ART. XXXIII.—*Communications from the U. S. Geological Survey, Rocky Mountain Division.* II. *Notes on some interesting Minerals occurring near Pike's Peak, Colorado;* by WHITMAN CROSS and W. F. HILLEBRAND.

THE region about Pike's Peak, in El Paso County, Colorado, has, within the past few years, become well known to mineralogists the world over through the large and perfect crystals of Amazon stone (microcline), which have found their way into almost every collection of importance, in Europe as well as in America. Other minerals, for the most part associated with the Amazon stone in occurrence, have also come into circulation to a less extent. The following minerals have been announced from this region, and are all authentic, viz: microcline, albite, biotite, quartz (smoky and clear), fluorite, columbite, göthite, hematite and limonite (pseudomorph after siderite), arfvedsonite, astrophyllite and zircon.

With but one or two exceptions the minerals named occur in "cavities" or "pockets" in granite, and although large quantities of some of the species have been found there is scarcely a mineral locality which at first sight seems more unpromising than this. The coarse reddish granite of the district disintegrates rapidly through the action of the weather into a coarse, gravel-like mass, and many of the mountain slopes are made of such material, lying at a very steep angle, with solid rock projecting through it here and there. On finding fragments of crystals in the debris, the prospector for minerals, with pick and shovel in hand, endeavors to find the original cavity from which the fragments came. The "cavities" are very irregular in shape and size, and yield varying quantities of crystals. A single cavity has been known to yield more than a ton of crystallized specimens. All so far discovered have been on the surface. That a direct connection exists between the tendency of the granite to disintegrate so readily, the formation of the cavities, and the deposition of these various minerals in them, can hardly be doubted.

Quite recently several occurrences of minerals, new to this region, have come to our notice, and are thought worthy of description. We can add to the above list of minerals, topaz, phenacite, cryolite, thomsenolite, and others not yet fully determined.

The phenacite and topaz were found about two years ago by Mr. Thebaut, a prospector of Colorado Springs, associated with feldspar, smoky quartz and zircon, in one of the "pockets" described. A crystal of phenacite came into the hands of Rev. R. T. Cross, of West Denver, to whom we are indebted for calling our attention to it, and for aid in procuring other of the specimens here to be described.

TOPAZ.

Three crystals of topaz have been examined, all of them remarkable for size and clearness.

The most perfect one measures $2{\cdot}5^{cm}$ parallel to the vertical axis, $3{\cdot}3^{cm}$ parallel to the brachy-axis, and $2{\cdot}8^{cm}$ parallel to the macro-axis. It is colorless, and some parts of the crystal are very clear. The prisms I (∞P) and i-2 ($\infty P2$) are well developed. The terminations are drusy, although many of the prominences are large enough to admit of the determination of some of the faces which bound them. The pyramid 2 ($2P$) has been recognized with certainty, while a form between $\frac{2}{3}$ ($\frac{2}{3}P$) and 1 (P), which is probably $\frac{4}{5}$ ($\frac{4}{5}P$), and another pyramid near 2–4 ($2P4$) are also present. Measurements of sufficient accuracy for the calculation of these latter forms could not be obtained. The lateral edges of these pyramidal prominences lie in a plane corresponding to the brachydome 2-$\breve{i}$ ($2P\breve{\infty}$), and although that form does not actually appear, the crystal has a domatic habitus. A rough face of 4-$\breve{i}$ ($4P\breve{\infty}$) is present quite distinctly. While one termination is more perfect than the other, both are alike.

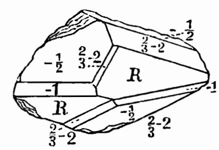
The second crystal is less perfect. The prism i-2 ($\infty P2$) predominates, and the terminations are low and indistinctly drusy. The crystal measures 5^{cm} parallel to the macro-diagonal, and has a slight greenish tinge.

The third crystal, or rather fragment, was found recently near Florissant, northwest from Pike's Peak, with Amazon stone, etc. It is mainly noteworthy on account of the enormous size of the original crystal from which it came. This specimen is but a corner of a large crystal, the forms appearing being two faces of i-2 ($\infty P2$), one of I(∞P), and one each of 2-$\breve{i}$ and 4-$\breve{i}$. The fragment is about 9^{cm} ($3\frac{1}{2}$ in.), in its longest diameter, and if the other faces were developed to correspond to those here seen, the complete crystal must have been nearly or quite one foot in diameter parallel to the brachy-diagonal. It is clear in parts and has a decided greenish tinge. It was supposed to be fluor spar, by the original collectors, and the other pieces of the crystal are undoubtedly lost.

The specific gravity of this fragment is 3·578 at 22° C., and its chemical composition is entirely normal.

PHENACITE.

The two crystals of phenacite examined were found together, and are, so far as we can learn, the only ones as yet obtained. They are but fragments, representing in each case somewhat less than half of the complete crystal. The accompanying figure represents the smaller crystal in about the natural size; the other one measures nearly 7^{cm} in longest diameter, and has the same faces developed in a similar manner. In neither crystal do any faces of the vertical zone appear, thus producing a flat lenticular habitus. The forms appearing have been identified as R, $-\frac{1}{2}$ $(-\frac{1}{2}R)$, -1 $(-R)$, and $\frac{2}{3}$–2 $(\frac{2}{3}P2)$, and although all faces are too rough to admit of exact measurements with the reflection-goniometer, the size of the faces and their simple development renders sufficient accurate results with the hand instrument possible. The angles obtained, as means of several measurements, are—



	Crystal *a*, (fig.)	Crystal *b*.	Authorities.
$R \wedge R$ (terminal) ------	-------	116° 20′	116° 36′ (D)
$R \wedge R$ (lateral) ---------	-------	63° 00′	63° 24′ (S)
$R \wedge -\frac{1}{2}$ (over $\frac{2}{3}$-2) ------	148° 30′	148° 50′	148° 18′ (D)
$R \wedge \frac{2}{3}$-2 ---------------	159° 45′	159° 58′	159° 56′ (D&S)
$R \wedge -1$ ---------------	74° 30′	74° 40′	74° 42′ 45″ (S)
$-\frac{1}{2} \wedge -\frac{1}{2}$ ---------------	143–144° 00′	-------	144° 1′ 26″
$-\frac{1}{2} \wedge -1$ ---------------	-------	163° 43′	163° 32′ 2″
$\frac{2}{3}$-2 $\wedge -\frac{1}{2}$ ---------------	168° 11′	168° 50′	168° 22′ (S)
$\frac{2}{3}$-2 $\wedge \frac{2}{3}$-2 ---------------	156° 40′	156° 00′	156° 44′ (D&S)

The figures of the third column are the calculated angles given for phenacite by Dana* or Seligmann†, or else our own calculations based on the theoretical values given by them. The agreement between the angles measured on these crystals and the theoretical ones is sufficiently close to justify the signs given to the faces of the figure. In the development of the different forms, R and $-\frac{1}{2}$ are always prominent, while the faces of $\frac{2}{3}$-2 are variable. One face of $\frac{2}{3}$-2 on crystal *b* is $2{\cdot}5^{cm}$ broad, although usually each face of $-\frac{1}{2}$ is broader than both adjoining faces of $\frac{2}{3}$-2; -1 is subordinate, and the faces are quite rough; $\frac{2}{3}$-2 appears with its full complement of faces. The roughness of the faces is in part caused by striæ which on $-\frac{1}{2}$ and $\frac{2}{3}$-2 run parallel to the terminal edge of R replaced by those faces. On R the markings are less distinct. These striæ and partially regular depressions seem like natural etch-figures, and bring out the rhombohedral symmetry of the mineral very plainly.

The crystallographic determination of these crystals as phenacite is confirmed by all the physical characteristics, as far as observed, and by the chemical composition. There is an imperfect cleavage parallel to i-2 $(\infty P2)$. Both crystals are clear and colorless, resembling quartz, and the hardness is nearly or quite 8. The specific gravity of the crystal figured, though containing some impurities, is 2·967 at 23° C.

* Dana, System of Mineralogy, Fifth Ed., p. 263.

† G. Seligmann, in "Neues Jahrbuch für Mineralogie," etc. 1880, I, 129.

According to the latest edition of Naumann–Zirkel's "Elemente der Mineralogie" (Leipzig, 1881), phenacite has been described from but four localities—two in the Ural Mountains, one in Lothringen, and one in Mexico. Dana* gives a second locality in Mexico. The crystals described recently by Websky† being from an unknown source, the locality near Pike's Peak seems to be the *sixth* authentic occurrence of this rare mineral, and the first in the United States.

A partly historical description of phenacite and its known forms was given by G. Seligmann in the "Neues Jahrbuch für Mineralogie" etc., 1880, I, 129.

Zircon.

G. A. König has described and analyzed zircon from two occurrences of the Pike's Peak district, in one case the mineral being associated with astrophyllite,‡ and in the other with Amazon-stone.§ In one of the instances we have to describe, the zircon is intergrown with large crystals of flesh-colored microline, in one of the localities above-mentioned, and is thus analogous to the latter occurrence noticed by König. There were many loose crystals in this cavity, but a few were found penetrating or imbedded in the microline. The crystals described by König showed both pyramid and prism, but the prism is entirely lacking on all of our specimens. Some crystals are more than an inch in diameter, and these large ones especially are often mere aggregates of numerous small pyramids grown together with a common crystallographic orientation. The lateral edges of such crystals are often continuous, but the terminations are made up of many small pyramids. Although the pyramid 1 is the only prominent form, one can notice, on looking at the terminations in the right position, a minute reflecting surface on each perfect apex. A closer examination with the loupe shows it to correspond to the basis *O*, but all observed surfaces are too small to admit of certain determination.

Near the Pike's Peak toll-road, about due west from Cheyenne Mountain, a prospect tunnel, in following a vein-like mass of white quartz in granite, has disclosed a number of interesting minerals. The main body of the quartz is pure white in color and contains only traces of galena and chalcopyrite. Within this body, however, is a second smaller vein consisting likewise chiefly of white quartz, but carrying in it a number of other minerals, the most abundant of them being zircon. The

* System of Mineralogy, p. 263.

† Websky, "Neues Jahrbuch für Mineralogie," etc. 1882, I, 207.

‡ G. A. König, Zeitschrift für Krystallographie, I, p. 423.

§ G. A. König, Proc. Acad. Nat. Sci. Philad.

boundary between the two masses of quartz is sharply drawn, but the development of the tunnel is not extensive enough to show clearly the relation of the two bodies.

Throughout the greater part of the vein the zircon is imbedded directly in the quartz and is so abundant that a cubic inch of the latter mineral contains from 25 to 100 crystals and particles of zircon, varying in size from 1^{cm} downward. In parts of the vein, however, are small, irregular spaces filled with a soft, yellow foliate mineral in which are imbedded very perfect crystals of zircon. Fluorite and a white foliate mineral are sometimes associated with the others. The two foliate minerals are as yet undetermined.

This occurrence is worthy of special notice on account of the perfection of the crystals and their transparency. Some of the crystals lying in the quartz are perfectly developed, but usually their growth has been more or less hemmed by the quartz, and many are fissured. The crystals imbedded in the soft, yellow material, however, are often absolutely perfect in form, and beautifully clear. The ruling color is a deep reddish-brown with variations toward pink or a pale honey-yellow. A few crystals are of a deep emerald-green, and spots of the same were noticed in some of the pink crystals.

The common habitus of all crystals is pyramidal, the prisms being always subordinate when they appear. The forms determined with certainty are, $1\,(P)$, $3\,(3P)$, $O\,(0P)$, $3\text{-}3\,(3P3)$, $I\,(\infty P)$ and $i\text{-}i\,(\infty P\infty)$. The rare face O is much less frequently developed than any of the others but it was observed distinctly on at least twenty-five crystals. Repeated measurements on different crystals of the angle $O \wedge 1$ give results varying less than 3′ from the calculated value (137° 50′). Between O and 1 is a low pyramid appearing quite constantly with O, which forms an angle of 164° 46′ with 1. This corresponds very nearly to $\frac{1}{2}\frac{4}{5}$ $(\frac{1}{2}\frac{4}{5}P)$. The angle between this form and 1 is a curved surface giving an almost continuous reflection, but the angle with O is distinct. The crystals showing O occur in the soft, yellow substance, and the face in question could not have been formed by pressure of the surrounding material. The face O was noticed by König (l. c.) on the zircon occurring with astrophyllite, but his statement has been either overlooked or discredited, as Zirkel, in the recent edition of Naumann's "Elemente der Mineralogie," says that O has not yet been observed, though he cites an analysis by König of the same zircon which showed the basis O. On all but one of our crystals O and the pyramid $\frac{1}{2}\frac{4}{5}$ are developed on one end only, the other showing simply 1, thus giving a hemimorphic appearance to the crystal.

The chemical investigation of this zircon shows it to be exceedingly pure, and the specific gravity of the transparent crystals is 4·709 at 21° C.

The perfection of the crystals, with their transparency and color, make this occurrence of zircon one of the most beautiful known.

In a paper which we hope may appear in this Journal within a short time, we shall describe several minerals of the cryolite group which occur in connection with a quartz vein in the neighborhood of the zircon locality. Most of these fluorides are identical with those associated with cryolite in Greenland. The body of mineral found is of small extent, but yields a large number of species.

There are also several interesting species more or less closely associated with the zircon, in the study of which we are now engaged. The results we hope to communicate in a future number of this Journal.

Denver, Colorado, August 3, 1882.