NOTES AND NEWS

INCLUSIONS IN MUSCOVITE FROM MITCHELL CREEK MINE, UPSON COUNTY, GEORGIA

J. G. LESTER, *Emory University, Georgia.*

The demand created by the exigencies of World War II for domestic mica suitable for industrial use stimulated the prospecting of new localities, the re-examination of old, abandoned properties, and the re-opening of mica mines which had been idle or semi-idle for several years. Many new and productive localities were found and mining instituted, while several of the older properties with a history of spasmodic mining were put back into steady production. As a result of these activities much excellent mica was mined in Georgia during the war years.[1]

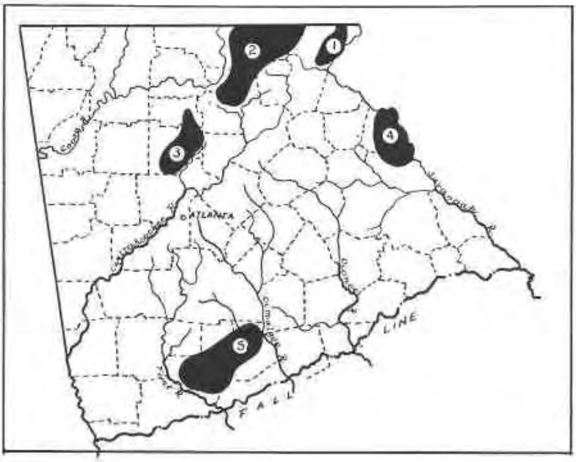

FIG. 1. Sketch map of Georgia north of the Fall Line showing location of mica zones. After Furcron & Teague, Bull. **48**, Georgia Geological Survey, 1943.

There are five mica-producing zones in Georgia. Zone No. 1 is located in the extreme north-eastern corner of the state in Rabun County; No. 2, the largest of the five zones, comprises parts of Towns, Union, Fanning, White, and Lumpkin Counties; No. 3 comprises parts of Pickens, Cherokee, and Fulton Counties; No. 4 lies in Hart and Elbert Counties along Savannah River; No. 5, the most productive and southernmost zone, comprises parts of Lamar, Monroe, Pike, and Upson Counties (see Fig. 1).

[1] Furcron, A. S., and Teague, K. H., Mica-bearing pegmatites of Georgia: *Georgia Geological Survey, Bull.* **48,** 18–19 (1943).

Mitchell Creek, one of the new mines, lies $7\frac{1}{2}$ miles southeast of Thomaston, Upson County, Georgia, and has been one of the more productive mines in Zone No. 5. The mica here occurs in a coarse pegmatite composed essentially of microcline, oligoclase, orthoclase, quartz, muscovite, and biotite. Accessory minerals are apatite, magnetite, and pyrite. Little or no alteration has taken place; all minerals appear fresh and clean.

The pegmatite cuts through a contorted augen gneiss of the Carolina series and generally is concordant with the gneissic structure, although occasionally apophyses of the pegmatite split around and across the gneissic bands. The vein trends about N 67° E and dips about 30° to the southeast. The dip, however, is highly variable and locally the contact between the gneiss and pegmatite is extremely indefinite. There is little, if any, banding in the pegmatite and, according to Maurice,[2] the Mitchell Creek pegmatite would correspond to a Class III pegmatite of the Spruce Pine, North Carolina, district.

The mica is hard, flat, ruby or rum-colored muscovite occurring in books which vary greatly in size. Some have been removed which weighed thirty to forty pounds and from which sheets as large as $6'' \times 6''$ were split. The average size of the books was such that sheets $2'' \times 2''$ could be obtained.

"A" structure and ribbon structure are occasionally seen in some of the smaller books or tablets. Spotty areas, resulting from included magnetite, apatite, or clay are the exception. Some tablets are wedge-shaped; a few are bent and contorted, but this is not common. All tablets apparently have developed a pseudo-hexagonal outline and exhibit greater translucency parallel to the cleavage than through the same thickness perpendicular thereto. Pale green to brownish-green colors are characteristic of the edgewise direction. Fairly good percussion figures are hard to obtain except on very thin sheets. Knotty cleavage is rarely encountered; thus splitting is relatively easy. On the other hand, small tablets of muscovite frequently interpenetrate one another or are included in larger tablets so that the cleavage planes are nearly at right angles, thus preventing or severely hindering splitting.

Biotite occurs in books varying in size from very small ($\frac{1}{8}''$ on a side) to large irregularly shaped books weighing several pounds. It is dark brown to nearly black, splits readily into thin sheets, and exhibits pleochrism from brownish green to dark brown. When viewed above a pin-point light a poorly developed asterism may be noted. In contrast to the muscovite, however, almost perfect percussion figures can be developed

[2] Maurice, Chas. S., The pegmatites of Spruce Pine District, North Carolina: *Economic Geology*, **35**, No. 1, 57–67 (1940).

in fairly thick sheets with angles between percussion lines corresponding with those noted by Sterrett.[3]

Biotite and muscovite intergrowths, which are a unique characteristic of the Mitchell Creek pegmatite, may be classed in two groups or types. The first type is a tight intergrowth in which the two micas possess a common cleavage plane along which cleavage occurs without separation of the muscovite and the biotite. Thin sheets of this type, split with sharp needles, cleave as easily across the line of contact between the

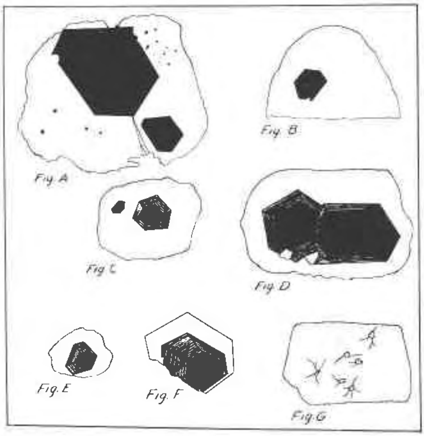

PLATE 1. Inclusions in muscovite. (Direct tracings made on light table, reduced $\frac{2}{3}$.)

two micas as within the individual crystal. Continued flexing of thin sheets, in which maximum flexure occurs along the line of contact or at right angles to the line of contact, also causes no noticeable separation of the two micas. Figures A, B, and H in Plates 1 and 2 illustrate this type of intergrowth.

The second type is a loose intergrowth in which the tablets of biotite and muscovite, though possessing common planes of cleavage, tend to separate when thin sheets are split across the line of contact. This is caused, in part at least, by the fact that the tablets of biotite, developed into strong pyramidal forms with pronounced eccentricity, are so arranged that each succeeding lower sheet of muscovite has a larger amount of biotite in it than the sheet above. Therefore it can slip more easily over the smaller part of the biotite pyramid. The axial convergence of the biotite pyramids is rapid and the corresponding variations in areas of cleavage surfaces are marked. Although the term

[3] Sterrett, Douglas B., Mica deposits of the United States: *U. S. Geological Survey, Bull.* **740,** 12, (1923).

pyramid is used to describe this type of intergrowth of biotite with muscovite, perhaps a more accurate term would be *frustrum of a pyramid* since no complete pyramid was observed. Figures C, D, E, F, J, and K in Plates 1 and 2 illustrate this type of intergrowth.

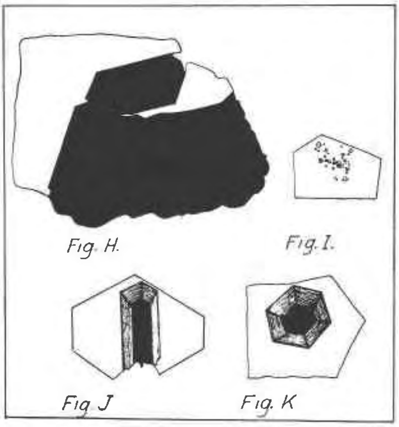

PLATE 2. Inclusions in muscovite. (Direct tracings made on light table, reduced $\frac{2}{3}$.)

The data in the following table will illustrate the eccentricity and the areal changes in the biotite pyramids of the second type:

Figure*	Thickness of sheet in mm.	Top area mm.^{2}	Bottom area mm.^{2}	Maximum axial convergence of pyramid faces
C	.75	64	198	73°
D (large)	2.51	592	788	40°
D (small)	2.51	326	756	44°
E	3.00	20	106	60°
K	3.50	141	396	60°

* These specimens were selected from several thousand as being representative.

Pale, greenish-yellow, euhedral crystals of fluor-apatite are frequently found embedded in tablets of muscovite. There is no uniformity of orientation; the *c*-axis of the apatite may lie parallel to the cleavage planes of the mica but more commonly cuts across them. Thus the two minerals do not possess a common cleavage plane. Even if the *c*-axis of the apatite happens to occur perpendicularly to the cleavage of the mica, thin cleavage sheets of mica from the tablets will not include thin layers of apatite. The apatite in some cases appears to have penetrated the mica, and, in so doing, to have caused small ruptures which roughly resemble percussion cracks. In other cases, the time of crystallization of the two minerals was about the same, for thin folia of the mica penetrate shallowly into the apatite.

Often when an attempt is made to remove a crystal of apatite the folia of penetrating mica either bend or slip, causing the friable apatite to shatter. Or, if the mica is too tightly intergrown with the apatite to allow slippage, it remains as an unsightly fringe on the apatite prism. Some few apatite crystals of gem quality have been taken from the mine.

Microscopic inclusions of apatite prisms are common both in the muscovite and the biotite. In the biotite and muscovite intergrowths microscopic apatite crystals frequently lie so as to seem to penetrate both micas to the same depth.

Bright, brassy-yellow crystals of pyrite are frequently found as inclusions in the muscovite; with the exception of the biotite inclusions, they exhibit the most perfect coincidence in cleavage. Extremely thin sheets of muscovite split from a tablet will include pyrite of the same thinness. Appearing as crystals of a square or rectangular outline, a few show imperfectly developed striations when viewed by inclined light. Figure I of Plate 2 illustrates this type of inclusion.

Anhedral masses of milky or clear quartz are common inclusions in the larger tablets of muscovite. These do not extend all the way through the tablets but seem commonly to be localized near the center. No single large tablet (several pounds in weight) was completely discarded during splitting operations because of interference from quartz inclusions. Fracture lines in the muscovite caused by the quartz are similar to those caused by the apatite, but because the quartz crystallized much later than the muscovite there is no evidence of the two having common cleavage planes. Neither does there appear to be evidence of intergrowth between the quartz and muscovite.

Occasional small, light green euhedral crystals of microcline are included in the mica. Characteristically, upon exposure to sunlight, such crystals lose their green tint and assume a dead white color. The microcline, however, exhibits excellent cleavage and typical luster, but no specimen was found in which the feldspar and the mica possessed a common cleavage plane.

The muscovite at Mitchell Creek Mine is generally extremely hard, of excellent quality, uniform color, and normally almost flat. Although the owner, S. P. Cronheim, of Atlanta, Ga., has ceased operations, the deposit is, so far as can be judged without extensive subsurface prospecting, by no means exhausted.