OCCURRENCE AND DISTRIBUTION OF CORUNDUM IN NORTH CAROLINA AND GEORGIA.*

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THE corundum localities in the United States are, with the exception of those in Montana, Colorado, and California, limited to the Appalachian region, the mineral having been found at various points throughout nearly its entire length. The mining of corundum has been, however, confined to a narrow section of the southern portion of that region, i. e., to northeastern Georgia and southwestern North Carolina, with the exception of the emery mines at Chester, Mass.

Often a distinction is made between emery and corundum, many persons not recognizing emery as a variety of corundum. There are three names in constant use to designate the varieties of corundum: (1) Sapphire, which includes all corundums, of whatever color, that are transparent to semitransparent; (2) corundum, including the translucent to opaque varieties of all colors; (3) emery, which is a mechanical admixture of corundum and magnetite or hematite. The last two varieties are those used in the arts for abrasive purposes, emery being used in very much larger quantities than corundum. It is, of course, the presence of corundum in the emery that gives to it its abrasive qualities and makes it of commercial value, and the abrasive efficiency of emeries varies according to the percentage of corundum they contain.

Any corundum that is transparent is included under the head of sapphires, although many of these have distinct names in the gem trade. The blue sapphire is known as the oriental sapphire, the red sapphire as the oriental ruby, the green sapphire as the oriental emerald, the yellow sapphire as the oriental topaz, and the purple sapphire as the oriental amethyst. There are also pink and white sapphires. The corundum gem or sapphire localities are usually distinct from the corundum localities, although very handsome gems have been found where the corundum was mined for abrasive purposes, notably at the Corundum Hill mine, Cullasagee, N. C.

Corundum as it is mined for abrasive purposes occurs as (1) sand, (2) crystal, or (3) gravel and block corundum. Sometimes all three types are found in the same deposit. The sand corundum consists of small grains or fragments of the mineral scattered through the vein. The crystal corundum consists of crystals up to 3 inches in length. Often these crystals have parting planes so thoroughly developed that, in crushing, the corundum breaks up into regular rhombohedrons, this breaking continuing to even the finer sizes and causing the grains of corundum to crumble when in use. This persistent regular breaking of the corundum destroys its cutting efficiency, for it is the irregular fracture that produces the best cutting edge. The block variety often occurs in masses of almost pure corundum from 10 to 1,000 pounds in weight. Again it occurs in large masses intimately associated with hornblende, feldspar, etc., making a rock which is tough and is difficult to work. Frequently the only way to break the masses is to build fires over them and then suddenly cool them by pouring water upon them. The parting planes are at times very noticeable in the block corundum, and are, as in the crystal corundum, detrimental to the commercial product. The parting planes are not lines of cleavage, but are planes developed in the mineral by synthetic twinning, usually parallel to the unit of rhombohedron.

It is the hardness of corundum that makes it of so great value as an abrasive. Next to the diamond it is the hardest mineral known, having a hardness of 9, while the diamond has a hardness of 10. Garnet, which is sometimes used as an abrasive, has a hardness of but 7 to 7.5. Corundum varies slightly in hardness; the sapphire varieties are generally considered the hardest, and of these the blue stands at the head. Some corundum has been observed that was readily scratched with a knife, as that from Acworth, Ga. The hardness of a corundum is often misjudged because, when made into a wheel, it does not cut so well as another, when in reality the degree of hardness may be the same in both cases, but the cutting efficiency of one surpasses that of the other.

The North Carolina locality for corundum gems which at the present time is attracting the most attention is the tract of land between the Caler Fork of Cowee Creek and Mason Branch, tributaries of the Little Tennessee River.† This tract is situated in Macon County, almost 6 miles below (north of) the town of Franklin. The bottom of the valleys are about 2,500 feet above sea level, and the mountain peaks or knobs in the immediate vicinity rise to a height of 3,000 or 3,500 feet.

In the gravels of Caler Fork Valley pieces of crystals of red corundum were picked up by the people of the district, which led to the driving of two or three tunnels with the expectation of striking the vein and finding the corundum in sufficient quantity for commercial purposes. Work in this direction was soon abandoned, and for a number of years there were only prospecting and a little mining for the red corundum for gem purposes.

Systematic search was made, which revealed the fact that ruby corundum was to be found in the gravels of Caler Fork Valley for a distance of 3 miles. In 1895 the American Prospecting and Mining Company, of New York, bought out the old claims and began work on a systematic basis. The property owned by the company is a large tract on both sides of Caler Fork of Cowee Creek and nearly all the land in the northern part of the watershed of Mason Branch, a total area of about 5,000 acres.

The gravels in which most of the rubies have been found are covered by soil averaging about 3 feet in depth, but varying from 1 to 5, and they are about 3 feet higher than the present alluvial gravel of the stream.

In washing these gravels for the rubies, hydraulic processes have been used very similar to those used in the West in washing gold-bearing gravels. All the soil, as well as the gravel, is washed into a short line of sluice boxes, *a* (Fig. 1), which lead into a large sieve box, *b*, where the large pieces of rock and boulders are removed and most of the dirt and fine

gravel is washed out. They are then shoveled into a rocker, *c*, where they are further cleaned and concentrated, the final concentration of the rubies being done by hand.

No basic magnesian rocks or serpentine derived from them, in which most of the corundum of North Carolina occurs, have been found in this valley. Corundum Hill and the Ellijay corundum region, are, however, less than 10 miles to the south.

Although, in many respects, the occurrence of the rubies and their associate minerals in the Cowee Valley is similar to the occurrence of the ruby in Burma, no limestone has been found near the alluvial deposits, the nearest point at which limestone has been found being at Cullowee Gap, about 8 miles to the southeast.

The country rock of the district is a gneiss, of a gray, fine-grained variety, which has a great many small garnets disseminated through it. The rock for the most part is in a highly decomposed condition, but there are small exposures of the undecomposed rock in many places. The gravels in which the rubies are found rest on a soft rock known as saprolite, which is the result of weathering of the basic silicate rocks in place. By means of shafts and the workings at the gravel washings it has been shown that at a depth of 35 feet or more these saprolitic rocks contain fragments of the undecomposed rock and pass into such rocks as eclogite-amphibolite and a hornblende gneiss.

A narrow dike of hornblende eclogite a few feet in width is exposed near the present workings of the company and can be traced for about 100 yards.

No rubies have been found in the undecomposed rock, but at In Situ Hill small rubies of a rather pale color were found in a narrow band of saprolitic rock. This band was, however, cut off by slickensides so that it could not be followed in any direction. There are four parallel slickensides that have been exposed at one place in the workings, the general direction of the slides being N. 75 deg. E. Some of these are 70 feet in length and of unknown depth. It is very evident that there has been a great deal of disturbance in this immediate vicinity through the breaking of the rock masses by faulting, the ready influx of water having caused the reduction of the rocks to their saprolitic condition.

In washing the gravels and masses of saprolite, masses of undecomposed rock have been uncovered, and in the center of these nodules of the pure hornblende rock have been found. The saprolite bordering these nodules often contains particles and crystals of corundum.

Less than 2 miles to the east of In Situ Hill, beyond Betts Gap of the Cowee Mountains, corundum of a gray to bluish color, but highly crystallized, has been found in hornblende-gneiss. One mile a little north of west, at the Sheffield mine, pink corundum has been found in amphibole-schist.

An association of corundum peculiar to this locality is with the garnet, rhodolite. Corundum and garnet occur not only constantly together in the saprolitic material and in the gravels, but corundum crystals have been found that bear the impression of the garnet. By means of wax a mold was taken of these impressions, and they were shown to be either the dodecahedron or trapezohedron. Then again some of the ruby crystals when broken are seen to have a garnet inclosed, and the garnet can often be seen in the transparent ruby crystal and the cut gem.

As has been said, there is no limestone in this immediate vicinity, and these rubies were probably derived from an amphibolite or eclogite. The usual flat tabular form is one that seems to be characteristic of the gem corundum when found in igneous rock.

The Cowee Creek rubies frequently contain inclusions, some of which are very minute, known to jewelers as "silk," and these give rise to a cloudiness or sheen in the polished gem. Rutile and menacanthite often occur in the rubies and greatly mar their beauty and value. Some gems that were 3 or 4 carats in weight have been cut which were free from inclusions, of fine color, and transparent. A great many smaller ones have been cut that are perfect gems. In color and brilliancy these gems are equal to the Burma ruby, and if the percentage of the unflawed transparent material increases but little this new field will be a worthy rival of the Burma field.

A considerable percentage of the transparent material is often very badly flawed by cracks due to parting, and by the inclusions of rutile or menacanthite, so that the percentage of perfect stone from this mine is small. This, however, is true of the rubies from the Burma field, for a large proportion of the rubies on the market to-day are usually more or less flawed with the parting cracks.

The pleochroism exhibited by the Cowee rubies is very marked, some of them being a very rich pigeon-blood red in the direction of the vertical axis—that is, looking down upon the basal plane—and changing to an almost pinkish-white color when viewed at right angles to this or looking through the prism. The pleochroism which nearly all the deep-colored varieties of corundum gems exhibit is one of the means of identifying a corundum gem; this often interferes with the cutting.

Under the head of corundum are included all the translucent to opaque varieties of all colors, subdivided into block, crystal, and sand corundum. While a sharp line can be drawn between corundum and emery, no such distinction can be made between corundum and sapphire, for many pieces of the former are found that have transparent portions. Many sapphire gems have been found in masses of corundum that were being mined for abrasive purposes.

Corundum was first discovered in Macon County, North Carolina, in 1870, at what is now known as the Corundum Hill mine, and mining was begun here about a year later. This mine has become one of the most important corundum deposits in this country. It is situated about 8 miles southeast of Franklin, the county seat, on the northeast side of Cullasagee Creek, a tributary of the Little Tennessee River.

The corundum found at this mine occurs in peridotite rock, and this has been worked very extensively, especially near the contact of this rock with gneiss. The hill is about 350 feet high, the summit being about 500 feet above the level of Cullasagee Creek.

The formation is a rather blunt lens-shaped mass of the dunite variety of peridotite, and has about 10 acres of surface, over most of which the rock is exposed. Most of the mines are located near the contact of the dunite with the gneiss or schist, and follow contact veins of corundum. A number of dunite veins have been worked within the formation, but with the exception of one they have all soon pinched out.

Most of the mining has been done on the south side of the formation, where was encountered what is known as the Big vein. This was first mined by means of open cuts and later by tunnels, the last one being about 300 feet below the summit of the hill. Fig. 2 is a view of the entrance to this tunnel, and shows the peridotite rock on the left and the gneiss on the right beyond the cut. For nearly the whole distance of the southern boundary of the dunite formation a cut has been made following the contour of the hill. This cut was sometimes wholly within the gneiss, at other times wholly within the peridotite, and again cutting directly on the contact. The tunnels are all to the left of the cut, and they have encountered corundum almost continuously for a distance of 1,280 feet, reaching nearly to the southeast boundary of the formation. Fig. 3 is a view of the upper or southeastern end of this cut, showing the peridotite on the left and the gneiss and schist on the right. The upper part of this cut is known as the Stanfield mine. A tunnel has been run into the hill near the contact, at the head of which the vein of corundum is 8 to 10 feet wide. No work has been done at this mine for a number of years.

On the northeast side of this formation is what is known as the Zeb Jones mine, where there was exposed (July, 1899) a bench of ore 25 feet in depth and 2 to 5 feet in width, uncovered for a distance of 50 feet, which averaged very close to 50 per cent corundum. This vein carries what is known as "buckwheat" corundum, which, as its name suggests, is made up of small, irregular particles about the size of buckwheat grains.

Numerous dunite veins have been found and worked, but they can be mined profitably only when they are large contact veins, for the reason that they are very likely to pinch out after being worked for a short time.

From these various openings, collectively known as the Corundum Hill mine, block, crystal, and sand corundum ores have been obtained, all of which can be readily cleaned and will make a commercial product that can be used in the manufacture of any kind of corundum wheel. A small amount of garnet is occasionally found associated with the corundum in the vein along the southern contact, but this portion of the ore can be readily eliminated by hand clobbering at the mine. This is the only mine that produced any quantity of corundum during 1899. It is now owned by the International Corundum and Emery Company, of New York, N. Y.

The water of Cullasagee River is utilized for the washing and cleaning machinery of the mill, which is located about a mile and a half below the mine, at Cullasagee. A line of sluice boxes connects the mine with the mill, and all the corundum ore that can be readily broken to pieces is carried down to the mill in these boxes.

Georgia corundum is well known, and perhaps has the best reputation of any on account of that obtained from the Laurel Creek mine, which, with the exception of the Track Rock mine, is the only one that has produced any considerable quantity of corundum. The peridotite formations are not so large as in North Carolina, nor are the corundum localities so numerous, and it is not probable that there is as much corundum in this State as in North Carolina, although the Laurel Creek mine may be superior to anyone thus far located in North Carolina.

The Laurel Creek mine, which is owned by the International Corundum and Emery Company, is located at Pine Mountain, Rabun County, Ga., and is 18 miles from Walhalla, S. C., the nearest point on the railroad. At this locality there is a large outcrop of peridotite, covering several hundred acres, and along the contact of this with the gneiss large deposits of corundum have been found. Several openings have been made, some of which have been worked very extensively.

The Big vein of massive corundum, for which this mine is noted, is at the foot of the south slope of the hill, and has been followed from the lower end of the cut for a distance of over 300 feet. Although this vein is near the contact of the peridotite with the gneiss, it is separated from it by a band of peridotite and a small vein of sand corundum. There is some doubt whether the block of gneiss is entirely surrounded by the peridotite or whether it penetrates the peridotite from the main mass of gneiss. From what could be seen, and from information obtained from Mr. Andy Evans, foreman of the mine, it has very much the appearance of being entirely inclosed in the mass of peridotite. The Big vein, which has been worked by an inclined shaft 116 feet deep, with tunnels 300 feet in length running from this, has brought the work up to the block of gneiss just referred to, and, according to Mr. Evans, a little work was done farther to the east which showed the corundum vein to extend on the south side of the block of gneiss, and it is not at all improbable that this vein continues further in this direction. Open cuts on the east and west side of this block of gneiss have followed contact veins of corundum. Little work has been done at Laurel Creek except on contact veins, the principal exception being a small dunite vein near the west end of the formation, from which considerable corundum was obtained, but the vein soon began to pinch out. Fig. 4 is a photograph of this vein, showing both the hanging and foot walls of peridotite. Considerable work has been done, immediately south of this cut, and some large crystals, for which this mine is noted, were obtained here.

This is perhaps the most famous corundum mine in this country, and has furnished ore from which an exceptionally good commercial product has been obtained.

It has not been worked since 1894, when the tunnels and shafts of the Big vein were cut off by the slipping of a large block of the peridotite formation, nearly a 200-foot cube.

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Plant for washing the gravels is shown in the foreground; a, sluice box; b, sieve boxes; c, rocker.
FIG. 1.—RUBY MINE AT COWEE VALLEY, N. C.

FIG. 4.—DUNITE VEIN OF CORUNDUM AT LAUREL CREEK, GEORGIA.

FIG. 2.—THE BIG VEIN BETWEEN THE PERIDOTITE AND THE GNEISS AT CORUNDUM HILL, MACON COUNTY, N. C.

FIG. 3.—UPPER END OF BIG CUT AT CORUNDUM HILL MINE, MACON CO., N. C.
Peridotite is shown on the left and gneiss and schist on the right.

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