The Blue Ridge province is an extended system of many mountain ranges with different local names. The ranges extend from northeastern Georgia into southern Pennsylvania and correspond to the Highlands of New Jersey and New York and the mountains of western New England. Prominent among these ranges are the Cohutta Mountains of Georgia, the Great Smoky and Unaka Mountains of Tennessee and North Carolina, the Blue Ridge and Canoe Mountains of Virginia and Maryland, and South Mountain of Pennsylvania. The Piedmont province differs little geologically from the Blue Ridge province, but its location is topographically so different that it has been given a separate name.

The Blue Ridge province rises gradually from an altitude of less than 500 feet above sea level in Georgia to more than 6,000 feet in western North Carolina. From this region the altitude decreases to less than 3,000 feet in southern Virginia, rises to 4,000 feet in northwestern Virginia, and descends to less than 2,000 feet at the Maryland-Pennsylvania line.

The drainage of the mountains is carried in both longitudinal and transverse streams, according to the geologic structure in the different regions. In the areas of ancient rocks few-shaped drainage basins have been developed by numerous crossing streams. Longitudinal valleys occur in sedimentary rocks that have been considerably folded and eroded in late ages. In general the borders are irregular and are not sharply marked, but in some places the passage from plateau to plateau or plateau to coastal plain is almost smooth.

The Piedmont province is a gently sloping plateau dissected by the rivers and streams that flow over its surface. The slope is gradual eastward and southeastern from the mountains toward the coast at an average of about 200 feet in 5,000 feet, or a little over 1 percent, along the streams and in part to differences in hardness and structure of the rocks. These factors have resulted in several lower plateaus, the general plateau region which are distinct from one another in altitude and extent.

The streams of the Piedmont province flow to the southeast, but there are many variations, as the flow is quite different, and westward in New England and which flow into the Coastal Plain on the south and east and the Blue Ridge and Valley and Ridge provinces on the north and west. The Piedmont province has an average width of about 20 miles, but in the southern and central parts it is more than 100 miles wide. In general the borders are irregular and are not sharply marked, but in some places the passage from plateau to plateau or plateau to coastal plain is almost smooth.

The Piedmont province is composed of several distinct physiographic divisions. Among these divisions are the Piedmont province, the Blue Ridge province, the Valley and Ridge province, and the Appalachian Plateaus. The Appalachian Plateaus include the Cumberland Plateau, the Allegheny Plateau, and the lower plateaus and plains of Tennessee, Kentucky, and Ohio extending westward toward Mississippi River. They range from nearly flat country that has an altitude of about 500 feet above sea level at the west to table-lands, dissected plateaus, hilly country, and mountains that range from 2,000 to 4,500 feet in altitude at the east.

The Valley and Ridge province extends from Allegheny northward into New York. It includes several large valleys and numerous small ones. Among the large ones are the Tennessee Valley, Kentucky, and Ohio extending westward toward Mississippi River. They range from nearly flat country that has an altitude of about 500 feet above sea level at the west to table-lands, dissected plateaus, hilly country, and mountains that range from 2,000 to 4,500 feet in altitude at the east.

The drainage of the Valley and Ridge province depends largely on the geologic structure. In general the courses of the streams are determined by the hardness of the rocks and by the structure, making mountainous valleys in general and parallel to the Great Valley. These longitudinal streams empty into larger transverse rivers that cut across the walls of the valley. The larger transverse rivers are the Tennessee, New or Kanawha, Monongahela, James, Potomac, Susquehanna, Schuylkill, Delaware, and Hudson.

By Arthur Keith and W. B. Sterrett

FIGURE 1—Index map of the vicinity of the Gaffney and Kings Mountain quadrangles

This boundary is the Gaffney-Kings Mountain area (Fol. 222) shown by the darker ruling. Published after other plates, 1921, by the author and D. B. Sterrett. The quadrangles are Gaffney, S. C., and Kings Mountain, N. C., from which the quadrangles are named, and Blacksburg, S. C. (See fig. 2.)

In geographic and geologic relations these quadrangles form part of the Piedmont province, the eastern division of the Appalachian Highlands.

APPALACHIAN HIGHLANDS

Sediments

The Appalachian Highlands are composed of several distinct physiographic divisions. Among these divisions are the Piedmont province, the Blue Ridge province, the Valley and Ridge province, and the Appalachian Plateaus. The Appalachian Plateaus include the Cumberland Plateau, the Allegheny Plateau, and the lower plateaus and plains of Tennessee, Kentucky, and Ohio extending westward toward Mississippi River. They range from nearly flat country that has an altitude of about 500 feet above sea level at the west to table-lands, dissected plateaus, hilly country, and mountains that range from 2,000 to 4,500 feet in altitude at the east.

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The metamorphic igneous rocks include schists and gneisses-some graywackes, schists, and gneisses which they have been converted to mica schists and gneisses which they have been metamorphosed, and not everywhere distinctly shown from the metamorphic rocks.

The unmetamorphosed sediments of the Piedmont province include conglomerates, sandstones, shales, and interstratified lenses of sedimentary rock. These rocks are chiefly Triassic and occur in several localities in North Carolina, Virginia, Maryland, Pennsylvania, and New Jersey. In a few places similar kinds of rocks of Cretaceous age overlap the eastern border of the Piedmont province.

The strike of the formations of the Piedmont province is generally north-south, or approximately parallel with the trend of the plateau and the Appalachian Mountains that border it, but in some places the beds trend nearly at right angles to the prevailing strike. The dips of the rocks are high but variable, and southeast dips prevail.

GEOLOGIC HISTORY
The geologic record of the Appalachian Mountains along the northwestern border of the Piedmont begins with Archean rocks that are among the oldest known in the world. They consist of unmetamorphosed igneous and sedimentary rocks, the origin of which is lost in obscurity. Others are extensively metamorphosed but still exhibit features characteristic of their original igneous or sedimentary type. Some of the metamorphosed sediments of the Piedmont province were laid down massively in Mesozoic and later times, but instead of the horizontal is rare. The Piedmont province was a vast area were submerged in early Mesozoic time, and deposits of Algonkian, in turn were uplifted, exposed over vast areas. This period was the longest of its kind in the world.

The Archean erosion was by volcanic activity, and the early sheets of lava were poured forth and large areas were eroded. Some of the unmetamorphosed sediments of the Piedmont province were laid down along the rivers and streams. The unconformable beds of the Archean rocks are numerous and show the development of the Pre-Paleozoic era. These rocks are more or less changed. Some of these rocks into mica and garnet gneisses or schists which can not be distinguished from those of sedimentary origin. Diatreme and many basic igneous rocks have become schistose diorite, hornblende gneiss, or iron oxide schist, serpentine, amphibolite, and other varieties of metamorphic rocks.

The igneous rocks of the Piedmont province include a wide range of such rocks as granite, diorite, gabbro, pyroxene, peridotite, pyroxene, and diorite and gneisses and are not everywhere distinctly shown from the metamorphic rocks.

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rocks have been cut by masses of later igneous rocks, some of them large. In the Gaffney quadrangle the Archean rocks and later intrusive rocks occupy about two-thirds of the northwestern part and scattered areas in the southeastern part. In the same quadrangle large masses of later igneous rocks are developed, but they do not occupy more than one-fifth of the northern part and nearly one-third of the southern part. The Triassic rocks are cut by several intrusive dikes that are only a few hundred feet thick and that have no significant effect on the structure.

Throughout the Kings Mountain quadrangle and in the eastern part of the Gaffney quadrangle, Triassic rocks are rather generally distributed in narrow dikes with a width of a few hundred feet or less. The earliest intrusive rocks occupy about one-fifth of the northeastern part of the northwestern part of the region and were named because of its extensive development in the Carolinas. It occupies nearly one-half of the Gaffney quadrangle. Triassic rocks are also found in the southeastern part of the region and were named because of its extensive development in the Carolinas. It occupies nearly one-half of the Gaffney quadrangle. Triassic rocks are also found in the southeastern part of the region and were named because of its extensive development in the Carolinas. It occupies nearly one-half of the Gaffney quadrangle. Triassic rocks are also found in the southeastern part of the region and were named because of its extensive development in the Carolinas. It occupies nearly one-half of the Gaffney quadrangle.

The relations of the rock formations and their thickness and composition are shown in the columnar sections of the Triassic rocks in the Gaffney and Kings Mountain quadrangles. The Triassic rocks in the Gaffney quadrangle are divided into two main groups: the Triassic rocks to the east of the Kings Mountain quadrangle and the Triassic rocks to the west of the Kings Mountain quadrangle. The Triassic rocks to the east of the Kings Mountain quadrangle are divided into two main groups: the Triassic rocks to the east of the Kings Mountain quadrangle and the Triassic rocks to the west of the Kings Mountain quadrangle. The Triassic rocks to the east of the Kings Mountain quadrangle are divided into two main groups: the Triassic rocks to the east of the Kings Mountain quadrangle and the Triassic rocks to the west of the Kings Mountain quadrangle.
greenish to yellowish-green and olive-green sandy clay soils. The structure and texture of the original rock in many places differentiates from the same magma as that of the Roan gneiss. A less altered form of the hornblende, the powder of which is green. Where a

isolated bodies appear in the Carolina gneiss and Bessemer granite, and similar rocks together with soapstone derived from them by the Roan gneiss are of good quality and fertile.

The Algonkian rocks of these quadrangles underlie the rocks which on general grounds are assigned to the Cambrian. Thus, the schist of the Battleground formation is rather fine and granular, north and south of the Gaffney-Kings Mountain quadrangle, is a highly schistose granite that occurs both in large masses and in small dikes cutting other rocks, especially the Bessemer granite. The large dikes are 4 miles wide and extend over 15 miles diagonally across the Kings Mountain quadrangle.

The Bessemer granite, named from Bessemer City, New York, is a porphyritic granite, north and south of the Gaffney-Kings Mountain quadrangle, is a highly schistose granite that occurs both in large masses and in small dikes cutting other rocks, especially the Bessemer granite. The large dikes are 2 miles wide and extend over 15 miles diagonally across the Kings Mountain quadrangle.

In general, the porphyritic texture is locally developed. In all orebodies in which the porphyritic texture is locally developed, the weathering of pyroxenite and hornblende-hypersthene peridotite, and olivine gabbro is killing, and the powder of which is green. Where a isolated bodies appear in the Carolina gneiss and Bessemer granite, and similar rocks together with soapstone derived from them by the Roan gneiss are of good quality and fertile.

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which much manganese is associated. Some layers of fine silvery-white sericite schist without manganese oxides are not distinguishable from other portions of the Backbone formation, but the parts that are also differentiated by being absent of manganese occur as masses of black micas in leuconitic vein fillings, or with quartz, or in places several feet thick. From these large deposits innumerable small assume and veins of manganese oxide extend through large masses of the schist filling the spaces between the crystals. The compact schist is impregnated with stains of black manganese oxide through nearly the entire mass.

The presence between the manganese schist and the other beds of the Backbone schist suggests that they have a similar origin. The manganese in veins and lenses is apparently of secondary origin and entered the formation in solution and later concentrated by solutions in veins that cut the schist.

The widespread dissemination of manganese oxides through the schist derived from this formation and through the partly altered rock under the soil is apparently due to surface action and concentration, for the unaltered rocks do not contain so much dissolved manganese.

The weathering of the manganese schist is similar to that of the Draytonville conglomerate, quartzite, and sericite schist. The large veins and joints in the schist and from these spread into the pore spaces between the mineral grains, depositing oxides and hydroxides of manganese. The larger veins represent the trunk channel through which the manganese solutions entered the rocks and from which all the smaller veins, seams, and impregnations probably fed.

Possibly, however, the manganese may have accumulated somewhat like bog ore in the same basin with the sediments, in a layer of water, wide and extended, in which the manganese oxide could have been impregnated with solutions of iron and other metallic elements

The Cambrian System

GENERAL FEATURES

The Cambrian rocks in this region are a metamorphosed sedimentary series, and now consist of quartzite, argillaceous, graywacke, slates, schists, soapstone, and marble. No fossils have been found in them, and the rocks are placed in the Cambrian system on account of their extensive metamorphism, their structure, and the character of the rocks to which they are clearly related. In places the Cambrian rocks are horizontally bedded and in others they are strongly deformed into a stony schistose, often with a sawdust or contorted structure, in places nearly vertical, and in others the layers are bent, arched, and portioned in a belt that extends from Gaffney through Blacksburg to Kings Mountain and on across the southeast corner of the Lincolnland quadrangle. The hard strata slope at a few feet above the surface or angular blocks of quartzite of different sizes are scattered along the ground. The quartzite in some places may be traced almost continuously for several miles in approximately one course. In other places the ledges are curved and bed down on themselves, and some terminate abruptly.

The beds of quartzite form high ground generally, and some of the peripheral ledges form the backscarp of high ridges, such as Whittaker Mountain and Silver Mines Ridge.

The quartzite is not thick, probably nowhere more than 50 or 60 feet. Folding has displaced the beds in some places, and as this structure is not invariably recognizable in the apparent thickness may not everywhere be the actual one.

The quartzite is composed of chiefly angular interlocking grains of quartz with here and there a few scales of mica or sericite of other minerals. The texture is medium grained and there is a tendency to a schistose arrangement of the grains, especially where mica is present.

The white quartzite breaks down under the action of weathering into fine sandy soil through which are scattered numerous blocks and fragments of different sizes. The soil consists of a more compact sand than that which generally results from the weathering of granite.

The convex and concave quartzite.

The most extensive belt of quartzite containing variable quantities of chlorite and sericite is in the region around Crowders Mill Pond and southwest of the Pinnacle. Another narrow belt lies about 4 miles south of the town of Kings Mountain. In most places this rock occupies high ground and forms ridges that have rather steep slopes. Even when the thickness of some of the outcrops indicates a thickness of more than 500 feet, the quartzite is also associated with the chloritic and sericite schists and schistose.

These rocks are generally fine grained and are chiefly grayish, greenish gray, and gray.

The chloritic and sericite quartzite is variable in composition. The chloritic quartzite is composed chiefly of quartz with either chlorite or sericite or both. In many places other minerals are more or less abundant, such as calcite, quartz, feldspar, and other more common minerals. Some of these other minerals are original constituents of the sediments, and possibly all constituents but the crystal have been metamorphosed during metamorphism. The crystals of hornblende were probably derived from outside sources, or at least part of their constituents, such as hornblende, were then introduced. Pyrite may have formed either from original constituents or have been added from other sources during metamorphism.

The proportion of the minerals of the chloritic and serpentinite quartzite differs much in the different outcrops, and variations in the amount of granular quartz yield rocks ranging from quartzite to schist.

As the content of quartz diminishes these rocks grade into typical chlorite-sericite schist. In places considerable secondary quartz has been deposited in them as lenses and broken veins, more commonly with the sericite. Some of the quartzose intrusions have been inclusions in the silt of the quartzite. The quartzose quartzite is termed by some as the schist and quartz.

The purer quartzitic phases weather to fine sandy soils, but where chlorite is abundant the resultant soils are too colored to brown and in some places resemble soils formed by the weathering of hornblende rocks.

The Kings Mountain quartzite, cushions, or ridges, generally 50 to 200 feet above the steep talus slopes below. (See pi. 2.) All these strata rise almost vertically 25 to 50 feet above the surface or angular blocks of quartzite of different sizes are scattered along the ground. The quartzite in some places may be traced almost continuously for several miles in approximately one course. In other places the strata are curved and bed down on themselves, and some terminate abruptly.

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through the town of Kings Mountain into the Lincolnton quadrangle. Between this and the town on the south, Stephens near the town, the marble is of a gray color which is due to the presence of epidote and pyrite in the marble and to the normal Whiteside granite. The Whiteside granite has yielded to metamorphism in the northeastern part of the Kings Mountain quadrangle, which biotite is scarce are nearly white. Most of it has a medium to fine grain, and in some places it has a porphyritic texture, in some it is massive.

The Whitinsville granite has yielded to metamorphism in different degrees. Frames of it exhibit a schistose structure of varying intensity. In many places there is a gradation from massive granite in the interior of a mass to strongly schistose or gneissic granite at the border. However, the bulk of the granite shows only moderate metamorphism, and in many places it is difficult to detect any structural planes.

In places the Whitinsville granite exhibits fine bedding in roughly parallel layers of mineral. The structure may have developed in two ways—either during the intrusion of the gneissic granite after a partial separation of the minerals had taken place, or by the mashing and flowing of granite which had included and partly absorbed masses of other rocks. The flow structure may be seen in certain parts of the granite, and absent in another a few feet distant but is more common near the contact of the granite and the diorite.

**Relations.**—The Whitinsville gneiss is intrusive into the Carolinian and Ross gneiss, and it is cut by the diabase described below. The intrusion of the gneiss at many places is shown by the discordance of masses from the borders of which the strata of the gneiss dip away at different angles, by the invasion of masses of gneiss into the granite with which it is in contact, by the occurrence of dikes both conformable with and cutting across the gneiss and the diorite, and by the relations to pegmatite that cuts other rocks.

Around Cherryville, in the Lincolnton quadrangle, north of the Kings Mountain quadrangle, a large mass of the Whitinsville granite has formed many hills in the gneiss, especially to the southwest of the main mass. Apparently there is a large body of granite near this locality, which the biotite occurs in lustrous black scales. Quartz is abundant in the main mass and is absent in another a few feet distant but is more common near the contact of the granite and the diorite.

**Character.**—The Whitinsville granite ranges from very fine to medium fine grains and from black gray to white. All varieties are locally called limestone, but the texture is sufficiently crystalline for them to all be classed as marble. Most of the rock has a gray or bluish gray color due to the presence of micas such as muscovite and hornblende. The rock is generally light gray, but those varieties in which biotite is more than a trace of minerals are gray or dark gray. Most of it is a medium to fine grain, and in some places it has a porphyritic texture, in some it is massive.

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The structure of the younger rocks of this district—that is, the Algonkian and Cambrian—is less complex than that of the Archean rocks, but nevertheless it is far from simple. Elongated belts of these rocks (such as the conglomerates, quartzites, or marbles) predominate, but locally irregular and broken outcrops occur. The long belts represent the outlines of eroded ridges and are parallel to the main structural features of many of the Archean and Cambrian rocks. Such changes and transitions are described more in detail in the section on the stratigraphy of the region.

The faulting has produced a lack of symmetry in the structural patterns; the rocks on one side of any large faults are often different from those on the other side.

Faults—Large faults in the Carolina gneiss are in general realigned only where other rocks of a different character are included, and even then the complexity of the faults can be appreciated only after considerable study has been made of the details of the folds. The horst blocks of the Boom quartzites in Carolina gneiss can be recognized in most outcrops, and their occurrence in long, narrow belts with branching outcrops or in larger areas with zigzag contacts shows folded structure of more or less complex nature. The horst blocks are separated by belts which dip in the same direction but at different angles are probably parts of overturned folds. These faults occur east of the Gaffney quadrangle, and near the front uplift of the Kings Mountain quadrangle.

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Faults—Large faults in the Carolina gneiss are in general realigned only where other rocks of a different character are included, and even then the complexity of the faults can be appreciated only after considerable study has been made of the details of the folds. The horst blocks of the Boom quartzites in Carolina gneiss can be recognized in most outcrops, and their occurrence in long, narrow belts with branching outcrops or in larger areas with zigzag contacts shows folded structure of more or less complex nature. The horst blocks are separated by belts which dip in the same direction but at different angles are probably parts of overturned folds. These faults occur east of the Gaffney quadrangle, and near the front uplift of the Kings Mountain quadrangle.

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The folds and faults are of very different lengths; some of them only a few yards long and others more than 10 miles. Those which can be traced the furthest are in the Cambrian beds that extend from the area near the Maybrook quadrangle through Backxley nearly to the town of Kings Mountain.

In many places it is impossible to tell whether the outcrops were in their position to folding or faulting because of the confusion between the two features and the lack of good exposures.

The Kings Mountain quartzite and the Gaffney marble have proved to be quite resistant, and suitable beds for cutting, and accordingly it has been possible to determine their structure in the most detail.

Fissuring—Another and much later form of structure occurs in connection with the dike-like dikes of Triassic age. The marked rock that now forms the dike was forced into open fissures, most of them less than 50 feet across but miles in length. These dikes and fissures have nearly parallel trends of N. 25°-30° W. and cut directly across other structural features and rocks. As no offsetting of the formations is visible where the fissure-cuts the bed there was nothing to prevent its motion in the rocks. The dike and fissures are closely parallel and characteristically jointed, unless the movement was along the planes of weakness and the quartzitic and mica schist. Some of the decomposed rock or saprolite associated with the veins contained considerable gold that could not be safely saved.

A method of shucking and washing, however, was devised by which the gold could be caught on amalgamated copper plates, and a large body of the saprolite was washed at the locality numbered 5 on Figure 4.

The gold deposits are associated with beds or lenses of blue gray banded dolomite marble included in chalcedonic quartz schist of Archean age. These schists also carry a belt of graphite schist along the southeast side of the marble and ore bodies.

A number of chert beds, also of Archean age but intrusive into the schists that contain the ore bodies, lie 100 feet or more southeast the veins. A few hundred feet north of the veins a belt of chert schist and mica schist of Cambrian age was outlined by the solidification of a granite sill.

The general direction of the folds is northeast, commencing from north by east of the Darwin mine. The Darwin mine is 1½ miles in a direction north of east of the Darwin mine. It is nearly in the center of a belt of deposits opened within a mile and a half to the north and to the east. Another group of deposits has been opened two-thirds of a mile in a direction north of east of the Darwin mine, was in operation during 1933. The McGil mine is also north of the Darwin, on Backxley Branch.

Openings have been made at intervals on the Darwin vein on the Darwin ground and on the Rose & Carrell ground, to the north. From the Darwin mine openings are irregularly scattered along the vein for more than a mile to the south on the Lineon, Bessemer, and other lines. These dolomitic veins are part of the Vein system and contain inclinations of beds of hornblende schist of the Rose


The five principal types of deposits that have been recognized are (1) ore in chertaceous schist or aspatite; (2) ore in biotite gneiss; (3) ore in chertaceous schist near contact with Bessemer granite; (4) ore in chertaceous schist; (5) ore in chertaceous schist near contact with Bessemer granite.

Of these different ores probably all but those in schistaceous schist have been worked probably under conditions that existed at the time of their deposit. It is not likely that any of the deposits would prove profitable under the conditions of mining and sales now prevalent or that they will be profitable in the near future.

Ore in serpentine.—The iron-ore deposits in serpentine are included in areas of Bn an area interbedded with Bessemer granite. Most of the deposits have been found in a mass of such ore that lies southeast of Blakely and extends to the south across Broad River. These deposits furnished considerable ore to the furnaces of this region during the Civil War. The deposits in this mass known as pit No. 2, is 2 miles W. N. W. of Blakely, in a small valley that drains into Broad River. It was worked by an open cut about 50 feet long, 35 feet wide, and 15 feet deep at the inner end, which was driven northeastward to the face of a steep hill. The country rock is hornblende schist of the Bonan group, cut by layers of schistose granite. The ore is composed of magnetite and serpentine and other magmatic minerals, such as calcite, chlorite, tremolite, or actinolite. Deposits of the same type occur in mass and grained disseminated throughout the serpentinite, chlorite, and tremolite. The disseminated ore would require concentration, but the ore selected here shows a large content of metallic iron. Little could be seen of the size of the ore bodies, but evidently the ore occurs in several sheets or shallow lenses. While such ore may be of serpentine-rock type. The ore deposit possibly originated through the solution of minerals from rock or ore by the intrusion of Bessemer granite upon an included mass of dolomite from the Andesite solidifies in Bonan ore.

The ore deposit worked under this condition may, which would agree well with their metamorphosed and distorted condition. A number of other iron-ore pits were found less than 2 miles northeast of the Black River. All of these are on the same bed southeast of Blakely. These deposits are apparently very similar in general appearance to some of the xenolithic and allied minerals seen to be less abundant. Near the hornblende schist epidote is mixed with the magnetite. Southeast and south of the Black pit No. 2, between Broad River and People's Creek, a number of other pits have been worked for ore of similar character.

These deposits are composed of schistose and similar minerals and are included in areas of hornblende schist and intruded schistose granite. The deposits bear a similar relation to the mass of Bn an area and the granite granitic intruded it in the different localities. From the Black pit No. 2, northeast of the deposits lie near the contact of the same formations where they pitch under the country rock of Bn.

Ore in chertaceous schist.—Certain chertaceous schists that contain considerable quartz, which are mapped as Asparite and are banded with a layer or a considerable amount of quartz. These schists have been prospected at a number of places, and the few Bn crystals have chargeable.

Lumps were made in deposits of this ore along the west side of Doubletree Creek near Cherokee Falls and between Cherokee Falls and Deerfield Falls. In the general region some of these deposits are difficult to distinguish from the ores in the quartzites, especially in their weathered condition and proximity to each other. The ores at these places consist of granular magnetite scattered thinly through chertaceous chertaceous schist or granite and in some localities almost entirely replaces the schist.

The deposits of magnetite southeast and east of the town of Cherokee in St. Johns, in rocks belonging to this group, but some of them carry sulphur at depth. The magnetic iron ore deposit near the Kings Mountain group has been opened by a number of prospects, but probably little ore was shipped. The main workings were between The Pine Creek and the Kings Mountain, along the west side of Yellow Ridge, where large quantities of ore are reported to have been mined.

The deposits of this group were probably formed by solutions or other mineralizing agents given off by the Bessemer granite that occurred on certain adjacent bed of schist.

Ore in schist.—The schistous tuff has not been regularly mined, but prospects have been opened at a few places, and the few ore is believed to be exposed on the surface at other places. These deposits consist of fine granular magnetite and specular hematite in granular columnar layers of the Battleground schist. These ore bodies are opened along the northwest side of the Kings Mountain range near Steppie Gap and at the north end of Cromedale Mountain. Good surface specimens have been obtained from beds of coarse schist tuff out of The Pine Creek.
within a mile in a direction a little west of south. Two prospects also have been opened at the north end of Crowders mountain. The work on the Lawton mine was on a fairly large scale, and the old work on the Craig place, now the south end of Battleground, was extensive. Property was also extended on the mine was opened by several shafts 30 to 100 feet deep, by drifts and by open cuts. Two or more veins were found about 100 feet apart. In most of the mines they ranged from 2 to 10 feet thick, but in one place they were nearly 12 feet deep. The tinstones were bleached in the sun on the old logs, and the areas were staked out with the unusually low dips. The beds were folded rather tightly in the area occupied by Limestone College, north and west of the quarters, but on the southern margin of the area they were overturned from the southeast, so that older quartzites and gneisses were brought above the marble. The overburden was probably accompanied by thrust faulting, which in places brought the underlying gneisses near to the marble.

In many of the other quarters along the limestone or marble beds the quality of the rock and the relations of the beds are similar to those in the Gaffney quarries. The beds of marble, however, do not sink as in the Gaffney quarries, and most of them dip more steeply. The bluish-grey beds turn into the best limestones, and most of the white marble is dismembered. In some of the quarries the two beds of bluish marble are worked, generally not more than 10 to 15 feet thick and separated by a few feet of fine granular bluish marble and in some places hornblende schist. Most of the deposits have the southerly dips, which result from folds overturned by compressive forces that acted from the southeast.

The marble reaches its greatest development in this locality, and the area underlain by it is especially wide on account of the unusually low dips. The beds were folded rather tightly in the area occupied by Limestone College, north and west of the quarters, but on the southern margin of the area they were overturned from the southeast, so that older quartzites and gneisses were brought above the marble. The overburden was probably accompanied by thrust faulting, which in places brought the underlying gneisses near to the marble. From these trends, the rocks are more or less parallelly folded, and the area last worked the dolomite was overlapped by about 10 feet of white calcareous schist. The lower part of the marble in the quarry is bluish grey and according to Sloan contains nearly 50 percent of marcasite. This part was worked for burning into lime and was 20 to 30 feet thick. Some parts of the marble contain inclinations of fine hornblende schist, bastite schist, and gneissic intrusions, but these can readily be sorted out. Fine crystals of pyrite occur in place, but not in sufficient quantity to injure the lime prepared from it.

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**BOOK FOR CONSTRUCTION**

At several places in the Gaffney quadrangle quarries were opened in the siliceous or the carbonaceous limestone and the schist. The schist is a very soft and friable rock and the gneissic bands that border the conglomerate beds included in the Gaffney schist, and the rock was used chiefly in the iron furnaces before and after the Civil War. Gas deposits for Gaffney were reported for 4 miles south of the Gaffney Kingston district. Some of the deposits were 2 miles south of the Kingston district. The deposits that were most promising were those at the Kings Mountain mine (fig. 4), on Kings Creek 4 miles north of Grover, and on to the town of Kings Mountain.

Other deposits.—A barite deposit in the extreme southeast corner of Gaffney County, N. C., has been worked by a trench about 150 feet long and 20 feet wide. The working is badly overgrown with or abandoned, and good bedrock has been reported to have been shipped from them a number of years ago. Apparently two veins were opened in alluvial siliceous schist and overlain by sandstone. Later prospecting has been opened on one 2 miles north of Piedmont Springs and 14 miles south of the King Mountain Battleground. Veins ranging from a few inches to 2 feet thick have been opened in some of these deposits. Much of the barite occurs in massive granular pure-white form. Locally lenticular and splenocratic occur in streaks and patches in the granite, and some of the ore near the surface is slightly pitchy.

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by the Blue Ridge Tin Corporation. At the northeast is an old
ore vein, which can be seen at about 900 feet. This is a trench of
about 200 feet long and 5 to 20 feet deep along the
contact strikes N. 25° E. and dips 80° NW., but at a depth of
northwest lie other large masses of pegmatite separated from
the pegmatite at this place is probably at least 25 feet wide. To the
west is a trench 100 feet long and 3 to 12 feet deep on a
contact similar to that just described. This contact strikes
sunk near a pit where good ore had been found. A 60-foot
trench on a mass of pegmatite. Cassiterite was reported in
the underground workings. Placer deposits have been worked in the
bottom land along
Main works of the Blue Ridge Tin Corporation.—At the
northeast end of the outcrops on the property of the Blue Ridge
Tin Corporation, a shaft 90 feet deep (No. 1) was sunk, and a
60-foot drift was driven to the southwest from it on the
60-foot level. The material in these veins consists of schistose
hypersthene-pegmatite and is reported to have been badly
Bluish mica schist forms the wall rock, but 45 feet to the
southwest is a belt of hornblende schist. A vein of tourmaline
pegmatite has been tested with favorable results. This placer ore was hauled
available, and parts of the placer ground are reported to have
been sold for $5 to $100 a carat wholesale.
Emerald contains a small percentage of chromium oxide. An analysis of Colombian emerald by F. Wilhould showed 0.186% of chromium oxide. A small mass of hornblende hyperstenite and olivine gabbro from the Old Platte
mine was found, but it was not possible to separate the various rocks, and no useful results were obtained.
Emeralds were discovered on the W. E. Turner place, nearly 4 miles west of Patterson Springs, in 1890. Other
emeralds have been found in similar spodumene-bearing pegmatite, inclosed in the
60-yard level. In the east end of the cut the pegmatite
hypersthenite to show where it had pinched out to the west
of the inclusions of diorite in the
emeralds. Other stones had a fine and deep color, but defects,
such as cracks, chipping, or flaws, were common. Some gems of paler green color but almost flawless were found.
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such as cracks, chipping, or flaws, were common. Some gems of paler green color but almost flawless were found.
Berylls and their uses.
The nature of the deposits has been briefly outlined in the description of the rock in which they are located. The manganese occurs as black oxides and hydrous oxides, both in masses and disseminated in felsite and schistous titaniferous gneisses. The veins range from mere streaks to deposits several feet thick. In many places streaks of the schist are included in the larger veins or lie between parallel veins. Smaller veins branch out from the larger ones and cut the schist at different angles. In one place a vein may be largely filled with manganese oxides, whereas in another place the same vein may carry more quartz than manganese minerals. The weathering of the manganese veins sets free large quantities of manganese oxides, which stain the surrounding schist strongly, and leave boulders of ore on the surface, thus giving the appearance of larger deposits than are really present.

Irregularities in the veins and the deceptive appearance of thin streaks at the weathered surface make prospecting for the manganese ore uncertain. Long crooked trenches have to be made in some places to locate the richest deposits, and veins of apparent promise at the surface pitch or lie below parallel veins. Several sources of manganese ore from such veins are reported to have been shipped from this region. Analysis of the ore shows a range from 15 to 37 per cent of metallic manganese, according to the care used in sorting.

Most of the prospects consist of surface pits or cuts and shafts only 20 or 30 feet deep, but a few shafts have been carried down 40 feet or more. At a deposit 1 mile northwest of the Kings Mountain quadrangle a shaft was sunk about 125 feet deep, and some drifting was done from it along the vein. Because of irregularities in the vein and the consequent uncertainties of the quantity of ore to be expected in mining, work was abandoned. The manganese deposits of this region have not proved of present value but may be of value in the future.

Garnet

A pyrite deposit in the Lincolnton quadrangle, north of the Kings Mountain quadrangle, has been worked on a large scale to supply ore for a sulphuric acid manufacturing plant at Blacksburg, but only a few small pyrite prospects have been tested in this region. One of these prospects is on the Ross property, 23 miles S., 29° W. of Kings Creek station, and is 3 miles nearly due north of the town of Kings Mountain. The Ross prospect is in a bed of quartz-sericite schist several feet thick, infolded in a large body of Bowers granite. The schist is locally impregnated with small grains of pyrite, and in places pyrite contains nearly all of the rock. An analysis by Dr. W. A. Venable, of the U.S. Geological Survey, showed 62.5 per cent of sulphur and 32.3 per cent of iron, and the coarse metallic iron with the rest chiefly inamslable material.

Similar deposits of pyrite have been found in the Schuyler quadrangle, at three places west of the town, and about 3 miles south of the town. Specimens of pyrite of a similar character have been found in a shaft that is now filled up. In theanalysis of the ore the quantity of pyrite in the ore has been separated from the country rock and was found to contain 78.4 per cent of sulphur. The deposit is a large one, but only a small part of it has been worked.

Manganese

Specimens of corundum have been found in several of the mica-bearing schists and in the placer gravel at the Ross mine. Many specimens have been found in the mail about 4 miles south-southeast of Ezel, along a belt about 1.5 miles long that has a northwest trend and crosses from South Carolina into North Carolina. No cavities have been seen, but in one place small crystals of corundum are embedded in the matrix. The country rock consists of muscovite-biotite schist that includes streaks of the quartz-sericite schist and is surrounded by a large body of White Salisbury granite. All the rocks have been weathered greatly, and only some highly micaceous beds that have retained their original structure are preserved. The boundary of the formations. These beds have an average strike of nearly north and an average dip of 30° to 35°. In one place small crystals of garnet were found, whilst that consist almost wholly of muscovite and biotite.

Most of the mica contained in the iron-rich products of weathering is corundum, and it contains some of the finest varieties. The corundum is grey to brown-colored, and some crystals show a strong sheen or chatoyancy.

Graphite

The alluvial soils along the Broad River were originally very rich, but many of these lands have been detrituated by denudation and the accumulation of sand and gravel over the surface during floods. Most of the alluvial lands are covered with 2 feet of less fine loam underlain by a layer of gravelly sand that rests on the bedrock. Drainage is usually good, and there are no extensive swampy areas.

The upland residual soils are variable, and their character depends largely on the character of the rocks from which they have formed and the extent of weathering that they have undergone. In general, after thorough decomposition, the limestone formations have residual soils of the type that rest on the bedrock. The lower formations have residual soils that are partly weathered. The bedrock bedrock forms include granite, granite and schist, and mixed-granit-schistous formations, forms soils in a descending grade of fertility, and the mixed-granit-schist formation makes soils that are among the poorest. Where rock debris has not extended deeply or has been only partly altered this order of fertility of soil derived from different formations does not hold.

As a whole, the depth of rock decay corresponds closely with the order of fertility as given.

Another use of the Brevard ore is in the form of spars or pyrites. A large deposit of pyrite has been worked at the Brevard mine, and the pyrite is now being shipped to the smelting plants.

Surface water—The surface water of the quadrangles is largely supplied by water from the springs of the district. Practically all the springs have been found near the river, but a few have been found far from the river, and even in the mountains.

The springs are rather numerous along the sides of the valleys and within and near the mountains, and the town and nearby areas. The springs contain 20 to 30 per cent of acid, but they are not always dependable.

Ground water—The ground water is well supplied with ground water suitable for drinking. The water is absolutely pure and is of excellent quality. It is available for all practical purposes, and the springs are few.

The springs into which the streams flow are usually of good quality and can be reached by wells from 30 to 60 feet deep. In some places the ground water is available for all practical purposes, and the springs are few.

The water power of the quadrangles is large, and the water is of excellent quality. It is suitable for all purposes, and the springs are few.

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