

ART. XXIX. — *On two new Occurrences of Corundum in North Carolina*; by JOSEPH HYDE PRATT.

WHERE formerly corundum was supposed to be rare in its occurrence and to be found in quantity only in the basic magnesian rocks, it is now known to occur in various types of rocks and in quantity, in syenites, gneisses and schists. Many new occurrences have been discovered during the past few years, some of which give indications of being of considerable economic importance, while others are only of scientific value. In the present paper two new occurrences are to be described, that have been observed in North Carolina, one in an amphibole-schist and the other in a quartz-schist.

*Corundum in Amphibole-Schist.*

At the Sheffield mine in Cowee township, Macon County, North Carolina, corundum has been mined in a saprolitic rock at various times for a number of years. While sinking a shaft eight feet square to penetrate the depth of the corundum-bearing saprolite, the solid unaltered rock was encountered. The shaft was 87 feet deep and showed the following sequence downward. The first 12 feet was through the saprolitic rock, in which there were seams, a few inches wide, of kaolin; the next two feet were corundum-bearing; from 14 to 28 feet the same saprolite was encountered and then another two feet that was corundum-bearing, followed by another ten feet of the saprolite and two more feet of the corundum-bearing rock; from 42 to 65 feet the rock began to be less decomposed and from 63 to 66 feet another seam that was corundum-bearing was encountered. From this point the rock became more and more solid, until at 77 feet the fresh rock was encountered. These various seams in the rock are very pronounced and are dipping  $30^{\circ}$  toward the west near the top, but become nearly horizontal nearer the bottom of the shaft. The seams of decomposed feldspar observed near the top of the shaft become less and less kaolinized downward, until in the solid rock the seams are of a pure plagioclase feldspar. In the hard rock exposed there are two seams of corundum similar to those above, although in the fresh rock the corundum seams are not as pronounced as in the saprolitic rock. There is often considerable of the feldspar bordering the seams of corundum. The general trend of the rock is about N.  $5-10^{\circ}$  E.

From what could be seen of the solid and the saprolitic rocks the corundum occurs in seams a few feet in width at intervals in the rock, and while the corundum may be ten or more per cent in these veins, its percentage in the rock, that it would be necessary to mine, would not probably be over three or four. The actual width of the dike is not known, but the saprolitic

rock has been cut across for nearly 100 feet in a direction about at right angles to the strike.

The fresh rock at the bottom of the shaft is somewhat varied in appearance and while it all does not show any definite gneissoid structure, the more finely divided portions are distinctly so. There are streaks, a few inches thick in the rock, that are composed almost wholly of a plagioclase feldspar. Some portions of the rock are decidedly porphyritic and contain phenocrysts of a light gray amphibole, a centimeter in diameter, in a groundmass of feldspar. A large part of the rock is made up, however, of small roughly-outlined prismatic crystals of an amphibole, probably hornblende, and irregular fragments of plagioclase feldspar. The hornblende is almost black in color but in thin splinters it has a bronze luster and a deep resinous color. Biotite of a deep brown color occurs sparingly, and a pink garnet is rather abundant. It is this part of the rock that is of a gneissoid structure and in which the corundum occurs. The corundum is of a light to a purplish pink color and in nodules up to two or three centimeters in diameter. There are some streaks in the rock that are very highly garnetiferous, composed essentially of the garnet and plagioclase feldspar, or of the garnet and biotite. Chalcopyrite occurs very sparingly in these portions of the rock. Small particles of graphite have been observed in the coarsely crystallized portions.

Prof. L. V. Pirsson has kindly made a microscopical examination of this rock, the results of which are embodied in the following paragraphs.

In thin section the microscope disclosed the minerals, hornblende, plagioclase feldspar, garnet, biotite, muscovite, staurolite and rutile. Hornblende is the most common, forming about two-fifths of the section, while of the remainder, plagioclase and garnet occur in about equal quantities and the others in comparatively insignificant amount.

"The hornblende is formless but tends to irregular columns almost invariably extended in the plane of schistosity; it has very rarely a somewhat stringy tendency in its cleavage but is usually homogeneous in broad plates. Its color is a clear olive-brown and it is somewhat pleochroic but not strongly so. It is everywhere dotted by the small grains of garnet, which rarely show good crystal form. The garnet occurs associated also with the plagioclase."

"The plagioclase occurs twinned according to the albite law only. In sections perpendicular to 010, the lamellæ show extinctions as great as  $30^\circ$  and the plagioclase is therefore rich in lime and as basic as labradorite, which it probably is. It shows strong evidence of shearing movement in the rock; it is

often broken, exhibits rolling extinctions and the albite lamellæ are curved and bent. It runs along the planes of schistosity between the feldspars and forms a mosaic of angular broken grains."

"Staurolite was found in rather broad irregular grains, and the rutile in small irregular grains and well crystallized prisms."

Prof. Pirsson has indicated that the character and structure of this rock, composed chiefly of amphibole, labradorite and garnet, suggests most strongly that it is a metamorphosed igneous rock of the gabbroid family. During metamorphism, the augite of the gabbro would be converted into the brown hornblende and any iron ore that was present would be taken up by the hornblende and garnet. The rutile would have resulted from the titanitic acid that is a regular component of the iron ores in these gabbro or diabase rocks. Staurolite is rather naturally expected, as it is usually a mineral of metamorphism, and its natural home is in the schistose rocks. The feldspar has suffered the least (except the corundum) chemically and shows only the shearing of dynamic processes.

The corundum does not occur in crystals but in small fragments and in elongated nodules, which are cracked and seamed, and appear to have been drawn out by the shearing processes. The general character and shape of the corundums would indicate that they were original constituents of the igneous rock and were not formed during its metamorphism.

The exact classification of this rock is not easy, but it will probably be nearer correct to bring it under the head of an amphibole-schist.

#### *Corundum in Quartz-Schist.*

In the crystalline rocks of the southwestern part of North Carolina and the northeastern part of Georgia an interesting occurrence has recently been observed, namely that portions or bands of these are corundum-bearing. These corundum-bearing bands are first encountered on the head waters of Tallulah river, in the northern part of Rabun County, Georgia, and can be followed in a northeasterly direction to the Yellow Mountain in Clay County, North Carolina. They are near the top of the Blue Ridge, at an elevation of from 3000 to 4000 feet.

The composition of these rocks vary from those that are a normal gneiss to those that contain no feldspar and can best be described as quartz-schist, composed of biotite mica and quartz. Some portions of the rock are rich in garnet, while others are almost entirely free from this mineral, and occasionally there are small bands of white quartz. They are distinctly laminated and are frequently intersected by granitic dikes, some of which are coarsely crystallized and of a pegmatitic character, that are often parallel with the beddings of the schists, although many

of them are cutting irregularly through them. Where these dikes are parallel to the bedding of the schists, the laminated structure of the latter is more apparent. The general strike of these crystalline rocks is N.E.-S.W. and with a dip of about 30° to the N.W.

Portions, or bands, of these schists are corundum-bearing, but they are irregularly defined and gradually merge into the normal rock. They have a similar relation to the normal schists that the garnet-bearing bands of a gneiss have to the normal gneiss in which they occur. They are not veins in any sense of the word, but are simply portions of the same mass of crystalline rocks in which corundum occurs as a constituent of the rock. These bands vary in width from a foot or two to 12 or 15 feet, but in these wider ones the corundum-bearing portion is not continuous but is intercepted by streaks of barren rock and granitic dikes.

These bands can be traced for a distance of five or six miles in a N.E.-S.W. direction, sometimes outcropping continuously for nearly a mile. There are at least two of these corundum-bearing bands which are parallel to each other and about two miles apart. The only variation that has been observed in them is the percentage of corundum and garnet, otherwise they are identical. The percentage of corundum is never high, and from determinations made on samples from various parts of the deposits, it varies from two to five per cent.

The corundum occurs for the most part in small particles and fragments that have no definite shape and are of a gray, white, and bluish-white color to almost colorless. It is also in crystals from minute ones to some that were observed two and a half inches long and about one-half an inch in diameter, which are usually fairly well developed in the prismatic zone.

It is probable that these schists are the result of the metamorphism of sandstones and shales formed from alluvial deposits of many thousand feet in thickness, that were formerly the bed of the ocean. By lateral compression these have been folded and raised into the mountain ranges of this section. That these were much higher than at the present time is very evident from the granitic dikes that are of deep-seated origin. By decomposition and erosion the mountains have been worn down to their present condition, thus exposing the schists in contact with granitic dikes which have aided in their thorough metamorphism. The shales were rich in alumina which not improbably was in the form of bauxite, and during their metamorphism the excess of the alumina crystallized out as corundum. This mineral has crystallized out along the planes of lamination so that during the subsequent weathering of the rock the corundum has been left in knotty nodules, studding the surface of the rock, giving it the appearance of containing a high percentage.