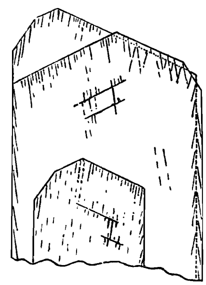
ART. XIII.—*Communications from the U. S. Geological Survey, Rocky Mountain division.*—V. *On Sanidine and Topaz, etc., in the Nevadite of Chalk Mountain, Colorado;* by WHITMAN CROSS.

CHALK MOUNTAIN is situated where Lake, Eagle and Summit Counties join, and is also upon the boundary of the maps of the Mosquito Range and of the Ten-Mile mining district, which are soon to be published with monographic reports by the U. S. Geological Survey. The description of the nevadite, which forms the mass of the mountain, will therefore be brief, and all references to manner of occurrence, etc., omitted. It is, however, thought desirable to describe at once the following interesting minerals occurring in the rock.

The nevadite, while showing local variations in structure, may be characterized as a porphyritic rock, showing large glassy sanidine and many smoky quartz crystals imbedded in a grayish ground-mass, which appears under the lens to be evenly granular, and is really so, with the exception of isolated glass particles revealed by the microscope. Biotite is but sparingly present. This nevadite is one of the most beautiful of rocks, owing to its abundant, smoky quartz crystals and to a very delicate but brilliant, satin-like luster exhibited by the sanidines. This luster, or rather its cause, is the chief subject of these notes.

The lustrous surface is in the ortho-diagonal zone and inclined a few degrees to the ortho-pinacoid, as is evident, in the Carlsbad twins, usually polysynthetic, the luster reaching its maximum of brightness simultaneously in alternate plates. Microscopic investigation shows a most perfect parting parallel to the surface of luster and with a knife blade flakes can be split off in this direction even more readily than parallel to the basal cleavage plane. Thin plates parallel to the base (O) show a very fine striation at right angles to the line of i-$\grave{\imath}$ and $\pm$ to the directions of extinction. Thin flakes split off parallel to the lustrous surface show, under the microscope, that the luster is due to interference of light in passing the films of air between the extremely thin plates produced by the parting. The thinnest flakes, composed of a few plates, are transparent and exhibit delicate colors of interference, while those composed of more plates are dull translucent, or opaque, the light having been completely extinguished by the repeated interference. The luster is, then, due to reflected light from the air films near the surface, and to its interference. By examination with a good hand lens a delicate play of colors may be seen upon the lustrous surface of the crystals.

At one point in the mountain, the nevadite, here unusually coarse-grained, was found to contain many small, round or irregular druses lined by minute but perfect transparent crystals, chiefly of sanidine and quartz. The quartz crystals are, for the most part, simple dihexahedrons; the sanidines thin tablets which are almost invariably Carlsbad twins with prominent development of the clino-pinacoid. Such crystals examined under the microscope, as they lie upon the predominant pinacoidal face, afford a means of determining approximately the position of the plane parallel to which the parting referred to takes place. The adjoining cut represents one of these crystals, a normal Carlsbad twin with a third and smaller plate, also in twin position. The faces shown are: *I* (110), *i-ì* (010), *O* (001), 1-$\bar{\imath}$ ($\bar{1}$01) and 2-$\bar{\imath}$ ($\bar{2}$01) as indicated. From all the outlines and from basal cleavage or irregular fissures run dark lines, in uniform direction for each individual of the twin, and penetrating varying distances into the crystal. This undoubtedly represents an incipient stage of that parting, which, in the large crystals of the rock, occasions the brilliant luster, for these dark lines do not represent needles of any mineral substance, but the air films filling the fissures.



$\frac{57}{1}$

This parting may be seen upon all microscopic sanidine crystals of the rock, and even the irregular grains of that mineral in the ground-mass, when cut in the right direction, show a very fine delicate striation which is undoubtedly due to the same cause. As seen from the figure, the position of the sur face is that of a positive hemi-orthodome, for the cleavage plates of large crystals show the plane to be at right angles to the clino-pinacoid. Assuming the axial ratio

$$\grave{a} : \bar{b} : \dot{c} = 0{\cdot}653 : 1 : 0{\cdot}552 \text{ and } \beta = 64^\circ$$

as determined by Strüver* for free crystals of sanidine, the face corresponds closely to $\frac{15}{2}$-$\bar{\imath}$ ($\overline{15}$·0·2). This would require an angle of 72° 40′ with the basal plane, while that measured in the crystal figured was 72° 53′. Of course this can not be regarded under the circumstances as anything more than an approximate determination.

I am indebted to Professor G. vom Rath for the information given during a recent visit in Denver, that a similar but much fainter luster frequently observed in crystals of adularia, has been proven by Reusch to be parallel to a surface in the orthodiagonal zone inclined but a few degrees to the pinacoid, and

* Cited by Tschermak, Lehrbuch der Mineralogie, 1883, p. 455.

probably identical with that above described. Unfortunately, neither the original nor any references to it are accessible to me, hence I cannot draw any further parallel between the two cases.

Accompanying the quartz and sanidine in the cavities are minute leaflets of biotite, a few ore grains, and in a few druses only, very perfect crystals of colorless, transparent *topaz*. Usually but a single crystal of topaz is present in one of the druses and that is larger and more perfect in development than any other. The topaz is attached directly to the walls of the cavity and often bears small tablets of sanidine upon it. The crystals which can be recognized as topaz vary from $0{\cdot}5^{mm}$ to 3^{mm} in length, but it seems quite probable that there are some smaller ones indistinguishable from quartz.

The determination as topaz rests upon the crystalline form, which is very distinct, and is that of common topaz. One crystal measuring 3^{mm} in length and 1^{mm} in thickness was removed from the rock and its angles measured with a Fuess reflection goniometer. This crystal presents I (110), $i\text{-}\breve{2}$ ($\bar{1}20$) and $2\text{-}\breve{i}$ (021) as the dominant forms; O (001) is a narrow face and $4\text{-}\breve{i}$ (041) $2\text{-}\bar{i}$ (201), 2 (221) and 1 (111) are minute but very distinct. The angles measured are as follows:

$I \wedge I$	124° 16′
$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$ over $i\text{-}\breve{i}$	93° 7′
$O \wedge 2\text{-}\breve{i}$	136° 30′
$O \wedge 1$	134° 11′
$O \wedge 2$	115° 55′

$2\text{-}\bar{i}$ appears as a very narrow face in the zone of 2 to 2. This is the usual habitus with occasional addition of $i\text{-}\breve{i}$ and a more prominent development of O. This crystal is also imperfectly terminated at the attached end showing $2\text{-}\breve{i}$ most prominently, with $4\text{-}\breve{i}$ and 2 also recognizable and there are no signs of hemimorphism.

In some druses all crystals are thinly coated by a black incrustation which seems to be pyrolusite.

So far as I can ascertain, all previously known and described occurrences of topaz are in granite, gneiss or some other member of the series of metamorphic or crystalline schists. In the present case topaz is found in an eruptive rock, probably of early Tertiary age, while the appearance of the associated minerals certainly suggests that they may all be sublimation products, though it is not capable of direct proof. The sanidine crystals from the druses, examined microscopically, contain gas inclusions, while neither fluid nor glass inclusions were seen.