FLATTENED GARNETS IN MICA AT SPRUCE PINE, NORTH CAROLINA

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The writer's interest in the flattened garnets in mica at Spruce Pine, North Carolina, was aroused several years ago when one of his students donated to the Geological Museum of the University of Tennessee a specimen of garnet in muscovite from that locality. This specimen consisted of a single garnet about a quarter of an inch in diameter included in a thin sheet of muscovite about three inches in diameter and a quarter of an inch thick. An opportunity to visit Spruce Pine did not occur until the spring of 1931 when the writer in company with Mr. H. C. Amick, Assistant Professor of Geology and Geography in the University of Tennessee, spent parts of two days in the area visiting feldspar and kaolin mines, and collecting specimens.

The Spruce Pine area has long been famous as a mineral locality and since May, 1911, has been an important producer of feldspar. Large kaolin mines have been developed and some mica and quartz have been produced. The region is part of the Appalachian Mountains and the rocks are part of the pre-Cambrian complex, chiefly gneisses and schists. The most important formations are the Carolina and Roan gneisses which have been intruded by granites and pegmatites. The most important of these intrusions from a mineralogic point of view are the pegmatites. Pegmatite dikes, some of large size, are found in profusion. Some of them extend for miles, and in general follow the main structural trend of the area; that is, they strike northeast-southwest. Locally, however, the dikes deviate greatly from the regional strike and cut across the main structural lines. In most places the dikes, or veins, dip steeply; but occasionally they are less steeply inclined and almost flatten out. Some of the dikes are a hundred or more feet wide, but narrower ones are more numerous. They range from stringers only a few inches wide to those which are several hundred feet wide. All dikes show more or less swelling and pinching. In places the pegmatitization of the country rocks is so complete that they appear to be granitic gneisses.

The most abundant mineral in the pegmatite dikes is feldspar, microcline, $KAlSi_3O_8$; with which is associated quartz, SiO_2; hematite, Fe_2O_3; garnets, $R_3'' R_2''' (SiO_4)_3$; micas, muscovite, $H_2KAl_3(SiO_4)_3$, biotite, $H_2K(MgFe)_3Al(SiO_4)_3$; and pitchblende together with some of its alteration products which are highly colored. Other minerals such as tourmaline and beryl are also found in the pegmatites.

Some of the feldspar bodies have been altered to kaolin which is mined, washed and shipped to potteries and other consumers.

Pitchblende and its brownish-black alteration product uraninite as well as the more highly colored gummite have been studied in detail. In 1889 Hillebrand[1] analyzed uraninite from Western North Carolina and discussed the occurrence of nitrogen in this uranium-bearing mineral. However, he failed to find the element helium associated with it. The element helium was discovered spectroscopically in the solar chromosphere by Janssen in 1868 and was isolated from cleveite from Norway by Ramsay in 1895. Hillebrand's failure to recognize the presence of helium in the nitrogen obtained from his work on uraninite cost him the honor of the discovery of terrestrial helium. Subsequently it was found that uranium is decomposing at a constant rate, yielding, among other products, helium, and that the end product is lead. The ratio of lead and uranium can be used to determine the age of the mineral. Holmes and Lawson[2] have made careful studies of uraninites from North Carolina and give an average age of 239,000,000 years and suggest that the minerals are late Carboniferous (Upper Pennsylvanian) in age. The formula used was

$$Age = \frac{Pb}{U+K.Th}.C$$

where K and C are constant factors, K being the amount of uranium which is equivalent in lead-producing capacity to 1 gram of thorium and $1/C$ being the amount of lead produced by 1 gram of uranium in one million years. More recently these uranium bearing minerals have been studied by Ross, Henderson, and Posnjak[3], and the new mineral clarkeite found and named.

Feldspar is the most abundant mineral in the openings visited. However, only openings developed as feldspar mines were visited. Of course, only those parts of the dikes rich in feldspar are developed and places in which quartz and other undesired minerals are abundant are abandoned. The feldspar occurs in enormous irregular masses which consist partly of anhedral and partly of euhedral crystals. Some huge crystals six feet in length have been found in the Chestnut Flat Mine and at the time of the writer's visit one of these huge crystals was being taken out for exhibition in Asheville, North Carolina. The feldspar is sold chiefly for abrasive purposes and only feldspar is wanted. The quartz and garnet associated with the feldspar are particularly undesirable on account of their greater hardness.

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[1] Hillebrand, W. F. 1891. On the Occurrence of Nitrogen in Uraninite and on the Composition of Uraninite in General. *U. S. Geol. Survey*, Bull. 78, pp. 43-78.

[2] Holmes, Arthur, and Lawson, Robert W. 1927. Factors Involved in the Calculation of the Ages of Radio-active Minerals. *Am. Jour. Sci.*, 5th series, 13: 327-344.

[3] Ross, C. S., Henderson, E. P., and Posnjak, E. 1931. Clarkeite, a New Uranium Mineral. *American Mineralogist*, 16: 213-221.

Both muscovite and biotite occur in the pegmatite dikes, but muscovite is far more abundant than biotite. Both micas are undesirable impurities except where muscovite is present in large quantities and of sufficiently high grade to enable the operator to sort out, cut and split mica at a profit. However, little of the muscovite is first quality, most of it is dark colored and contains imperfections such as "A's" or "herring-bones." Some of the better mica is recovered and sold for electrical insulation, but the bulk of it goes on the waste heap. There is no sale for the biotite.

Garnet occurs both in the feldspar and quartz and in the moscovites. It ranges in composition from approximately pyrope, $Mg_3Al_2(SiO_4)_3$, to almandite, $Fe_3Al_2(SiO_4)_3$, to andradite, $Ca_3Fe_2(SiO_4)_3$. The garnets occur as equant crystals in the feldspar and quartz and as much flattened crystals in the muscovite. None of the crystals seen in the feldspar and quartz were more than an inch in diameter and

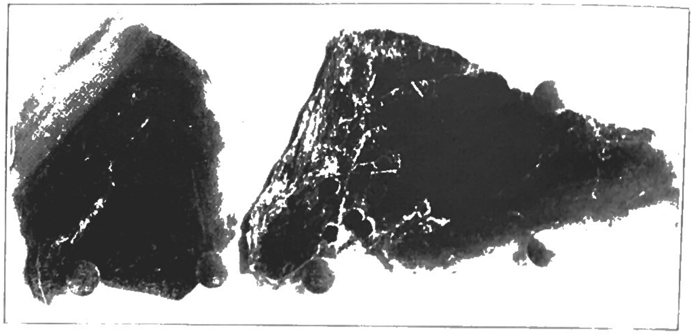

Fig. 1. Flattened Garnets in Muscovite.

the greater number were less than a half inch. The occurrence of flattened garnets in mica has been known for years and has been mentioned in the literature.[4] They are reported to occur in a number of mica deposits. Mathews[5] described some flattened garnets from an unknown locality in Western North Carolina. He discussed the crystal form and optical properties of material obtained through the late Dr. George F. Kunz. His specimens were combinations of the rhombic dodecahedron and the trapezohedron. The crystals all showed an optical anomaly; that is, they showed double refraction. Normally garnet is isotropic. The occurrence of flattened garnets at Spruce Pine is well known and hundreds of specimens are carried away each year by visitors. However, little has been published concerning them.

[4]Sterrett, Douglas B. Mica Deposits of the U. S. *U. S. Geol. Survey*, Bull. 740, p. 18, Pl. VIII.

[5]Mathews, E. B. 1895. Notes on Some Flattened Garnets from North Carolina. *Johns Hopkins Univ.*, Circ., Vol 15, No. 8, pp. 1-4.

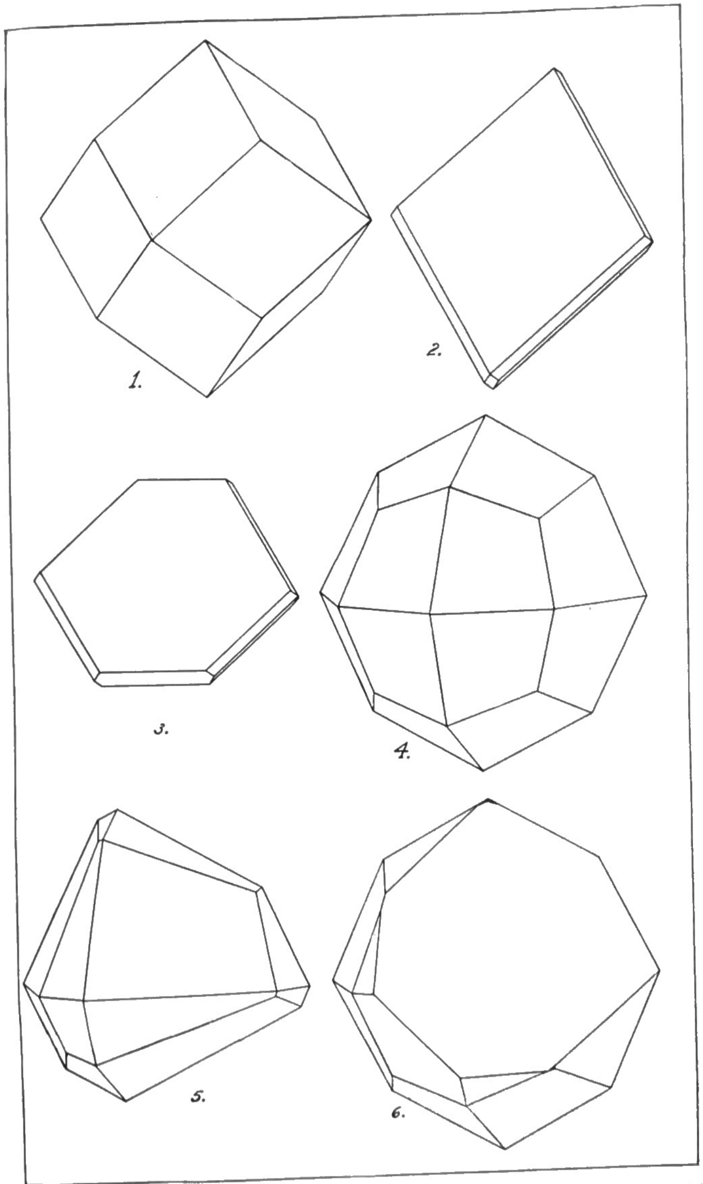

Fig. 2. *1.* An Equant-faced Rhombic Dodecahedron. *2.* A Flattened Rhombic Dodecahedron. *3.* A Flattened Rhombic Dodecahedron Showing Six-sided Outline. *4.* An Equant-faced Trapezohedron. *5.* A Flattened Trapezohedron. *6.* A Flattened Trapezohedron Greatly Modified.