *a* (100). As shown in the figure, they are simple in form, being made up of the unit prism *m* (110), the macropinacoid *a* (100) and the brachydome *d* (025). This dome is a form new to olivenite. Its determination was based on a good measurement of $d \wedge d' = 32° 45'$. A somewhat similar habit is exhibited by the crystals shown in Fig. 2, Pl. LII (Mus. No. M 9400), except that the basal plane occurs here and the macropinacoid is lacking. The dome and base are characterized by striations || to *a* (100). These crystals are of dark, nearly black, color, about 1 mm. in length and occur thickly encrusting a somewhat porous gangue. Another simple habit consists only of the unit prism and basal plane, producing a tabular form. This is exhibited in Fig. 3, Pl. LII (Mus. No. M 9413). These crystals occur lining a cavity about one inch in diameter. Sheaf-like crystals of azurite of a tabular habit are implanted upon the olivenite. The olivenite crystals are of a light olive-green color, with dull planes, and are usually attached by the basal plane. The average length of these crystals, measured in the direction of the macro-axis is 5 mm. A rather unusual habit for olivenite is that represented in Fig. 4, Pl. LII (Mus. No. M 9421). These crystals are elongated in the direction of the brachy-axis. The extension seems to be rather the result of growth of a number of

*Am. Jour. Sci., 1888, 3, 35, p. 298.

crystals in a parallel direction than the development of a single crystal. Nevertheless many of the planes give reflections like those of a single plane. The color of these crystals is a dark olive-green and they usually exhibit a radiated arrangement in their attachment. The individual crystals are attached by the end of the brachy-axis, their length averaging about 5 mm. The planes are as a whole brilliant and give fair reflections. Fig. 5, Pl. LII, represents a habit tabular with respect to *a* (100). This habit is exhibited by the crystals of a single specimen, Mus. No. M 9403. These crystals are very small, their greatest length being .5 mm. and thickness .1 mm. They are also peculiar in being nearly transparent and having a pale olive-green color rather than the deep green to black usually characteristic of the mineral. The cavity in which the crystals occur is lined with chrysocolla, and upon this the olivenite is implanted. The above specimens are all from Eureka, Utah. A single specimen, Mus. No. M 9419, from Mammoth, Utah, exhibits crystals differing somewhat in habit from any of the above. This habit is shown in Fig. 6, Pl. LI, and is characterized by prominent development of the basal planes, and elongation in the direction of the macro-axis, producing a tabular form. A brachydome not previously noted on olivenite also occurs on these crystals. This lies between the base *c* (001) and the unit dome *e* (011) and its determination is based upon its occurrence in the zone noted and the measurement $e \wedge s = 7° 50'$. Occurring with crystals of this habit are others of the habit shown in Fig. 2, Pl. LII. All the crystals on this specimen, Mus. No. M 9419, are greenish-black in color, opaque, and have brilliant planes. They occur encrusting cavities in massive malachite.

In the measurement of the crystals as a whole it was found that the angles observed did not agree with those obtained from the axial ratios of Washington as fully as could be desired. This discrepancy was especially noticeable in the measurement of the prism $m \wedge m'''$. A large number of measurements of this angle gave a value closely approximating 87° 28′, which differs nearly a degree from that obtained by Washington, his value being 86° 26′. Further, the measurement obtained for $e \wedge e'$, approximated in several good measurements closely to the value 69° 18′. These values agree more closely with the measurements of Phillips * than with those of Washington. The excellence of the measurements on the Eureka crystals seemed to warrant the calculation of axial ratios from them, and these

* Mineralogy, 1823, p. 319

were accordingly obtained as follows, the ratios of Washington and Phillips being given for comparison:

$a : b : c = 0.95873 : 1 : 0.69114$, Farrington and Tillotson.
$a : b : c = 0.9573 : 1 : 0.6894$, Phillips.
$a : b : c = 0.9396 : 1 : 0.6726$, Washington.

The total forms observed with the measured and calculated angles are as follows, new forms and fundamental measurements being marked with an asterisk:

a	(100)	*v*	(101)
b	(010)	*e*	(011)
c	(001)	**s*	(034)
m	(110)	**d*	(025)

			Observed	Calculated
$m \wedge m'''$	=	$(110) \wedge (1\bar{1}0)$	=	*87° 28′	
$e \wedge e'$	=	$(011) \wedge (0\bar{1}1)$	=	*69° 18′	
$a \wedge v$	=	$(100) \wedge (101)$	=	53° 59′	54° 9′
$e \wedge s$	=	$(011) \wedge (034)$	=	7° 50′	7° 15′
$d \wedge d'$	=	$(025) \wedge (0\bar{2}5)$	=	32° 45′	32° 20′

No marked pleochroism of any of the crystals could be observed. On examination of some of the acicular forms with the polarizing microscope the usual characters were observed with the exception that a red variety occurred which does not seem to have been hitherto mentioned. These crystals are characterized by a brownish-red color, occur in tufts, and the individuals average from .5 to 2 mm. in length. They are transparent and of marked brownish-red color but show little or no pleochroism.

ORPIMENT

MERCUR, UTAH

PLATES XLIV AND LIII

Among the specimens obtained from Maynard Bixby, orpiment from Mercur, Utah, was represented by an especially notable one, (Mus. No. M 8206). This specimen consisted of a piece of limestone about 3x4 inches in size, upon which were implanted about fifteen large crystals of orpiment together with fragments of orpiment crystals and numerous crystals of calcite. The size and perfection of many of the orpiment crystals seem to exceed any that have been hitherto described. The largest of the crystals measure 20 millimeters in length by 17 millimeters in width, and from this they diminish to about one-half this size. They are arranged upon the matrix in a nearly parallel position though not exactly so. The mode of attachment may be in general stated to be that of the lower end of the vertical axis, though this attachment varies somewhat. The crystal planes do not present brilliant surfaces, but though dull are not rounded. They do not afford sharp signals with the reflecting goniometer, but give tokens sufficiently well defined so that very close estimates of the angular values can be obtained. The cleavage parallel to the clinopinacoid is, as usual, very strongly marked. This cleavage affords reflections which are sharp but vicinal. The color of the crystals is a dark orange-red, on cleavage surfaces bright golden-yellow. The crystals are opaque. In development the crystals exhibit monoclinic symmetry throughout and leave little doubt that orpiment should be considered as crystallizing in this system. They are all of the same habit and one which seems to be new for this mineral. It is especially characterized by the large development of the positive pyramid ν ($\bar{3}43$). This occurs in broad planes, sometimes 1.5 cm. in length by 1 cm. in width. Grouped with this pyramid occurs in greater or less development the pyramid v($\bar{1}21$). Accompanying this occur several prisms and in less prominent development several other pyramids. The habit generally exhibited is illustrated in Fig. 1, Pl. LIII, the crystal being drawn in the normal position. As this position is not, however, favorable to exhibiting the positive pyramid, Fig. 2, Pl. LIII, shows the crystal drawn in reverse position. Three forms new to orpiment were detected upon the crystals. These were the 3/2 clinodome, 023, designated as *l*, the 1/3 negative pyramid $\bar{1}33$ designated as *n*, and the 1/3 positive orthodome $\bar{1}03$ designated as *d*. In addition two forms were noted which had been observed by Stevanovic,* but to which he had assigned no letters, apparently because he did not regard his results as conclusive. These forms were the 1/3 negative orthodome 103 to which the letter *e* has been assigned, and the positive pyramid $\bar{1}23$ to which the letter *k* has been assigned. The habit of the Mercur crystals, it may be noted, somewhat resembles that of one figured by Stevanovic† from Allchar except that in the crystal figured by him, the prisms are the prominent forms instead of the pyramids. A basal projection showing the usual development of the different forms found upon the Mercur specimen is given

*Zs. Kr., 1904, 39, p. 14.

†Loc. cit. Fig. 3.

in Fig. 3, Pl. LIII. In calculating the forms the axial ratios established by Stevanovic have been employed rather than those of Mohs. These values are as follows:

$$a : b : c = 0.5962 : 1 : 0.665 \qquad \beta = 90° 41'$$

The following is a list of the forms observed on the Mercur orpiment, those marked with an asterisk being new:

a (100)	*e* (103)	*q* $(\bar{4}49)$
b (010)	**d* $(\bar{1}03)$	*k* $(\bar{1}23)$
m (110)	**l* (023)	**n* $(\bar{1}33)$
u (120)	*ν* $(\bar{3}43)$	*i* (243)
o (101)	*v* $(\bar{1}21)$	

				Observed	*Calculated*
$b \wedge o$	=	$(010) \wedge (101)$	=	90° 28′	90° 00′
$a \wedge m$	=	$(100) \wedge (110)$	=	31° 2′	30° 48′
$a \wedge u$	=	$(100) \wedge (120)$	=	50° 10′	50° 1′
$a \wedge o$	=	$(100) \wedge (101)$	=	41° 19′	41° 35′
$a \wedge e$	=	$(100) \wedge (103)$	=	70° 8′	69° 14′
$e \wedge d$	=	$(103) \wedge (\bar{1}03)$	=	40° 58	41° 32′
$b \wedge l$	=	$(010) \wedge (023)$	=	65° 23′	66° 5′
$o \wedge l$	=	$(101) \wedge (023)$	=	54° 35′	53° 14′
$\nu \wedge \nu'$	=	$(\bar{3}43) \wedge (\bar{3}\bar{4}3)$	=	61° 34′	61° 32′
$v \wedge v'$	=	$(\bar{1}21) \wedge (\bar{1}\bar{2}1)$	=	82° 58′	83° 32′
$b \wedge n$	=	$(010) \wedge (\bar{1}33)$	=	59° 45′	58° 21′
$o \wedge n$	=	$(101) \wedge (\bar{1}33)$	=	70° 35	72° 22′
$b \wedge k$	=	$(010) \wedge (\bar{1}23)$	=	68° 41′	67° 44′
$o \wedge k$	=	$(101) \wedge (\bar{1}23)$	=	70° 00′	70° 48′
$b \wedge q$	=	$(010) \wedge (\bar{4}49)$	=	75° 52′	75° 6′
$b \wedge i$	=	$(010) \wedge (243)$	=	54° 21′	54° 43′
$o \wedge i$	=	$(101) \wedge (243)$	=	36° 17′	36° 50′

In connection with these crystals the well-known crystals * from this locality occurring in cavities in clay were examined. These crystals are of smaller size and are for the most part obviously twins but their planes were found to be so poorly developed that no satisfactory measurements could be obtained.

* App. Dana's Mineralogy, 1899, p. 50.

PHENACITE

NORTH CHATHAM, NEW HAMPSHIRE

The first published mention of phenacite from this locality seems to have been by Kunz in 1890* This brief mention may be repeated here:

"In May, 1888, E. A. Andrews, of Stow, Me., discovered some crystals of phenacite on Bald Mountain†, North Chatham, N. H., near the State line between Maine and New Hampshire and in the neighborhood of Stoneham, Me. They were found in a vein of coarse albitic granite, associated with crystals of smoky quartz, topaz and muscovite, some implanted on smoky quartz, and a few attached so loosely to the matrix by one of the rhombohedral faces that they could be removed without being broken. They were about fifty in number, lenticular in shape, and measured from ⅛ inch to ½ inch (3 mm. to 12 mm.) across, and from 1-25 inch to ⅛ inch (1 mm. to 3 mm.) in thickness. They were all white or colorless, with polished faces, and for the most part very simple in form."

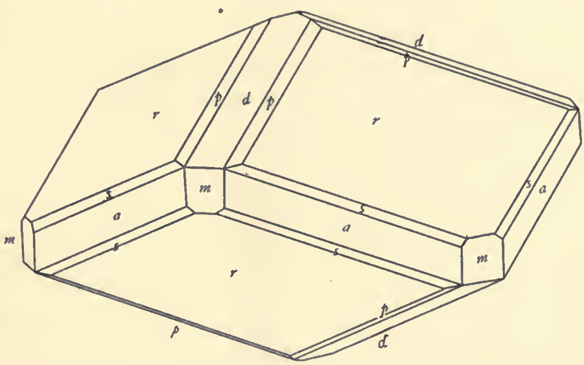

FIG. 4. Phenacite.

No crystallographic investigation seems to have been undertaken by Kunz and no further mention of the occurrence has been made so far as the writers are aware. The Museum is in possession of three specimens of phenacite from this locality. In two of the specimens single phenacite crystals are implanted on crystals of smoky quartz. The phenacite crystals of these specimens are about 10 mm. in diameter and 5 mm. thick. They are whitish in color and semitransparent. They exhibit the lenticular habit mentioned by Kunz, this habit being produced by the prominence of the rhombohedron *r* ($10\bar{1}1$).

* Gems and Precious Stones of North America, 1890, p. 100.

† The correct name of the mountain is Bald Face Mountain.—O. C. F.

This is also usually truncated by the positive ½ rhombohedron *d* $(01\bar{1}2)$. The unit prism *m*, $(10\bar{1}0)$ also appears as small planes. The third specimen (Mus. No. M 10276) consists of a large crystal of orthoclase 3 x 5 inches in size more or less intergrown with albite, and showing also three crystals of topaz 2 to 3 inches in length. Scattered about upon the albite and orthoclase about 50 crystals of phenacite occur. These vary in diameter from 1 cm. to 1 mm. All are whitish to colorless, the larger crystals tending to be semitransparent and the small ones perfectly transparent. In habit all show the lenticular shape previously described, which is produced by the forms already mentioned. Many of the smaller crystals, however, are more highly modified than the large ones and the planes being brilliant and giving good reflections afford easy identification of the forms. The following is a list of the forms observed and some of the measurements obtained:

m $(10\bar{1}0)$	*d* $(01\bar{1}2)$	*s* $(21\bar{3}1)$
a $(11\bar{2}0)$	*p* $(11\bar{2}3)$	s_1 $(3\bar{1}\bar{2}1)$
r $(10\bar{1}1)$		

				Observed	*Calculated*
$a \wedge r$	=	$(11\bar{2}0) \wedge (10\bar{1}1)$	=	58° 14′	58° 18′
$r \wedge p$	=	$(10\bar{1}1) \wedge (11\bar{2}3)$	=	20° 11′	20° 4′
$r \wedge m$	=	$(10\bar{1}1) \wedge (10\bar{1}0)$	=	52° 41′	52° 39′
$m' \wedge d$	=	$(01\bar{1}0) \wedge (01\bar{1}2)$	=	68° 35′	69° 7′
$r \wedge d$	=	$(10\bar{1}1) \wedge (01\bar{1}2)$	=	31° 35′	31′ 42′
$r \wedge s$	=	$(10\bar{1}1) \wedge (21\bar{3}1)$	=	30° 17′	29° 57′
$s \wedge s_1$	=	$(21\bar{3}1) \wedge (12\bar{3}\bar{1})$	=	55° 40′	56° 42′

The appearance of one of the crystals is shown in the accompanying figure, Fig. 4, it having been drawn as is usual with phenacite, with the negative rhombohedrons in front.

REALGAR

MERCUR, UTAH

PLATES XLIV AND LIV

Among other specimens from Mercur, Utah, obtained from Maynard Bixby, two exhibiting realgar deserve especial mention. In one of these specimens (Mus. No. M 8204), the realgar occurs as small crystals partially filling a narrow fissure in limestone: in the other (Mus. No. M 8205) it occurs as elongated prisms intergrown with large and small calcite crystals. The color of the realgar in both specimens is a superb carmine-red. The crystals are transparent. The habit of the crystals in the specimen numbered M 8204 is, as is usual with realgar, short-prismatic. These crystals are highly modified and doubly terminated. A marked feature is the large number of prisms present, no less than nine being observed. The planes are remarkably brilliant and afford excellent signals on the reflecting goniometer. The prisms are often scarcely more than lines, but nevertheless give well-defined signals with the goniometer. In some of the crystals the basal plane is quite prominent, while in others pyramids and clinodomes are extensively developed. The clinopinacoid may also be quite fully developed. The two most prominent types exhibited by these crystals are shown in Figs. 1 and 2, Pl. LIV. As there represented, a slight elongation in the direction of the clino-axis usually occurs. The crystals average about 4 mm. in length.

The specimen numbered M 8205 is from the Golden Gate mine. In habit the crystals of this specimen seem to be different from any hitherto noted in realgar in that the prism is elongated in the direction of the vertical axis. None of these crystals is doubly terminated. The terminations on the single terminated end are simple as compared with those of the crystals previously described and there is no large number of prisms present. The prismatic development here is produced chiefly by the prisms *m* (110) and *l* (210). Like the crystals previously described these crystals also show a slight elongation in the direction of the clino-axis. The average length in this direction is about 7 millimeters. In the direction of the vertical axis a length of 15 millimeters is frequently exhibited. Fig. 3, Pl. LIII, illustrates these crystals. Some of the smaller crystals of this specimen are hollow in the direction of their length. A basal projection of all the forms observed upon both specimens is given in Fig. 4, Pl. LIV.

The following is a list of the forms observed, together with measured and calculated angles:

a (100)	*z* ($\bar{2}01$)	*v* (230)
b (010)	*h* (610)	*μ* (120)
c (001)	*l* (210)	*δ* (250)
q (011)	*β* (320)	*f* (212)
r (012)	*w* (430)	*e* ($\bar{1}11$)
y (032)	*η* (650)	*n* ($\bar{2}12$)
x ($\bar{1}01$)	*m* (110)	

			Observed	Calculated
$b \wedge h$	=	(010) ∧ (610)	= 77° 48′	77° 38′
$b \wedge l$	=	(010) ∧ (210)	= 56° 37′	56° 38½′
$b \wedge \beta$	=	(010) ∧ (320)	= 48° 38′	48° 44′
$b \wedge w$	=	(010) ∧ (430)	= 45° 21′	45° 22′
$b \wedge \eta$	=	(010) ∧ (650)	= 42° 13′	42° 21′
$b \wedge m$	=	(010) ∧ (110)	= 37° 12′	37° 13′
$b \wedge v$	=	(010) ∧ (230)	= 26° 52′	26° 51′
$b \wedge \mu$	=	(010) ∧ (120)	= 20° 47′	20° 48′
$b \wedge \delta$	=	(010) ∧ (250)	= 17° 10′	16° 54′
$c \wedge r$	=	(001) ∧ (012)	= 24° 3′	23° 58′
$c \wedge q$	=	(001) ∧ (011)	= 41° 32′	41° 39′
$c \wedge y$	=	(001) ∧ (032)	= 53° 5′	53° 8′
$c \wedge f$	=	(001) ∧ (212)	= 30° 56′	30° 51′
$c \wedge n$	=	(001) ∧ ($\bar{2}$12)	= 46° 13′	46° 20′
$b \wedge e$	=	(010) ∧ ($\bar{1}$11)	= 47° 3′	46° 59′
$b \wedge n$	=	(010) ∧ ($\bar{2}$12)	= 65° 5′	64° 59′
$b \wedge x$	=	(010) ∧ ($\bar{1}$01)	= 90° 20′	90° 00′
$c \wedge z$	=	(001) ∧ ($\bar{2}$01)	= 69° 36′	69° 53′

RUTILE

JEQUITINHONHA RIVER, BRAZIL

FIG. I, PLATE LI

Several crystals of rutile of an interesting habit were presented to one of the authors by Olaf E. Ray, Esq., of the Chicago Brazilian Diamond Company. The crystals were obtained by Mr. Ray from sands washed for diamonds on the Jequitinhonha River near Diamantina, Brazil. The crystals are twins ranging from 9 mm. to 13 mm. in length and 8 to 10 mm. in width in the direction of one lateral axis while in the direction of the other lateral axis their thickness is only 2 to 3 mm. The crystals have the typical brownish-black color of rutile and are practically opaque but occasionally are dark-red by transmitted light. The planes are splendent. Examination by the reflecting goniometer shows the crystals to be made up of the ditetragonal prism *h* (210) and the pyramid of the second order *e* (101). The development of the planes of the pyramid is not uniform, two planes always being larger than the other two. The twinning plane is *v* (301). The prismatic planes are frequently striated parallel to the prismatic edges and hence usually give successive signals. Fig. 1, Pl. LI, exhibits the usual development. In addition it may be noted that one individual of the twin usually shows a tendency to grow by the other, suggesting a penetration twin; but the growth is never extended far. Determination of the specific gravity gave 4.284 The forms and measurements observed are as follows:

h (210) *e* (101)

			Observed	Calculated
$h \wedge h'$	= (210) ∧ (120)	=	36° 13′	36° 52′
$h \wedge h^{vii}$	= (210) ∧ (2$\bar{1}$0)	=	52° 10′	53° 8′
$e \wedge e''$	= (101) ∧ ($\bar{1}$01)	=	65° 38′	65° 35′
$e \wedge e$ of twin		=	54° 12′	54° 42′

SPHALERITE

TUCKAHOE, MISSOURI

As is well known, sphalerite occurs in the Joplin district in the form of small crystals in clay, and occasionally in sufficient abundance to be used as an ore. Mr. James Roach of Tuckahoe, Missouri, who mines ore of this character, kindly selected about 25 of the best crystals and presented them to the Museum, Mus. No. M 6382. The crystals are of interest as showing an unusual habit for sphalerite and one which is in some respects difficult of interpretation. The crystals range from 5 to 20 mm. in diameter and are of a generally tetrahedral form. In color some, generally the smaller ones, are reddish-brown and nearly transparent, but the majority are dark-colored and opaque. The development of the crystal planes varies from almost indiscriminate rounding to well-defined. All the crystals however, as stated, show a general tetrahedral form. Now and then apparent re-entrant angles are to be seen, which suggest that the crystals are probably twins; but on breaking the crystals no differences of cleavage can be observed to confirm this supposition. As a rule the crystals are made up of only fifteen planes, but occasionally eighteen can be observed. None of the planes are sufficiently brilliant to give measurements with the reflecting goniometer, but the crystals are of such size that satisfactory results can be obtained with the contact goniometer. By study of the crystals in this manner the presence of the tetrahedron and cube can be definitely and satisfactorily determined. These forms are always present in their full number of planes. Moreover, the character of their planes is distinctive, the tetrahedrons being always more or less rough from etching and pitting and the cubical faces usually smooth and often more brilliant than the other planes. The remaining planes show an angular measurement upon the cube and tetrahedron corresponding to that of planes of the hemitetragonal tristetrahedron *p* $(2\bar{2}1)$, but the full number of planes of this form is never present. As a rule a single plane of the form occurs in three quadrants and two in the fourth. One crystal, however, exhibits two planes of the form in each quadrant. It is of interest to note that in the pyrite described by Penfield from French Creek, Pennsylvania * a somewhat similar lack of planes occurs. Owing to the etched character of the tetrahedral faces on the sphalerite it is probable that the tetrahedron present is the positive one and the tristetrahedron is therefore to be regarded as negative. Fig. 5 illustrates the development exhibited by the majority of the crystals. The crystals with rounded planes have as a whole more nearly the appearance of the tetragonal tristetrahedron than those which are more fully developed. The tristetrahedron may therefore be regarded as in a sense the fundamental form which is modified in the more fully developed crystals by the cube and tetrahedron. A list of the forms and angles follows:

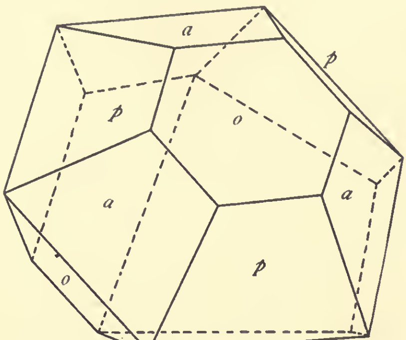

FIG. 5. Sphalerite.

a (100) *o* (111) *p* $(2\bar{2}1)$

	Observed				Calculated
$a \wedge o = (100) \wedge (111)$	$= 55° 12'$	(average of	11	measurements)	$54° 44'$
$a \wedge p = (\bar{1}00) \wedge (\bar{2}21)$	$= 48° 14'$	" "	15	"	$48° 11'$
$a \wedge p = (001) \wedge (\bar{2}21)$	$= 70° 00'$	" "	6	"	$70° 31'$

* Am. Jour. Sci., 1889 (3), 37, p. 209.

VIVIANITE

SILVER CITY, IDAHO

A crystal of vivianite of unusual size and transparency, Mus. No. M 9454, from Silver City, Idaho, was received from Maynard Bixby. The crystal, attached to a group of small quartz crystals, constitutes the only specimen of the occurrence known to the writers. This crystal is transparent and dark-green in color by transmitted light but by reflected light in certain positions appears azure-blue. It is prismatic in habit and elongated both in the direction of the *c* and *b* axes. Its length in the direction of the *c* axis is 3.5 cm., in that of the *b* axis 1.7 cm., and in that of the *a* axis 1.1 cm. It is completely developed except for the terminations of one end of the vertical axis. Measurements made partly with the reflecting and partly with the contact goniometer show the following forms and angles:—

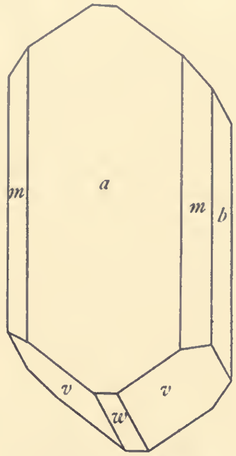

FIG. 6. Vivianite.

a (100), *b* (010), *m* (110), *w* ($\bar{1}01$), *v* ($\bar{1}11$).

				Observed	Calculated
$a \wedge m$	=	$(100) \wedge (110)$	=	36° 30′	35° 59′
$a' \wedge w$	=	$(\bar{1}00) \wedge (\bar{1}01)$	=	56°	54° 40′
$b \wedge v$	=	$(010) \wedge (\bar{1}11)$	=	58°	60° 13′

The development of the crystal is illustrated in the accompanying figure, Fig. 6.

Plate XLV.

Anglesite.

EUREKA, UTAH.

Forms: *a* (100), *b* (010), *c* (001), *m* (110), *δ* (230), *n* (120), *o* (011), *r* (112), *z* (111), *τ* (221), *p* (324), *y* (122).

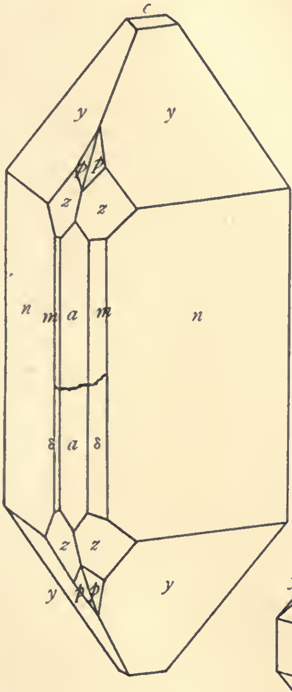

Fig. 4

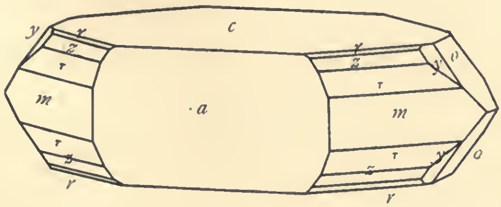

Fig. 1

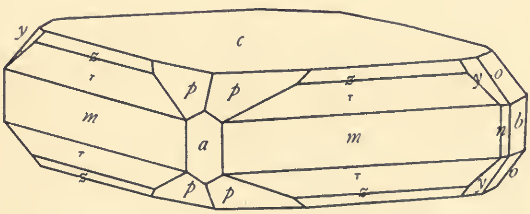

Fig. 2

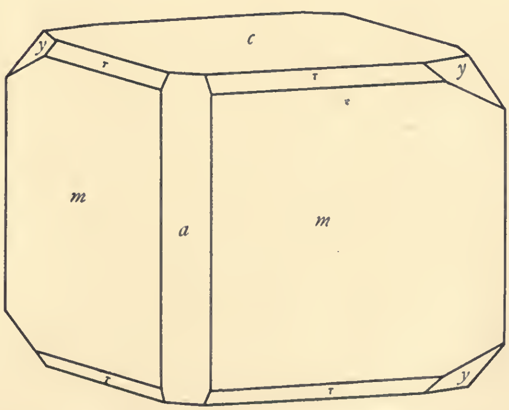

Fig. 3

PLATE XLVI.

ANGLESITE.

EUREKA, UTAH.

Forms: *a* (100), *b* (010), *c* (001), *m* (110), M (410), *n* (120), *o* (011), *d* (102), (104), *z* (111), *p* (324), *y* (122), *μ* (124).

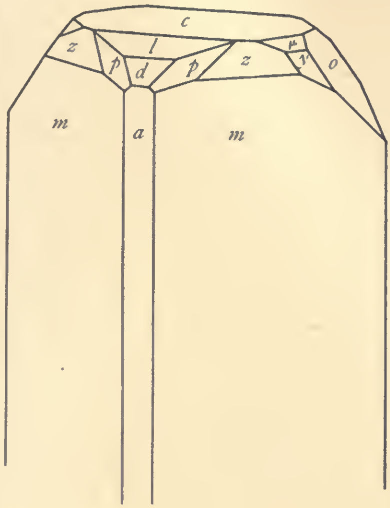

Fig. 1

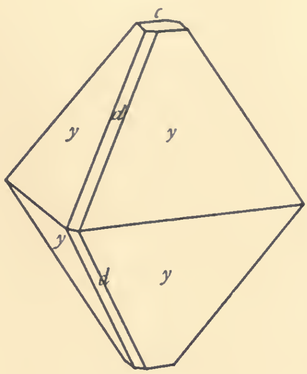

Fig. 5

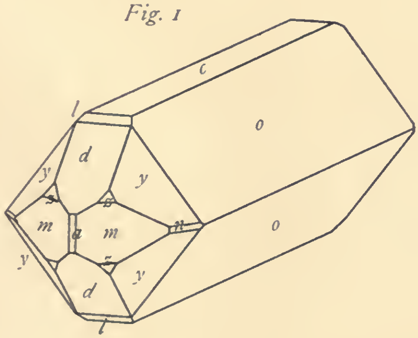

Fig. 2

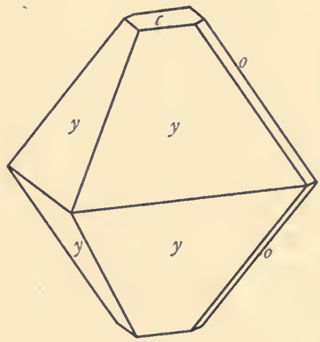

Fig. 4

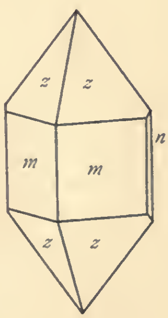

Fig. 6

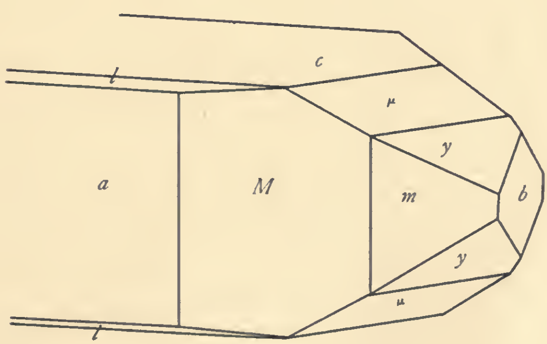

Fig. 3

Plate XLVII.

Figs. 1–3.

Barite.

CARTERSVILLE, GEORGIA.

Forms: *a* (100), *c* (001), *m* (110), *n* (120), χ (130), λ (210), *o* (011), *z* (111), *f* (113), *q* (114), *y* (122).

Figs. 4–5.

Bertrandite.

ALBANY, MAINE.

Forms: *a* (100), *b* (010), *c* (001), *m* (110), *f* (130), *l* (203).

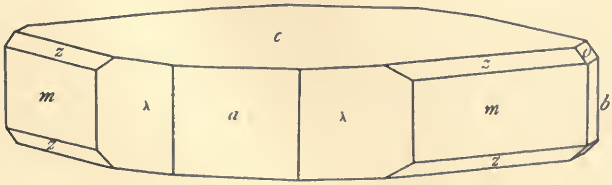

Fig. 1

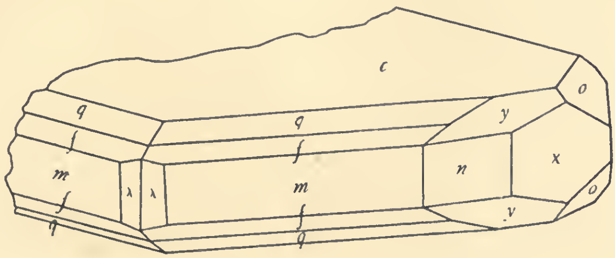

Fig. 2

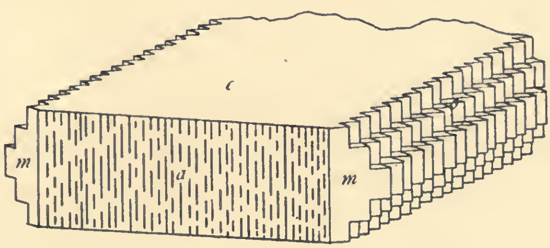

Fig. 3

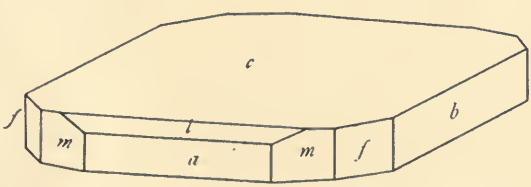

Fig. 4

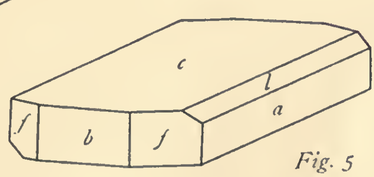

Fig. 5

Plate XLVIII.

Fig. 1.

Calcite.

CRYSTAL PALACE MINE, CENTRAL CITY, MISSOURI.

Forms: *e* ($01\bar{1}2$), *υ*. ($05\bar{5}3$), *M* ($40\bar{4}1$), *v* ($21\bar{3}1$).

Fig. 2.

Calcite.

CUBAN MINE, JOPLIN, MISSOURI.

Forms: *r* ($10\bar{1}1$), *μ* ($54\bar{9}1$), *J*: ($52\bar{7}3$), $\mathfrak{B}$: ($51\bar{6}1$), *G*: ($72\bar{9}5$), *z* ($12\bar{3}5$), Δ ($23\bar{5}2$).

The letters followed by dots are Goldschmidt's; those without dots, Dana's.

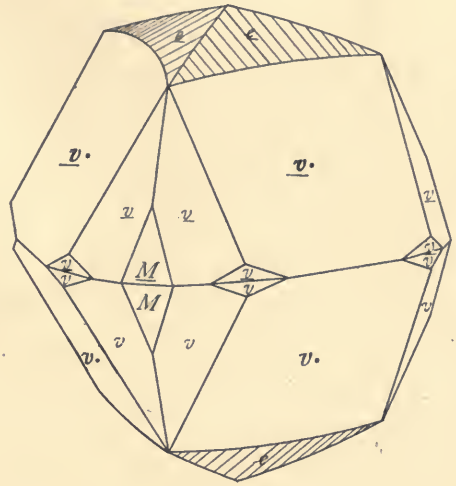

Fig. 1

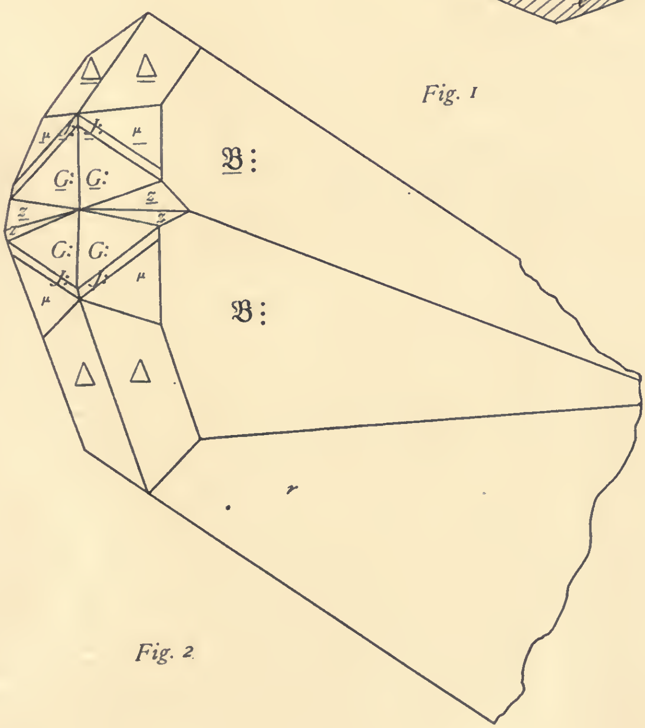

Fig. 2

PLATE XLIX.

Fig. 1.

CALCITE.

BELLEVUE, OHIO.

Forms: π $(11\bar{2}3)$, a $(44\bar{8}3)$, γ $(8.8.\overline{16}.3)$, r $(10\bar{1}1)$, μ: $(20.11.\overline{31}.11)$.

Fig. 2.

CALCITE.

BLACKBERRY MINE, JOPLIN, MISSOURI.

Forms: e $(01\bar{1}2)$, f $(02\bar{2}1)$, M $(40\bar{4}1)$, t $(21\bar{3}4)$, v $(21\bar{3}1)$, E $(41\bar{5}6)$, ν: $(11.4.\overline{15}.3)$.

The letters followed by dots are Goldschmidt's; those without dots, Dana's.

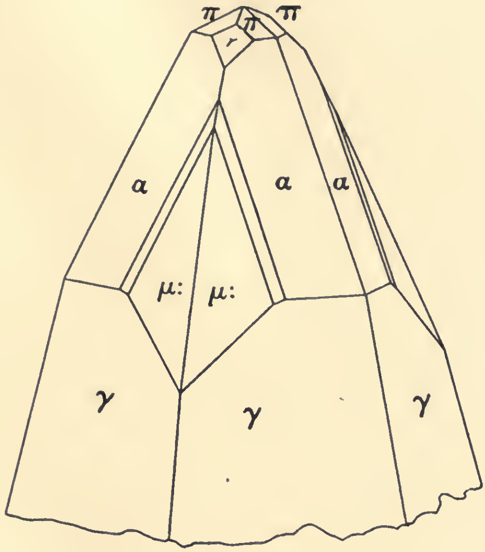

Fig. 1

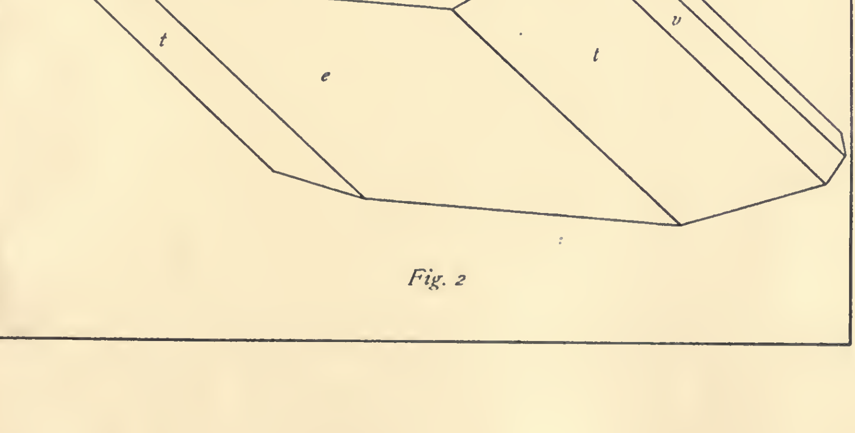

Fig. 2

PLATE L.

Fig. 1.

LEADHILLITE.

SHULTZ, ARIZONA.

Forms: *t* (112), *f* ($\bar{1}01$).

Fig. 2.

LINARITE.

EUREKA, UTAH.

Forms: *a* (100), *c* (001), *m* (110), *r* (011), *δ* (10.0.9), *ψ* ($\bar{9}$.0.10), *x* ($\bar{3}02$), *μ* ($\bar{2}01$), *g* ($\bar{2}11$), *f* ($\bar{5}23$).

Fig. 3.

LINARITE.

EUREKA, UTAH.

Projected on the clinopinacoid.

Figs. 4–5.

MIMETITE.

EUREKA, UTAH.

Forms: *c* (0001), *m* ($10\bar{1}0$), *x* ($10\bar{1}1$).

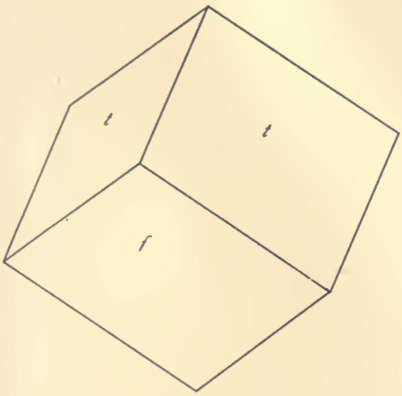

Fig. 1

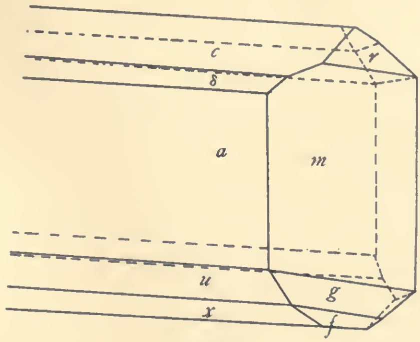

Fig. 2

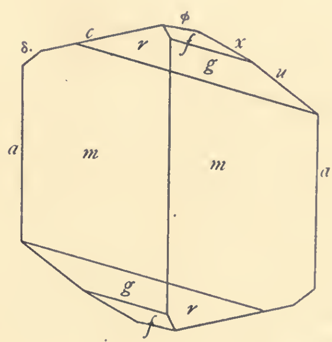

Fig. 3

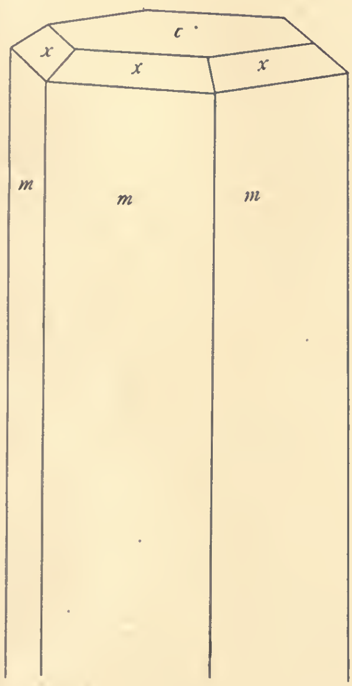

Fig. 5

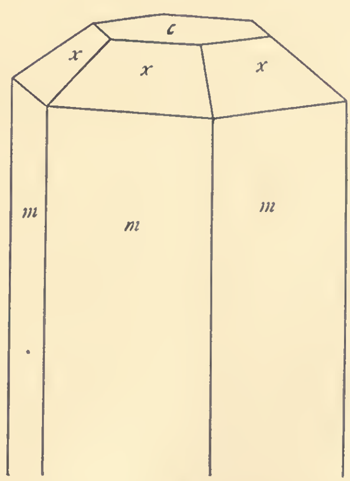

Fig. 4

PLATE LI.

Fig. 1.

RUTILE.

JEQUITINHONHA RIVER, BRAZIL.

Forms: *h* (210), *e* (101).

OCTAHEDRITE.

Figs. 2–4.

JEQUITINHONHA RIVER, BRAZIL.

Forms: *c* (001), G (104), *p* (111), *r* (115), *v* (117), M (338), s_1 (5.1.19).

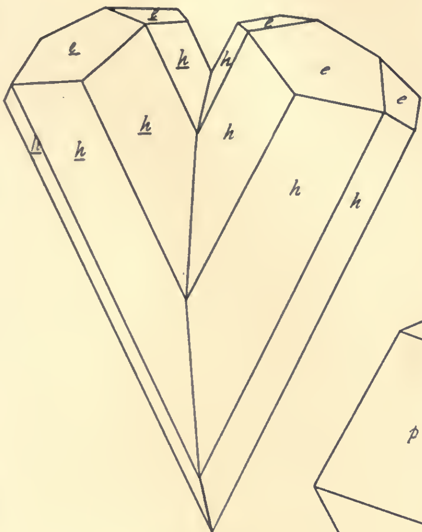

Fig. 1

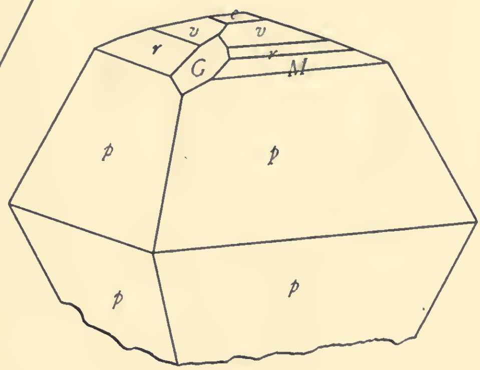

Fig. 2

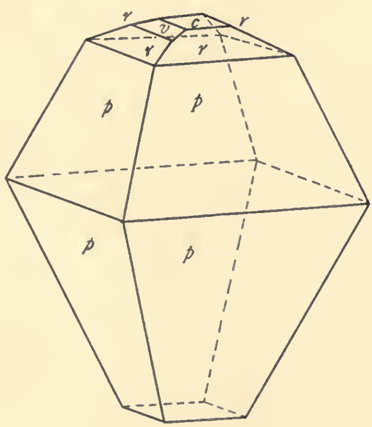

Fig. 3

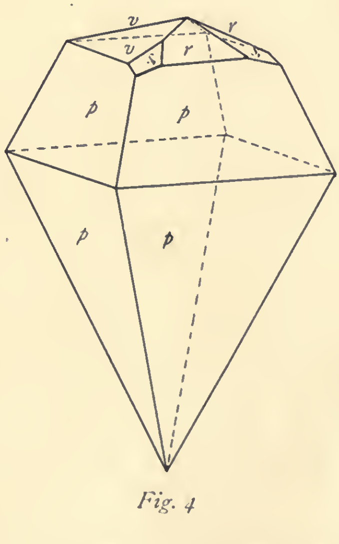

Fig. 4

PLATE LII.

OLIVENITE.

TINTIC DISTRICT, UTAH.

Forms: *a* (100), *b* (010), *c* (001), *m* (110), *v* (101), *e* (011), *s* (034), *d* (025).

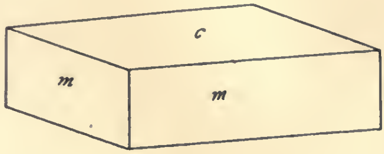

Fig. 3

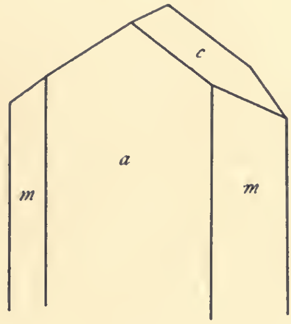

Fig. 5

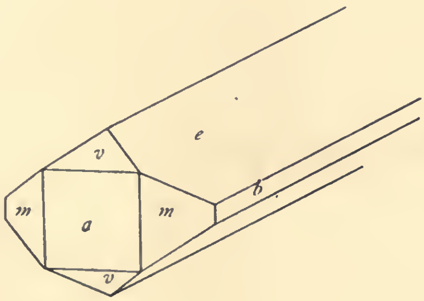

Fig. 4

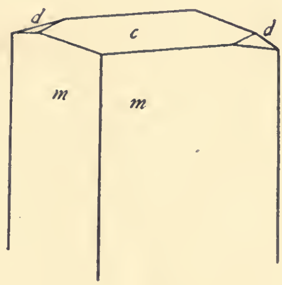

Fig. 2

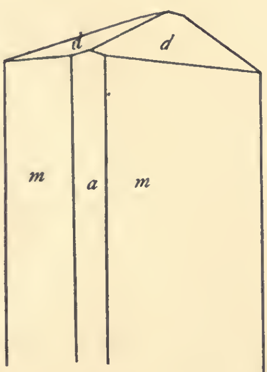

Fig. 1

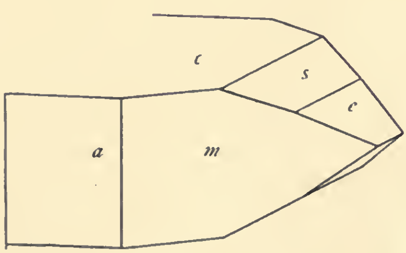

Fig. 6

Plate III.

Fig. 1.

[illegible]

[illegible]

[illegible]

Fig. 2.

[illegible]

[illegible]

Drawn with [illegible] in [illegible].

Fig. 3.

[illegible]

[illegible]

Basal progression of [illegible] chambers.

PLATE LIII.

Fig. 1.

ORPIMENT.

MERCUR, UTAH.

Forms: *a* (100), *b* (010), *m* (110), *u* (120) *o* (101), *e* (103), *d* ($\bar{1}$03), *l* (023) *ν* ($\bar{3}$43), *v* ($\bar{1}$21), *q* ($\bar{4}$49), *k* ($\bar{1}$23), *n* ($\bar{1}$33), *i* (243).

Fig. 2.

ORPIMENT.

MERCUR, UTAH.

Drawn with positive forms in front.

Fig. 3.

ORPIMENT.

MERCUR, UTAH.

Basal projection of forms observed.

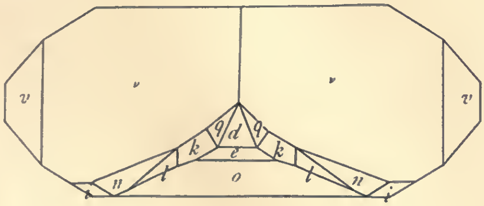

Fig. 3

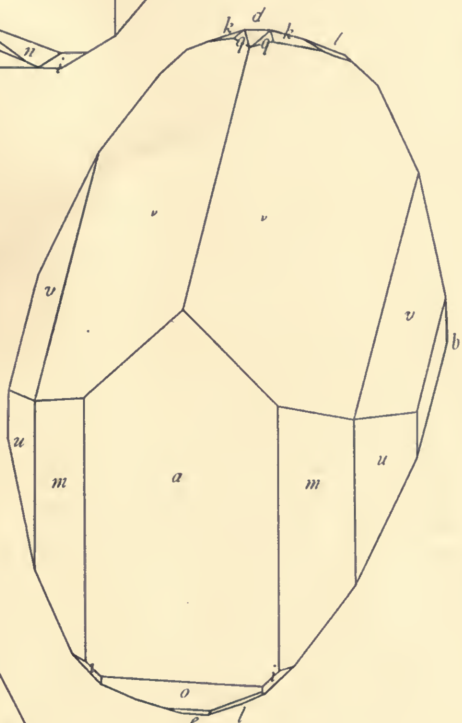

Fig. 2

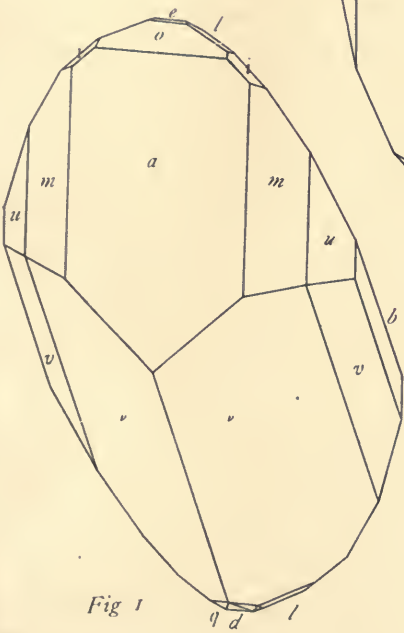

Fig 1

PLATE LIV.

Figs. 1–3.

REALGAR.

MERCUR, UTAH.

Forms: *a* (100), *b* (010), *c* (001), *q* (011), *r* (012), *y* (032), *x* ($\bar{1}$01), *z* ($\bar{2}$01), *h* (610), *l* (210) *β* (320), *w* (430), *η* (650), *m* (110), *v* (230), *μ* (120), *δ* (250), *f* (212), *e* ($\bar{1}$11), *n* ($\bar{2}$12).

Fig. 4.

REALGAR.

MERCUR, UTAH.

Basal projection of forms observed.

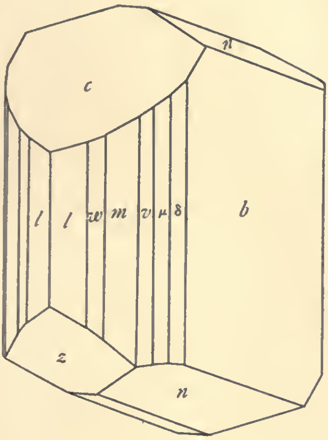

Fig. 1

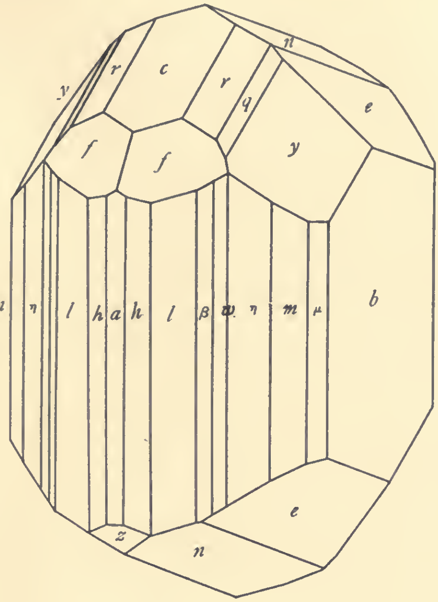

Fig. 2

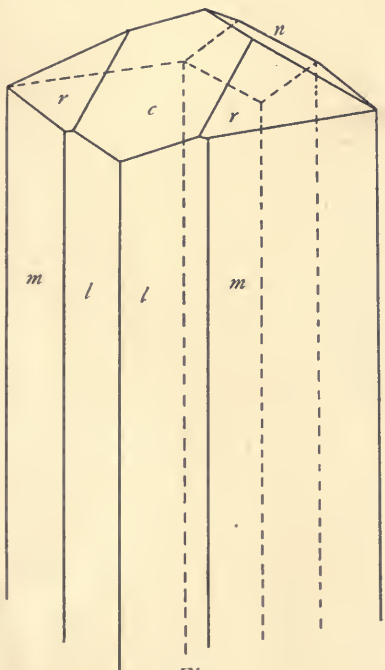

Fig. 3

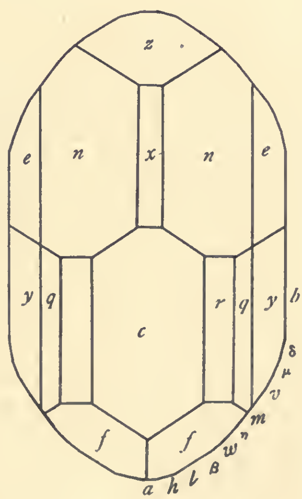

Fig. 4