PHENACITE FROM COLORADO.

BY SAMUEL L. PENFIELD (by invitation).

The occurrence of phenacite in the United States was first mentioned by Messrs. Cross and Hillebrand, who published a short description and figure of a crystal occurring with microcline (amazon stone) from the Pike's Peak region, El Paso Co., Colorado; later these same authors gave a more detailed description of more complicated crystals from Florissant, in El Paso Co. At about the same time Mr. W. E. Hidden mentioned the occurrence of phenacite from Florissant; a second note by him, recently published, contains some crystallographic notes and two figures by Prof. Des Cloizeaux, of Paris. Some additional facts regarding the crystallization of this remarkable mineral with some new figures may not be without interest to those who are specially interested in American minerals. In addition to the crystals from the above mentioned locality, I have also, through the kindness of Mr. Whitman Cross, been provided with crystals from an entirely different locality, and with different associations and crystalline habits, which are especially worthy of description.

The lenticular crystals which have already been more or less described, are from Topaz Butte, near Florissant, and about sixteen miles from Pike's Peak. In studying them one cannot help noticing their great similarity in habit to those described and figured by N. von Kokscharow,* from the Ilmengebirge, Urals, where they occur with the same associations on amazonstone. All of the forms mentioned by Kokscharow occur on the crystals from Topaz Butte and besides them I have found no others. His figures also represent very closely the habit of the crystals. The specimens which I have examined are contained in the collection of Prof. George J. Brush, the

* Materialien zur Mineralogie Russlands, II, 322.

Yale College cabinet, and two loose crystals from the collections of Mr. C. S. Bement, of Philadelphia. The forms which have been identified are as follows: and are of especial interest because belonging to the rhombohedral-tetartrohedral division of the hexagonal system.*

Rhombohedrons 1st order.	Rhomb. 2d order.	Rhomb. 3d order.	Prisms.
r, $10\bar{1}1$, $+1$	p, $11\bar{2}3$, $r\,\frac{3}{2}$-2,	x, $\bar{1}3\bar{2}2$, $-r\,\frac{3}{2}$-$\frac{3}{2}$	a, $11\bar{2}0$, i-2
z, $01\bar{1}1$, -1	$p_{\prime\prime}$, $2\bar{1}\bar{1}3$, $l\,\frac{3}{2}$-2,	$x_{\prime}$, $12\bar{3}2$, $-l\,\frac{3}{2}$-$\frac{3}{2}$	m, $10\bar{1}0$, I
d, $01\bar{1}2$, $-\frac{1}{2}$	o, $4\bar{2}\bar{2}3$, $l\,\frac{4}{3}$-2,	s, $21\bar{3}1$, $+r\,3$-$\frac{3}{2}$	
μ, $02\bar{2}1$, -2			

In addition to the above Des Cloizeaux identified a third prism k, $41\bar{5}0$, i-$\frac{5}{4}$, and a new plane which he lettered z, $13\bar{4}4$, $-l$ 1-$\frac{4}{3}$ which were not identified on the crystals which I have examined. In lettering the forms I have followed Kokscharow, making however a few deviations so that the lettering will conform to the system to be adopted in the new edition of Dana's System of Mineralogy; r, z, μ and m above equal R, r, m and g of other authors.

All of the crystals which I have seen occurring in the feldspar are lenticular in shape resulting from the slight development of prismatic, and predominence of rhombohedral, forms. Fig. 1, represents the form of crystals which occur with topaz on a brownish, lamellar albite. This specimen is in Prof. Brush's collection labelled Pike's Peak only; the crystals are a trifle simpler than those occurring on the amazonstone from Florissant, and it may be that they are from some other special locality in the Pike's Peak region. Here the rhombohedron r predominates, d is large, and the two forms, p and P, are, as is usually the case, about equally developed; the other forms z, a and m are at times wanting and scarcely ever more developed than shown in the figure. The crystals occurring on the amazonstone are usually more highly modified. Fig. 2 represents the forms which were observed on a crystal from Mr. C. S. Bement's collection, while fig. 3 is a basal

* As all of these forms are tetartrohedral ¼ should be understood before each of the Dana's symbols.

projection of the same with the position of the lower faces dotted in, which is well suited to show the tetartrohedral character of the crystal. All of the forms mentioned in

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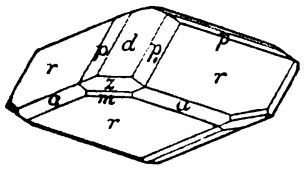

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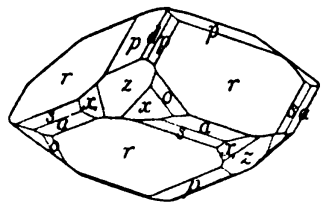

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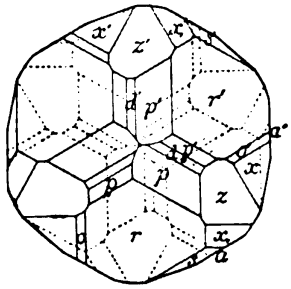

the above list are shown in these figures except μ and m; μ was not observed on this crystal and m only as a very narrow face. While the usual custom has been followed of drawing these crystals so that an edge of the positive rhombohedron above runs toward the observer, the basal projection has been so turned that the positive rhombohedron above is in front so that the indices in the above list of forms can be better understood. The relative size and position of the rhombohedrons of the first order can be readily understood from the figures. Of rhombohedrons of the second order there is a decided predominence in size of p to the right of r over p, to the left. Unfortunately the crystal had been so attached that the relative size and position of the faces on the lower side could not be observed; on the top of the crystal, however, the three alternating faces were large, the other three small, as shown in the figure: o occurs only to the left of r,

being present three times above and three below. Of rhombohedrons of the third order *x* and x, occur under the negative rhombohedron *z*, both to the right and left and are about equally developed, while *s* occurs under the positive rhombohedron *r* to the right only. These forms have not only the same symbols but also the same positions with reference to the positive rhombohedron on the Colorado as on the Russian phenacites, as shown by a comparison with the figures of Kokscharow.

The remaining crystals which are to be described are from an entirely new locality. Mt. Antero in Chaffee Co., about one hundred miles southwest of Denver, fifty-five miles from Topaz Butte, and sixty-five miles a little to the south of west from Pike's Peak. Mt. Antero is over 14,000 feet high, and the phenacites were found by a prospector, whose name I do not know, at one spot on the surface, in a streak up and down the steep slope of the mountain and above the timber line, probably 12,000 feet high. The crystals were given by the discoverer to the Rev. R. T. Cross, of Denver. As far as known the country rock is granite, and the associations are beryl, quartz and feldspar. The suite of specimens in the author's possession consist of eight specimens of a pale, bluish green aquamarine upon three of which the crystals of phenacite are implanted. The crystals are prismatic, and the largest, about 7^{mm} in length, is implanted in an inclined position upon the basal plane of the beryl, while others are scattered irregularly over the prismatic faces. The specimens were probably not found in place, as the edges of the crystals are more or less rounded and nicked, as if they had been rolled around in contact with other hard minerals. The beryl crystals are deeply striated parallel to the vertical axis and eaten out, having perhaps furnished the material for the formation of the phenacite. The habit of the phenacite crystals is remarkable, and is shown in fig. 4 in ordinary projection, and in fig. 5 in basal projection, the figures being placed in the same relative position as those above. In the pris-

matic zone the prism of the second order *a* prevails while *m* is always small, in some cases wholly wanting. The crystals are terminated mainly by the rhombohedron of the third order *x*, $\bar{1}3\bar{2}2$, $-r$ $\frac{3}{2}$-$\frac{3}{2}$. The unit rhombohedron *r* is small and in a zone between it and the prism *a* is the rhombohedron of the third order *s*. At the top of the crystal are the three small faces of the minus one-half rhombohedron *d*. The prismatic faces are striated not only vertically, especially that part of the prism farthest away from the *s* face, but also near each *s* face parallel to the intersection between *s* and *a*. These two sets of stria-

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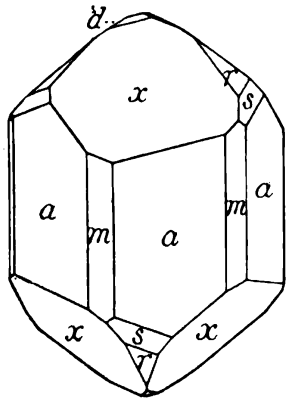

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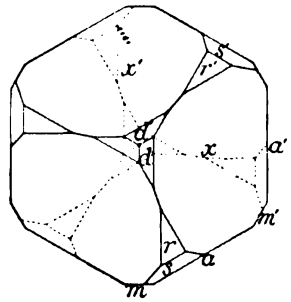

tions do not cross but meet along a line running in an inclined direction across the *a* face. The *s* and *r* faces, especially the former, are also striated parallel to the intersection between *s* and *a*. These striations point to vicinal faces, prisms and pyramids of the third order, but no definite indices could be assigned to them. The *x* faces are not smooth and polished but covered with little prominences with curved unsymmetrical contours. Crystals with exactly this habit have previously been described by Prof. M. Websky,* of Berlin, from an unknown locality in Switzerland, and they are the only crystals, so far de-

* Jahrb. f. Min., 1882, i, 207.

scribed which are terminated mainly by rhombohedrons of the third order.

It is interesting also to note that while in the Russian localities the crystals of phenacite occurring on amazonstone are lenticular, as is the case also in Colorado, the crystals from the emerald mines in Katharinenburg are prismatic, terminated, however, not by rhombohedrons of the third, but by those of the first and second order.

Below are given the angles, which were measured for the identification of the above mentioned forms, and the corresponding angles calculated from the fundamental angle of Kokscharow, $r \wedge r'$, $10\bar{1}1 \wedge \bar{1}101 = 63° 24'$, $c = 0.66106$. In measuring those faces which are deeply striated and where there were a number of reflections of the signal the most prominent reflection was chosen.

	Lenticular crystal from Topaz Butte.	Prismatic crystal from Mt. Antero.	Calculated, Kokscharow.
$r \wedge r'$ $10\bar{1}1 \wedge \bar{1}011$	63° 14′	63° 24′	63° 24′
$r \wedge d$ $10\bar{1}1 \wedge 01\bar{1}2$	31° 40′	31° 30′	31° 42′
$r \wedge p$ $10\bar{1}1 \wedge 11\bar{2}3$	20° 4′		20° 4′
$r \wedge o$ $10\bar{1}1 \wedge 4\bar{2}\bar{2}3$	19° 19′		19° 18′
$r \wedge x$ $10\bar{1}1 \wedge 12\bar{3}2$	27° 42′		27° 43′
$r \wedge s$ $10\bar{1}1 \wedge 21\bar{3}1$	29° 59′		29° 57′
$r \wedge a$ $10\bar{1}1 \wedge 11\bar{2}0$	58° 17′	58° 13′	58° 18′
$d \wedge z$ $01\bar{1}2 \wedge 01\bar{1}1$	16° 26′		16° 28′
$z \wedge \mu$ $01\bar{1}1 \wedge 02\bar{2}1$	19° 25′		19° 25′
$s \wedge a$ $21\bar{3}1 \wedge 11\bar{2}0$		28° 52′	28° 21′
$x \wedge x'$ $\bar{1}3\bar{2}2 \wedge \bar{2}\bar{1}32$		75° 48′	75° 57′

In closing I wish to express my obligations especially to Mr. Whitman Cross, of the U. S. Geological Survey, for information regarding the localities and associations of the Colorado phenacites, and to Rev. R. T. Cross, Prof. George J. Brush and Mr. C. S. Bement for the material which they have placed at my disposal.

Mineralogical Laboratory,
Sheffield Scientific School, Nov. 19th, 1886.