ondary twinning on (01$\bar{1}$2). Microscopically homogeneous fragments of the twins mounted in viscous Canada balsam gave the optical anomalies similar to those observed on the natural material. The artificially twinned portion of one specimen of calcite gave a value for 2V of about 30°. A twin produced from another piece of calcite gave 2V of about 5°, with an extreme dispersion $\rho > \nu$. The dispersion was so strong that three sets of isogyres were observed; orange, red and blue, from the acute bisectrix outward. In all cases the fragments showed incomplete extinction with anomalous colors near the extinction positions.

A more complete discussion of the experimental work will be published by Mr. Buerger in the near future.

A biaxial character in quartz as a result of strain caused by differential stresses has been described[12] as have other deformation structures in quartz.[13]

Although a biaxial character was found on artificially twinned calcite grains, many naturally twinned grains do not show it. A section of the Grenville limestone from a locality on the east shore of the Hudson River near the south end of the North Creek quadrangle in the Adirondacks contains calcite so mashed that its gliding planes are curved. The grains are not biaxial. The grains from the contact metamorphosed limestones that do show a biaxial character usually exhibit little or no other visible evidence of strain.

It is hoped that further experimentation will fully explain the cause of the biaxial character of the members of the calcite group.

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## STELLERITE FROM NEAR JUNEAU, ALASKA

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In the spring of 1925 while at Juneau, Alaska, the writer collected in the upper part of the Granite Creek basin, several miles west of the town, several crystals forming an incrustation on the rock surface. These crystals were later determined as stellerite, and as the literature on this mineral is rather meager the occurrence was considered worthy of description.

[12] Grubenmann, U. and Niggli, P., Der Gesteinsmetamorphose, Bd. I, p. 220 (1924).

[13] Holmquist, P. J.; Deformationsstrukturen der Gesteinsquarze. *Geol. För. Förh.*, Bd. 48, pp. 410–428 (1926).

It occurs in a limonitized zone perhaps fifty yards wide which crosses the Granite Creek basin in a general northwest-southeast direction. This zone may be traced for several miles and is visible from points a mile or so down the valley. On examination of the geologic map of the region,[1] which was not available for some time after the mineral was obtained, the locality was thought to be in the strip of schist between the two large dike-like masses of Coast Range diorite which cut Granite Creek.

The rock to which the crystals are attached is in agreement with this determination, as it is a rather light colored, fine grained, limonite stained mica schist, not at all like the coarse grained diorite of the region. It contains much disseminated pyrite. A study of some of the powdered rock under the microscope showed the presence of quartz, muscovite, a small amount of orthoclase feldspar, nearly colorless tourmaline crystals, and slender needles of rutile. The largest grains of quartz were 0.12 mm. in diameter. This mineral composition and the structure of the rock indicate that it is a somewhat mineralized schist rather than a locally metamorphosed phase of the Coast Range diorite.

The stellerite occurs in tablets approximately 2.5 mm. long, 2 mm. broad, and 1 mm. thick. They are attached at one end, often forming flattened hemispherical rosettes of radiating individuals. In places the crystals have formed on slickensided surfaces and are also cut by slickensides, so that they apparently formed in an open fault fissure between periods of movement along the fault.

The crystallization of the mineral was studied with a Fuess reflecting goniometer. Though the crystal faces appeared quite good under the hand-lens, they did not yield sharp images so that no very accurate results were secured. The crystals correspond exactly with those described by Morozewicz,[2] even to the relative development and perfection of the forms.

Although the interference figure of the mineral showed it to be biaxial, and therefore not in the tetragonal system, the unit prism angle was very near 90°. All effort to determine whether the angle between Morozewicz's (010) face and the prism was greater than or less than 45° was indecisive, even after a large number of

[1] A. C. Spencer; The Juneau Gold Belt, Alaska. *U. S. G. S. Bull.* **287,** Plate 4, p. 12.

[2] J. Morozewicz; Über Stellerite, ein neues Zeolithmineral. *Bull. Int. de l'Acad. Sc. de Cracovie,* **1909,** part 2, p. 344.

measurements had been made, some of which varied by as much as 4° from 45°. The orientation of Morozewicz will be used, though the Alaskan occurrence, as will be shown, indicates that there may be some doubt as to which of the lateral axes is longer. The forms recognized were {010}, {110}, {100} and {111}. The brachypinacoid was best developed, and no faces of the {210} prism were observed though Morozewicz mentions their occurrence on crystals collected by him. The angles between the different forms as measured on the goniometer were $(111):(1\bar{1}1) = 63° \pm 1°$, and $(110):(1\bar{1}0)$ approximately 90°.

The plane angle formed by the edges (111) to $(1\bar{1}1)$ and $(\bar{1}11)$ to $(\bar{1}\bar{1}1)$ was measured under the microscope on crystals resting on the (010) face. This angle was found to be $105° \ 22' \pm 7'$, the probable error being computed by Bessel's formulae from 35 readings, which gave residuals agreeing quite well with the curve of probability. This is undoubtedly the most accurate measurement made by the writer.

The ratio $a:c$ was computed from this angle, and found to be $1:0.762 \pm .002$. Using the prism and pyramid angles given above the ratio $b:c = 1:0.776$ was calculated. From these two ratios it was apparent that $a$ and $b$ as given by Morozewicz must be reversed if the macro-axis is to be greater than the brachy-axis, as required in the rhombic system. Making this change, an axial ratio $a:b:c = 0.982:1:0.762$ was obtained. It may be pointed out in connection with this change of orientation that a very slight difference in the value of the pyramid angle will reverse the orientation of the mineral.

Morozewicz gives $(111):(1\bar{1}1) = 64° \pm 1°$ and $(110):(1\bar{1}0) = 89° \pm 1°$. He also gives the axial ratio as $a:b:c = 0.98:1:0.761$, and says that this ratio was computed from the pyramid and prism angles given. However, using these values an axial ratio $a:b:c = 0.98:1:0.806$ was obtained, so that either he made an error in his calculations or used data not given in his paper. Thus the exact significance of his axial ratio is not clear.

The mineral was easily scratched with a knife. One excellent cleavage was observed under the microscope parallel to the brachypinacoid, and traces of two others corresponding to the (100) and (001) cleavages of Morozewicz could be seen, giving the mineral a tendency to break up into cubes on crushing.

Its specific gravity was determined by suspension of a number of crystals in a mixture of bromoform and alcohol. These crystals showed more or less surface staining with limonite so that it was to be expected that they would have a specific gravity slightly higher than the pure mineral. The purest crystals floated in a mixture with a specific gravity of 2.141 as determined by means of a Westphal balance, but sank in one with a specific gravity of 2.134, giving a value only slightly above 2.124 as determined by Morozewicz.

When heated before the blowpipe the mineral fused readily with intumescence to a white enamel; a flame test showing the absence of sodium. On treatment with hydrochloric acid it was decomposed with the separation of flocculent silica, but did not yield gelatinous silica on evaporation of the solution, which reacted for calcium with ammonium oxalate. Water was given off upon heating in the closed tube. These reactions are in agreement with the chemical tests of stellerite, the formula of which is $CaAl_2Si_7O_{18} \cdot 7H_2O$.

The mineral showed parallel extinction in all fragments examined under the microscope. The elongation of the crystals was negative, and in a fragment which in converging polarized light showed the emergence of both optic axes, it was found that the mineral was biaxial and negative, with 2V equal to 38° as determined by the Mallard method for sections showing the emergence of both optic axes. Morozewicz's value is 43.5°. The negative character of the mineral coupled with the negative elongation of the crystals showed that crystallographic $c$ was the acute bisectrix. When grains rest on the (010) face the form and symmetry of the interference figure and the birefringence, which was then at a maximum, indicated that Y was perpendicular to this face, so that the axial plane was parallel to it.

The indices of refraction were found by the immersion method to be $\alpha = 1.486 \pm .004$, $\gamma = 1.500 \pm .002$, giving a value of 0.014 for $\gamma - \alpha$.

The birefringence was more accurately determined by measuring the thickness of crystals placed on edge under the microscope with a micrometer ocular, and determining the order of the interference color of the crystals when resting on the (010) face. An average of 5 determinations on different crystals gave a value of 0.0115 for $\gamma - \alpha$, the maximum and minimum values obtained being 0.0130 and 0.0105.

To make the determinations of indices agree with this determination of birefringence $\alpha = 1.488$ and $\gamma = 1.499$, the distribution of error being based on the relative closeness of the index of the mineral to that of the liquids above and below the index. These values are distinctly higher than those given by Morozewicz, namely $\alpha = 1.484$, and $\gamma = 1.495$.

Thus the physical, chemical, and optical properties, as well as the crystallization of the mineral agree so closely with those determined for stellerite that there can be no doubt as to the identity of the mineral.

The occurrence of stellerite in two localities having such similar and unusual climatic conditions as the Komandorski Islands and the southeast coast of Alaska, where precipitation is very high and the average temperature comparatively low, and its absence so far as known in other localities suggests that these factors may have some influence on the stability of this zeolite. The coating of the zeolite in both localities with limonite, which would seem to have formed while the mineral was in the zone of weathering makes it probable that the stellerite formed at a great enough depth to be beyond the influence of climatic conditions. Therefore, if they are connected with the occurrence of stellerite it is more likely to be by preventing its alteration to other minerals than as a cause of its formation. This is also suggested by the occurrence of a reticulation of minute cracks on the surface of the crystal apparently due to corrosion, as though the mineral were not altogether stable under the existing surface conditions. The marked effect of temperature on the water content of stellerite pointed out by Morozewicz lends weight to this suggestion. In warmer, drier climates the water content might be reduced, stability being restored in time by a change to some other mineral.