UNITED STATES DEPARTMENT OF THE INTERIOR

GOLD DEPOSITS OF THE SOUTHERN PIEDMONT

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ILLUSTRATIONS

GOLD DEPOSITS OF THE SOUTHERN PIEDMONT

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ABSTRACT

This report deals chiefly with the gold mines in the Southern Appalachian gold belt whose workings were accessible at the time of examination, but it also summarizes available information concerning many mines that were not accessible. Most of the mines lie within a belt, 10 to 100 miles wide, that extends along the southeast front of the Appalachian Mountains from the Great Falls of the Potomac River to east-central Alabama, in the gently sloping region known as the Piedmont. The field work was done during parts of 1934 and 1935, on funds allotted by the Public Works Administration.

The dominant rocks of the region are schists, slates, and gneisses formed by metamorphism of sedimentary rocks, altered volcanic tuffs and flows, and intrusive granitic masses which are partly gneissic. All these rocks are of Paleozoic or pre-Cambrian age. The volcanic rocks occupy a broad northeastward trending central band, bordered on the east and on the west by schists and gneisses. Four subdivisions based on geographic distribution are made. They are (1) a northern group, which includes the Wissahickon formation and the Peters Creek quartzite in Virginia; (2) a central group, which includes the Carolina gneiss and the Roan gneiss of the Carolinas and Georgia; (3) a southern group, in west-central Georgia and Alabama, which includes the Talledega slate, the Hillabee chlorite schist, the Wedowee formation, and the Ashland mica schist; and (4) the volcanic series, which extends northward from eastern Georgia into Virginia. The rocks of the first three groups which are continuous along their strikes and are similar lithologically, may well be equivalent to one another.

The intrusive rocks are dominantly granites or granitic gneisses, although many other types are recognized. Only the masses near the gold lodes were studied. Intrusion has been accompanied by igneous metamorphism, the effects of which are difficult to distinguish in some places from those of regional dynamo-metamorphism.

After the accumulation of great thickness of sedimentary and volcanic material now represented by metamorphic rocks, the region was subjected at one or more periods to orogenic stress. Pressures directed from the southeast or east faulted and threw the rocks into close folds, many of which are overturned to the west. Intrusive rocks were emplaced, both sedimentary and igneous rocks were largely recrystallized, and schistosity was developed. Near the end of the deformation, shear zones or distributed faults that strike northeastward and are nearly vertical were formed. Northwestward striking tension cracks were opened as a result of the shearing. At the close of the mountain-making period, which came at the end of the Paleozoic era, the ore-bearing solutions were introduced.

After the Paleozoic era there was a short period of quiescence, which was followed by deposition of conglomerates, sandstones, and shales of Triassic age, and later by the intrusion of basaltic dikes. At some time later than the Triassic period the region was cut by many normal faults, and blocks of the Triassic beds downfaulted at this time were preserved during a succeeding period of profound erosion that affected the entire region, presumably during early Cretaceous time. Late Cretaceous and Tertiary sedimentary beds, generally known as the Coastal Plain deposits, were then laid down, overlapping the older rocks.

Weathering has generally decomposed the rocks to a depth of 50 feet or more and has produced a claylike mass, called saprolite, that remains essentially in place. Beneath a thin mantle of soil the saprolite preserves the structures of the original rocks. It also contains resistant minerals derived from these rocks, such as zircon, magnetite, and rutile, which locally help to identify the formation from which the saprolite was derived.

Although a fragment of gold ore had been found earlier on the Rappahannock River in Virginia, gold mining in the region really began in 1799 with the finding of a nugget in Cabarrus County, N. C. With what would now seem incredible slowness, a gold boom developed, and when finally under way it spread rapidly throughout the region. Mining was at first limited to placer deposits. Later the lodes were exploited, and eventually became the chief source of gold. Mining activities fluctuated from time to time and from place to place, reaching its greatest height after 1840. It practically ceased during the War between the States (1861 to 1865), but afterward revived temporarily. Gold production has shown corresponding fluctuations. The total to the end of 1934, according to revised estimates in Mineral Resources of the United States, was somewhat more than $51,000,000 (approximately 2,550,000 ounces). Considerable silver, copper, lead, and zinc have also been recovered.

The gold deposits have been divided for purposes of description into two main groups—lodes and placers—each of which has been subdivided. The lodes are found only in the metamorphic and intrusive rocks, and except for a few in the mountains to the west they are confined to the Piedmont. They are widely distributed, but most of them are in zones or belts parallel to the general structural trend. On the basis of form and relation to country rock, the lodes are subdivided into veins and mineralized zones; the veins have tabular forms and are sharply bounded, while the mineralized zones have indefinite limits and are generally but not always irregular in form. The lodes may be further subdivided according to strike, as trending northeastward or northwestward; and according to their mineral composition, as quartz-pyrite lodes or lodes containing mixed sulfides. All are gold-bearing, but a few are valuable chiefly for copper, or for silver, lead, and zinc.

The form of the lodes is largely determined by the physical properties of the enclosing rocks. In general the more irregular deposits are in the more schistose rocks and the better-defined ones in the harder and more brittle rocks, such as granites or granitic gneisses. These brittle rocks enclose many of the larger northeastward trending veins and most of those that trend northwest. The veins range from mere stringers to bodies 2,000 feet or more in length and as much as 20 feet in greatest width, but long, continuous, and well-defined veins are gen-

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erally rare, except in a few places where the walls consist of granitic rocks. Many of the veins split, pinch, and swell and terminate in strings of lenses. Postmineral faulting, both normal and reverse, has affected many of the veins but has not as a rule caused appreciable offsets. The ill-defined mineralized zones which range from 50 to 200 feet in width and attain lengths of 1,000 feet or more constitute many of the larger gold deposits of the region. They occur principally in the more schistose rocks, and are believed to have been formed chiefly by replacement of the host rock rather than by filling of open spaces or by solution pressure. They include not only fairly large masses with indefinite boundaries, but also stringer leads and irregular aggregates of lenses, which are commonly of tabular or lenslike form.

Barren veins of coarse-grained white quartz, ranging from mere stringers to bodies 10 to 20 feet or more in thickness and hundreds of feet in length, are common throughout the region. Some of them are later than the gold-bearing lodes and cut through them where the two are in contact.

The common gangue minerals of the gold-bearing lodes are quartz, muscovite (sericite), biotite, carbonates (calcite-siderite group) and chlorite; garnet, amphiboles, and tourmaline occur locally. Pyrite and pyrrhotite form the bulk of the ore minerals, but chalcopyrite, galena, sphalerite, and arsenopyrite are found in small quantity in many of the lodes and are abundant in a few. Fine-grained topaz rock forms a large mass at the Brewer mine in South Carolina. A list of the known minerals is given on pages 37–43, and some of them are described in detail. Gold is generally the most valuable constituent of the lodes. Its purity varies somewhat but is on the average high—between 850 and 900 parts per thousand. Masses of native gold weighing from an ounce to several pounds have been found in the weathered zone, and a few large masses of free gold have been found below the zone of oxidation. In the deposits that remain unworked, however, nearly all of the gold occurs as small particles that in unoxidized ore are partly free and partly locked up in pyrite or other sulfides.

Ore shoots in the lodes are most likely to be found where the lodes cut brittle or rigid rock masses, and in the most disturbed and porous parts of those masses. Passage of solutions and deposition of ore have been controlled by individual structural features or by combinations of such features; tension cracks, crests of rolls in shear planes, foliation planes, and grooves and other linear elements have all exerted some influence. Although many of the ore shoots are very irregular, most of them can be described either as tubular or lenslike, or as cylindrical or cigar-shaped. The shoots that have been mined range from small pockets of high-grade ore to bodies 200 feet or more in strike length, several hundred feet in pitch length, and 30 or 40 feet in width, that carry 0.1 ounce or less of gold to the ton. Many smaller shoots average between 0.1 and 0.5 ounce of gold to the ton.

Two types of altered wall-rock are associated with the lodes, one a fine-grained quartz-sericite aggregate that grades outward from the lode into chloritized rock, the other a coarse-grained rock that contains the same mineral constituents as the surrounding finer-grained country rock.

Downward migration of gold from the surface is suggested by the occurrence of enriched ore near the surface and of poorer ore below. Concentration of the gold is thought to be due partly to settling, partly to removal of valueless material in solution and to mechanical washing out of such material, and partly to solution and redeposition of gold.

When the locations of the gold deposits, and of the deposits of chalcopyrite, pyrite, pyrrhotite, lead, zinc, and barite, and of the principal masses of granites and granitic gneisses, are plotted on a map, it appears that the deposits are regionally zoned. Gold is found chiefly in the zone nearest the magmatic source, and this zone grades outward successively into a zone characterized by chalcopyrite, pyrite, and pyrrhotite and a zone characterized by galena, sphalerite, and barite.

The lodes were formed by hydrothermal fluids at depths and temperatures characteristic of the middle or deep vein zones. Several facts indicate that the gold deposits are of late Palezoic age: they are zoned regionally with known Paleozoic ores; they are associated with late Paleozoic faulting; many of them are undeformed by the late Paleozoic mountain-building forces; and they are overlapped by the Triassic strata.

As in other districts where operations are small and relatively scattered, there are very few properties in which noteworthy reserves of ore have been developed in advance of production. For the greater part of the region, estimates of future production are based on past performance.

Placer deposits yielded the greater part of the gold produced during the earlier years, and placers are still worked in a small way. They are of two types—(1) alluvial placers, consisting chiefly of stream alluvium, and (2) the residual material termed saprolite.

Under the heading Mine Descriptions, brief accounts are given of a large number of mines and prospects, and the few extensively developed deposits that were accessible at the time of the examination are described in some detail.

INTRODUCTION

SCOPE OF REPORT

This report deals chiefly with the history, character, and occurrence of the gold deposits in the Southern Piedmont. It describes the geology of the region only in so far as the geology seems likely to shed light on the extent of the gold deposits and their possibilities for future production. In the geological descriptions the authors have drawn from the reports of men who have investigated special areas, and have accepted the views of the geologists of the State Geological Surveys regarding the names of formations and the extent of these formations in their respective states.

Gold occurs, and has been mined to some extent, in the Southern Appalachians west of the Blue Ridge, particularly in North Carolina and eastern Tennessee; but these occurrences are not considered in this report, which, as the title indicates, is concerned chiefly with deposits in the gold belt proper, lying east of the Blue Ridge. The mines most fully described are those whose workings were accessible at the time of examination, in 1934–35. The generally meager details to be gathered from the outcrops and surface workings of many others, chiefly old or abandoned, are given, and for the larger of these old mines there are added brief summaries of information culled from former reports, published and unpublished, many of which are now not readily available. Within the principal gold-bearing areas, most of the mines that have been active at one time or another during the past 100 years were found. Some, however, were not found, and some others are in outlying areas that were not covered. Failure to mention any particular deposit, therefore, does not necessarily mean that it is regarded as of no value. A fairly complete bibliography is given on pages 3–8. Lists of all the known gold mines and properties in the five states are given in the tabular summaries by states, in the section headed Mine descriptions.

PREVIOUS WORK

During the early and middle parts of the nineteenth century, the Southern Appalachian region, including the areas that contain gold deposits, was studied by many of the leading geologists of the time. Most of the work was done under the auspices of State Geological Surveys or by individuals interested in certain individual properties. Of the many early reports, the one by Whitney, published in 1854, is probably the most comprehensive. Particularly valuable papers were contributed by Emmons, Lieber, and Tuomey. From 1861, the beginning of the War between the States, to about 1880, mining was inactive and little real study of the geology seems to have been made. Most of the material published within that period consists of short articles and notes describing individual properties. For about 20 years after 1880 a mild mining boom was under way, and geological interest accordingly revived. The State Geological Surveys again became active, and comprehensive works by Becker, Nitze, Wilkins, Hanna, Yeates, McCallie, and King appeared. Since about 1900 interest has been spasmodic. In 1906 a bulletin by L. C. Graton and Waldemar Lindgren was issued that dealt with certain deposits in North and South Carolina and Georgia. Pogue and Laney, in 1909, 1910, and 1917, produced detailed reports on certain North Carolina and Virginia districts, and in 1913 Taber's thorough work on the deposits of the James River basin, in Virginia, was published. A bulletin on the gold deposits of Georgia by S. P. Jones was issued in 1909, and a paper on the gold deposits of Alabama by G. I. Adams appeared in 1930. A bulletin on the geology of the gold-pyrite belt of the northeastern Piedmont, in Virginia, by J. T. Lonsdale, was published in 1927.

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As can be seen from the following list of titles, the bibliography of the gold deposits in the southern Piedmont is voluminous. In compiling it, an effort was made to include all articles, except very short notes and comments, that dealt directly with gold. Many valuable papers dealing with stratigraphy and with deposits of metals other than gold have been excluded.

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FIELD WORK AND ACKNOWLEDGMENTS

An examination of most of the known gold deposits in Virginia, North Carolina, South Carolina, Georgia, and Alabama was made during parts of 1934 and 1935 by the United States Geological Survey with funds allotted by the Public Works Administration. The areas covered lie in the Piedmont region, in a belt that extends in general southwestward from the Great Falls on the Potomac River to Chilton and Elmore Counties in east-central Alabama.

Altogether about 1,000 mines and prospects were visited. At many of them, few or no observations of value could be made, either because the workings had been abandoned for years or because they had never extended below the weathered mantle or saprolite. In many places, the only information available as to the character of the deposit was that afforded by a few specimens of more or less decomposed rock. Fairly comprehensive and satisfactory data were obtained, on the other hand, from a few mines that had been reopened, extended, or were otherwise accessible.

Field work was conducted by the writers from March 1 to the end of November in 1934, and from February 1 until late in September in 1935. The following geologists and engineers have worked on the project and have contributed materially to the report: C. E. Bass, C. B. Brown, C. G. Dickinson, D. H. Eargle, E. W. Ellsworth, J. G. Englebert, P. P. Fox, W. J. Green, W. C. Hansard, W. T. Holland, W. D. Johnston, Jr., T. L. Kesler, J. V. Lewis, J. C. McCoy, R. A. Martin, J. A. Morrell, Decatur Osburn, Jr., L. M. Prindle, C. B. Reed, L. D. Rowland, W. W. Simmons, W. A. White, R. A. Wilson, and E. R. Woolfolk.

In preparing the text of this report the two writers have made full use of the notes and maps submitted by the men listed above. Both writers participated in preparing the generalized descriptions of the geology, ore deposits, and related subjects. Mr. Pardee described the mines and prospects in North Carolina and South Carolina, and Mr. Park described those in Virginia, Georgia, and Alabama.

It is with pleasure that the geologists engaged in this investigation acknowledge the generous aid of the mine operators and others with whom the work brought them into contact. They are indebted to many persons for valuable information, and particularly to the State Geologists W. B. Jones of Alabama, R. W. Smith and G. W. Crickmay of Georgia, H. J. Bryson of North Carolina, Stephen Taber of South Carolina, and Arthur Bevan and W. M. McGill of Virginia. A. B. Whiting, chairman, J. J. Hedrick, W. L. Cotton, and other members of the North Carolina Mineral Conferences have cooperated throughout the work. The North Georgia College, at Dahlonega, kindly made office space available during two field seasons. Prof. J. C. Barnes of the college faculty supplied maps and other material that it would have been difficult to obtain elsewhere, and his thoroughgoing and hearty cooperation did much to forward the preparation of the report. Of the many mine operators and owners who were helpful, special acknowledgment is due to R. A. Newton of the Battle Branch mine, and to the managements of the Howie, Haile, Hog Mountain, Vaucluse and Franklin (Virginia) mines. The manuscript has benefited by the constructive criticisms of several members of the Survey, in particular F. C. Calkins, T. B. Nolan, G. F. Loughlin, A. I. Jonas, and W. D. Johnston, Jr., and of J. H. Pratt, who was State mineralogist of North Carolina from 1898 to 1906 and State geologist from 1906 to 1917. Welcome assistance in the microscopic study of the rocks was given by Jewell J. Glass and Clarence S. Ross of the Federal Survey, particularly in identifying the topaz and related rocks from the Brewer mine in South Carolina. Acknowledgment for chemical work and assays performed in the laboratory of the United States Geological Survey is given in the body of the report.

GEOGRAPHY

LOCATION AND ACCESSIBILITY

The gold deposits of the Southeastern States are scattered throughout an area nearly 700 miles long, extending from the Great Falls of the Potomac, at the north tip of Virginia, to eastern Alabama. Most of them are confined to a belt from 10 to 100 miles wide that lies along the southeast front of the mountains and within the gently sloping and easily accessible region known as the Piedmont. The belt is widest in the southern part of North Carolina. In the northern part of Virginia it narrows to 10 miles or less and in eastern Alabama to about 20 miles wide. Within this belt the distribution of gold is not uniform; certain parts of the belt contain many deposits, others few or none. A few scattered gold deposits are known to occur in the bordering mountainous region, mostly in western North Carolina.

Most of the belt described is traversed by railroads, and in recent years automobile highways have been extended into the most remote sections. A few districts are 25 miles or more from a railroad or a paved highway, but most of them can be reached over dirt roads a few miles long. The ready accessibility of the region is favorable to the future development of the gold deposits, for much of the gold-bearing material mined in recent years is sulfide ore, which, either in the crude form or after concentration, must be shipped out of the region for further treatment.

TOPOGRAPHY

The area considered in this report is a part of the Piedmont province, a gently sloping dissected plateau that lies east of the Blue Ridge and extends from southeastern New York to Alabama. Its general surface, as represented by interstream areas, rise westward from the edge of the coastal plain to the foot of the Appalachian Mountains. In northern Virginia the Piedmont is 50 miles across. It widens greatly southward within the State, and from southern Virginia to Alabama it maintains a width of about 100 miles. The maximum altitude of the surface increases southward for a long distance, being about 300 or 400 feet in northern Virginia, 1,000 feet in North Carolina, and 1,500 feet in northern Georgia.

The plateau is drained by streams that have cut valleys from 50 to 300 feet or more below the general surface. The interstream areas are for the most part flat or gently rolling, but in many places hills or low mountains rise a few hundred feet or even 1,000 feet or more above them. These features include isolated masses, such as the celebrated Stone Mountain in Georgia and Kings Mountain in North Carolina, and also belts or chains of hills extending parallel to the trend of certain rocks or structures, such as Findley Ridge at Dahlonega in Georgia, and the South Mountains, Brushy Mountains, and Uwharrie Hills in North Carolina.

CLIMATE AND VEGETATION

The climate of the Piedmont region as a whole is characterized by long, relatively warm summers and short mild winters. In the mountains and the higher parts of the Piedmont, the summer weather is in general delightfully cool; in the lower country the temperature sometimes exceeds 100° F. Except for two or three months during the winter, outdoor work can be carried on in comfort. Each winter usually brings at least a little snow, which however seldom lasts more than a few days. Long-continued freezing temperatures are unusual, but there is frequently a long succession of cold rainy and cloudy days. Thunder showers are common during the summer months.

The average annual precipitation in most parts of the region varies from 45 to 60 inches, but it is greater in the foothills of northern Georgia, particularly Rabun County, south of the Great Smoky Mountains. The average monthly and annual precipitation and temperature for 12 representative points scattered throughout the Piedmont region are given in the following table:

Average precipitation and temperature in Southeastern States

Location	Years record	January		February		March		April		May		June		July		August		September		October		November		December		Annual	
		Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature
Birmingham, Ala.	45	5.52	45.1	5.06	48.0	5.30	55.4	4.81	63.3	3.95	71.1	4.46	77.9	5.17	79.0	4.26	79.2	3.38	74.8	2.42	64.8	3.31	53.9	5.14	46.4	53.18	63.3
Goodwater, Ala.	39	5.24	45.4	5.53	46.7	5.86	55.8	4.16	62.6	3.67	70.8	4.07	77.8	5.82	79.8	4.70	79.4	2.90	73.6	2.74	64.4	3.25	54.0	4.85	45.8	52.79	63.0
Atlanta, Ga.	67	4.95	42.6	4.79	45.3	5.30	52.0	3.61	61.0	3.47	69.9	3.74	76.0	4.65	78.1	4.45	77.0	2.99	72.4	2.59	63.0	3.03	52.1	4.70	44.7	48.27	61.2
Dahlonega, Ga.	41	5.75	41.2	5.77	42.7	6.06	50.8	4.48	58.6	4.92	66.3	5.03	73.3	5.96	75.8	5.31	74.9	4.36	70.5	3.71	59.7	3.71	49.7	6.19	42.2	61.25	58.8
Tallapoosa, Ga.	34	4.46	42.6	5.14	43.9	5.50	52.9	4.12	60.0	3.66	68.6	4.01	75.7	4.66	78.1	4.55	77.4	3.50	73.1	2.94	-----	4.14	51.0	4.91	43.2	51.65	-----
Asheville, N. C.	55	3.10	35.4	3.15	38.5	3.97	45.0	3.02	53.9	3.43	62.6	3.93	68.7	4.30	71.7	4.16	70.5	3.04	65.0	2.75	55.3	2.23	45.1	3.20	37.8	40.28	54.2
Charlotte, N. C.	58	4.00	41.2	4.18	43.9	4.17	50.4	3.31	59.8	3.63	68.9	4.22	75.5	5.10	78.4	5.07	77.1	2.99	71.5	2.95	61.7	2.57	50.6	3.86	43.0	46.05	60.2
Greensboro, N. C.	53	3.51	40.1	3.91	41.5	4.36	50.0	3.61	58.3	4.08	67.8	5.00	74.9	5.19	77.9	5.23	76.6	3.41	71.0	3.07	60.4	2.57	48.9	3.60	41.1	47.54	59.0
Greenwood, S. C.	50	3.91	43.0	4.73	44.4	4.29	52.7	3.11	61.2	3.77	70.3	3.93	77.2	5.21	79.5	4.93	78.3	3.64	73.4	2.93	62.2	2.67	51.9	4.37	43.6	46.89	61.5
Spartanburg, S. C.	57	3.97	41.7	4.71	43.5	4.85	51.2	3.38	60.1	4.03	69.0	4.36	76.1	4.74	79.0	5.42	77.5	3.46	72.2	2.75	60.9	2.90	50.6	4.18	42.2	48.75	60.3
Danville, Va.	18	3.47	39.4	3.48	43.1	3.64	50.6	3.26	58.8	3.73	67.4	3.79	76.1	4.52	79.3	4.44	77.8	3.06	72.4	2.82	60.9	2.33	49.6	3.27	41.4	41.81	59.7
Fredericksburg, Va.	43	3.18	36.6	2.90	36.9	3.40	46.8	3.48	55.3	3.83	64.9	4.21	72.2	4.32	76.6	4.76	74.9	3.13	69.2	3.12	58.7	2.14	47.1	3.01	37.5	41.48	56.4

A vegetation characteristic of the mild, rather humid climate flourishes throughout the Piedmont. In many places, particularly along stream bottoms, a dense growth of blackberries, brambles, and many other vines and shrubs makes travel difficult. Timber for mining purposes is generally abundant and cheap. It is mainly oak and pine, although hickory, poplar, and locust are obtained locally. Most of the forest that originally covered the whole region has been cut, and in large sections it is replaced by dense second growth. Burning these woods to destroy underbrush is a common practice, which, combined with excessive cutting, has laid waste many square miles of country.

GENERAL GEOLOGY

The dominant rocks of the region are schists, quartzites, slates, gneisses, granitic rocks, and volcanic tuffs and flows (pl. 1). Except for some intrusive masses that appear to be undeformed, the rocks are intricately folded and faulted. In general they are deeply weathered. The area that contains the gold deposits is so large that limitations of time precluded detailed study of the rocks except in the vicinity of the more favorably situated deposits. In an attempt, therefore, to round out the report for the region as a whole, much material gleaned from existing reports is utilized. A few of the most informative of these reports are listed in the footnote below.[1]

METAMORPHIC ROCKS

DISTRIBUTION AND SUBDIVISIONS

The gold-bearing metamorphic rocks crop out in three well-defined northeast-trending belts. The eastern and western belts are similar, both being occupied by schists and gneisses intruded by granitic and gneissic rocks. Between them lies a belt occupied by a series of old volcanic tuffs and flows (pl. 1).

[1] Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Nantahala folio (No. 143), 1907. LaForge, Laurence, Keith, Arthur, and Campbell, M. R., Physical geography of Georgia: Georgia Geol. Survey Bull. 42, 1925. Adams, G. I., and Butts, Charles, Geology of Alabama: Alabama Geol. Survey Special Rept. 14, 1926. Bayley, W. S., Tate quadrangle, Georgia: Georgia Geol. Survey Bull. 43, 1928. Knopf, E. B., and Jonas, A. I., Geology of the McCalls Ferry-Quarryville district, Pennsylvania: U. S. Geol. Survey Bull. 799, 1929. Keith, Arthur, and Sterrett, D. B., U. S. Geol. Survey Geol. Atlas, Gaffney-Kings Mountain folio (No. 222), 1931. Jonas, A. I., Structure of the metamorphic belt of the Southern Appalachians: Am. Jour. Sci., 5th ser., vol. 24, pp. 228–243. 1932.

The metamorphic rocks are separated into four groups, based on geographic distribution, namely: (1) the northern group, which includes the Wissahickon formation and the Peters Creek quartzite in Virginia; (2) the central group, which includes the Carolina gneiss and the Roan gneiss of the Carolinas and northern Georgia; (3) the southern group, in west-central Georgia and Alabama, which includes the Talladega slate, the Hillabee chlorite schist, the Wedowee formation, and the Ashland mica schist; and (4) the volcanic series, which is known to extend from eastern Georgia northward. The rocks of the first three groups are lithologically similar. Together they form a belt that is continuous along the strike and may well be correlative, although their relationships are only partly known.

Gold deposits are found in each of the formations described, and it was near these deposits that the rocks were most thoroughly studied. For this reason the following descriptions tend to emphasize the features associated with metallization. An effort has been made, however, to keep the descriptions regional in character.

NORTHERN GROUP

WISSAHICKON FORMATION

The term "Wissahickon mica gneiss" was first applied by Bascom to a group of crystalline rocks in Cecil County, Md.[2] Wissahickon has since been used by Knopf and Jonas for schists in southeastern Pennsylvania,[3] and by Jonas for much of the crystalline belt in the Southern Appalachians (see pl. 1).[4] On the State geologic map of Virginia [5] the Wissahickon is shown as occupying a belt 5 to 50 miles wide extending southwestward from the Great Falls of the Potomac across the entire State. It is assumed in this report that the gneiss of the Wissahickon formation is equivalent to the Carolina gneiss of the Carolinas and Georgia. A few of the Virginia gold deposits are in gneiss of the Wissahickon formation.

The Wissahickon formation was described by Knopf and Jonas [6] as consisting of oligoclase-biotite-muscovite schist and gneiss with layers of micaceous quartzite. This description applies well to the formation as it occurs in Virginia. Its rocks are mostly dark gray or greenish gray, and they are mostly fine grained, though they include locally coarser layers and nodules. In places they are finely banded; elsewhere they are massive. Garnet, kyanite,[7] staurolite, amphibole, and chlorite are widely distributed, and in many specimens they can be recognized with the unaided eye. In addition, calcite, epidote, zircon, apatite, and allanite have been identified. The parallelism of the minerals is well shown in thin sections. Some of the schist contains small rounded quartz nodules, usually made up of numerous interlocking grains. Foliation planes, as brought out by micas and chlorite, may either abut against the nodules or curve around them. A few crystals of pyrite are nearly everywhere present.

PETERS CREEK QUARTZITE

The Peters Creek quartzite is shown on the geologic map of Virginia [8] as a band 2 to 5 miles wide extending from southern Stafford County southwestward through Buckingham County. Many of the Virginia gold deposits are in this quartzite.

The formation is dark gray or greenish gray, and is chiefly composed of micaceous and chloritic quartzite, with thin interbedded layers of schist. The minerals are the same as those in the gneiss of the Wissahickon formation that borders the quartzite, and although quartz is generally more abundant in the quartzite than in the gneiss, it is impossible in many places to distinguish between the two formations.

CENTRAL GROUP

CAROLINA GNEISS

"Carolina gneiss" is a term introduced by Darton and Keith in 1901,[9] and it has been used since that time in many reports dealing with the crystalline rocks of the Piedmont from Virginia southward. It has also been used for crystalline rocks west of the eastern escarpment of the Blue Ridge.

Jonas [10] correctly does not consider the Carolina gneiss a mappable unit, and refers most of the rocks usually included in it to the Wissahickon formation. But as the term "Carolina gneiss" is well established in literature, it is here retained as a general name for the micaceous crystalline schists and gneisses of Georgia and the Carolinas.

As thus defined, the Carolina gneiss includes so many kinds of rock that it is not possible to outline its extent with precision. In Alabama it is probably represented by the crystalline formations described in the following pages. North of the Carolinas these rocks are called Carolina by some authors and Wissahickon by others.

[2] Bascom, Florence, The geology of the crystalline rocks of Cecil County: Maryland Geol. Survey, Cecil County, pp. 83–148, 1902.

[3] Knopf, E. B., and Jonas, A. I., Geology of the McCalls Ferry-Quarryville district, Pennsylvania: U. S. Geol. Survey Bull. 799, 1929.

[4] Jonas, A. I., Structure of the metamorphic belt of the Southern Appalachians: Am. Jour. Sci., vol. 24, pp. 228–243, 1932. Geologic map of the United States, U. S. Geol. Survey, 1932.

[5] Geologic map of Virginia: Virginia Geol. Survey, 1928.

[6] Knopf, E. G., and Jonas, A. I., op. cit., pp. 25–35.

[7] Jonas, A. I., Geology of the kyanite belt of Virginia: Virginia Geol. Survey Bull. 38, pp. 5–16, 1932.

[8] Geologic map of Virginia: Virginia Geol. Survey, 1928.

[9] Darton, N. H., and Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Washington folio (No. 70), 1901.

[10] Jonas, A. I., Structure of the metamorphic belt of the Southern Appalachians: Am. Jour. Sci., vol. 24, pp. 228–243, 1932. Geologic map of the United States, Southeastern quarter, U. S. Geol. Survey, 1932.

Isolated areas of Carolina gneiss have been described by Keith,[11] by LaForge and Phalen,[12] and by Bayley.[13]

The Carolina gneiss is extremely heterogeneous, comprising interlayered mica gneiss and schist, quartzose schist, garnet schist and gneiss, kyanite schist, graphitic schist, conglomerate, and quartzite, together with layers and lenses of granitic and pegmatitic rocks. These rocks grade into one another and do not form mappable units. Many gold deposits occur in this formation, and the following descriptions are of rocks found near the mining properties, particularly in northern Georgia, but these rocks are thought to be more or less representative of the formation throughout its extent.

Mica schist.—Mica schist is the dominant country rock of the mineral deposits in northern Georgia. It is light gray or bluish gray and breaks along smooth or gently undulating mica-covered surfaces. The individual minerals are difficult to recognize in hand specimens. Muscovite is generally more plentiful than biotite, but both are abundant and widespread, and both are present in most specimens. Biotite is particularly noticeable around individual garnet grains. Quartz is also abundant, and many other minerals, usually determined with the aid of a microscope, have been found in small quantities. Feldspar grains, including medium to sodic plagioclase, orthoclase, and microcline, occur locally; they are usually dusty and in part are altered to mica. Chlorite is generally present; it is apparently derived in greater part from biotite, and more rarely from amphibole, which is one of the less abundant constituents of these rocks. Fine-grained kyanite and tourmaline are found, especially near bodies of pegmatite and quartz. Garnet and staurolite are persistent minerals, and in a few areas garnet is one of the most abundant constituents, some of the rock being classifiable as garnet-mica schist. Locally calcite is abundant, and several of the specimens obtained consist almost entirely of calcite and muscovite. Apatite crystals and grains of magnetite, rutile, and ilmenite occur in small quantity, and epidote and zoisite are common. A little allanite has been seen in several specimens.

The rock is almost entirely recrystallized. The mineral grains are usually parallel and have a wide range in size. In places the fine-grained schist grades into coarser schist and into mica gneiss of approximately the same composition.

Garnet-mica gneiss.—One phase of the Carolina gneiss consists mainly of quartz, garnet, and micas (both biotite and muscovite). This garnet-mica gneiss is a reddish or grayish mottled rock. In some specimens it is massive, but most of it is foliated, and the gneiss grades into mica schist. Much of the garnet is in well-developed crystals (pl. 2, *A*), but in places the mineral has yielded to great pressure and forms flat discoidal nodules. The mica plates usually bend around the garnets, but the other constituents of the rock form elongate particles between the mica flakes. Feldspars are abundant in a few places. The accessory minerals are the same as those in the mica schists.

Quartzites and conglomerates.—The Carolina gneiss includes isolated lenses of quartzite and conglomerate, and of the material described by Bayley [14] as graywacke. The quartzites vary in texture, and are generally in massive beds a few feet thick separated by thin layers of mica schist. In color they range from light to dark gray, depending largely upon the proportions of the different minerals; in places they are mottled or speckled. In general they contain considerable mica and are distinctly foliated.

Exposures near the White County mine, in Georgia, appear to be typical of the quartzite over large areas. The rock is so coarse grained that most of its constituents can be identified in hand specimens. Quartz is the most abundant mineral, but some of the rock is about 25 percent biotite. Feldspars are common; medium to sodic plagioclase, orthoclase, and microcline have been identified. The accessory minerals present in the mica schist are all found in the quartzites. The minerals are in parallel arrangement, and locally the rock grades into typical quartz-mica schist.

At the Kin-Mori mine, in Georgia, layers of black or dark-brown quartzite are common in mica schist. No unweathered rock of this type has been seen. The weathered material examined consists almost entirely of rounded and elongated grains of quartz, stained with iron oxide or manganese oxide. In places this quartzite contains small pebbles and grades into pebbly quartzites and conglomerates. Small shreds of micas and chlorite and a few garnets are commonly found.

Kyanite schist.—Small crystals of kyanite occur in much of the Carolina gneiss. Kyanite is rarely abundant near the gold-mining properties, but in a few places it becomes one of the dominant minerals, and locally it may be of some commercial importance.[15] The kyanite schist is generally a facies of the mica schist and garnet-mica schist, into both of which it grades, and some quartzitic layers contain much kyanite.

Limestone and graphitic schist.—Marble of various kinds occurs with the Carolina gneiss at and near Kings

[11] Darton, N. H., and Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Washington folio (No. 70), 1901. Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Cranberry folio (No. 90), 1903; idem, Ashville folio (No. 116), 1904; idem, Mount Mitchell folio (No. 124), 1905; idem, Nantshala folio (No. 143), 1907; idem, Pisgah folio (No. 147), pp. 2–3, 1907; idem, Roan Mountain folio (No. 151), 1907. Keith, Arthur, and Sterrett, D. B., U. S. Geol. Survey Geol. Atlas, Gaffney-Kings Mountain folio (No. 222), 1931.

[12] LaForge, Laurence, and Phalen, W. C., U. S. Geol. Survey Geol. Atlas, Ellijay folio (No. 187), p. 4, 1913.

[13] Bayley, W S., Geology of the Tate quadrangle, Georgia: Georgia Geol. Survey Bull. 43, pp. 13–27, 1928.

[14] Bayley, W. S., Geology of the Tate quadrangle, Georgia: Georgia Geol. Survey Bull. 43, pp. 19–24, 1928.

[15] Prindle, L. M., and others, Kyanite and vermiculite deposits of Georgia: Georgia Geol. Survey Bull. 46, 1935.

Mountain.[16] Some of the rocks rich in calcite (pl. 2, *B*) may have been derived from impure limestone. In a few places disseminated fine-grained graphite gives a black color to the schists.[17]

ROAN GNEISS

The Roan gneiss, as defined by Keith,[18] comprises all the hornblende schist, hornblende gneiss, and schistose diorite that form sheetlike irregular masses in the essentially coextensive Carolina gneiss. Especially in the larger masses, the Roan gneiss apparently cuts across the bedding planes of the Carolina gneiss and is probably derived from intrusive rocks.[19] Bayley[20] believes that the rocks called Roan gneiss are of several different ages. They include dikelike and sill-like bodies of amphibolite. Some of them are only a few inches thick, but in Lumpkin County, Ga., Keith mapped much larger bodies, in places several miles wide.[21] In this same region thin layers of amphibole schist are associated with the ore deposits. Many of these layers, and also scattered crystals of amphibole, appear to have been formed by recrystallization of original constituents of the schists.

The Roan gneiss is generally dark greenish-gray to nearly black. Amphibole needles are commonly visible in it, and streaks of epidote and quartz are conspicuous in some places. Elsewhere the rock is speckled and streaked with dark-green amphibole and white quartz. Locally biotite takes the place of amphibole as the most abundant constituent, and some layers, generally not more than a few feet thick, consist mainly of chlorite. Some of the gneiss is so dense and fine-grained that its minerals cannot be identified with the unaided eye.

Rock that is characteristic of much of the Roan gneiss is well exposed in two abandoned quarries near Clay Creek Falls, in Lumpkin County, Ga. This rock is a dark-greenish, medium- to fine-grained amphibole schist. It contains much quartz, veinlets of which fill many of the joint cracks. In places the foliation is crosscut by epidote stringers, which are commonly bordered by fine-grained white quartz that contains no amphibole next to the epidote; away from the cracks the quartz gradually decreases in quantity and amphibole increases. Some of the quartz stringers, which contain small amphibole needles oriented at random, apparently crystallized after the formation of the gneissoid structure. Pyrite crystals are widely distributed. Under the microscope this rock appears banded, and is found to consist almost entirely of pale-blue to straw-colored amphibole, mixed in varying proportions with quartz. Epidote, calcite, chlorite, and rutile are generaly present in small quantity. The rock has been so entirely recrystallized that it shows no trace of its original texture or structure.

Specimens of Roan gneiss collected at 15 localities in Georgia, from Cherokee County to White County, have been studied microscopically. Hornblende is the most abundant mineral in the rock, of which it may form as much as 90 percent. Quartz is next in abundance. Small quantities of medium to sodic plagioclase, biotite, epidote, chlorite, carbonates, rutile, magnetite, sulfides, and apatite are generally present. Kyanite, staurolite, muscovite, garnet, zircon, and titanite have been found but are not of frequent occurrence and are nowhere abundant. The rocks are all gneissic and completely recrystallized.

SOUTHERN GROUP

TALLADEGA SLATE

The Talladega slate occupies a belt, as much as 10 or 15 miles wide, in east-central Alabama, extending from Georgia southwestward through Heflin, in Cleburne County, to Chilton County, where the formation passes under the Coastal Plain deposits. On the north and west the slate is bordered by formations known to be Paleozoic, and on the southeast by crystalline rocks, chiefly the Hillabee chlorite schist and, in a few places, the Ashland mica schist.[22] Its contacts with adjacent rocks are obscure, and its relation to them is unknown.

Butts[23] describes the Talladega slate as possibly 30,000 feet thick. The formation consists in greater part of slate or phyllite, interbedded with conglomerate, sandstone, limestone, marble, dolomite, chert, graphitic slate, and quartz schist. Near the gold deposits of the Riddles Mill-Gold Log district the country rocks are typical phyllites of the Talladega formation; they are mostly of a uniform gray color and break readily into flat slabs. Small crystals of pyrite can be seen, but the other minerals are rarely coarse grained enough to be distinguishable. In partly weathered outcrops the pyrite grains have been oxidized to tiny spots of red or yellow iron oxide which contrast with the gray phyllite; extreme weathering transforms the rock to laminated red and yellow clay.

Under the miscroscope Larsen found the phyllite to be a fine-grained aggregate of muscovite and quartz mixed with a little chlorite, kaolin, and feldspar.[24] In

[16] Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Gaffney-Kings Mountain folio (No. 222), 1931.

[17] LaForge. Laurence, and Phalen, W. C., U. S. Geol. Survey Geol. Atlas, Ellijay folio (No. 187), p. 4, 1913.

[18] Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Roan Mountain folio (No. 151), p. 3, 1907.

[19] Keith, Arthur, idem. Bayley, W. S., Geology of the Tate quadrangle, Georgia: Georgia Geol. Survey Bull. 43, pp. 27–29, 1928. Crickmay, G. W. Status of the Talladega series in Southern Appalachian stratigraphy: Geol. Soc. America Bull., vol. 47, pp. 1385–1386, 1936.

[20] Bayley, W. S., op. cit., pp. 28–29, 1928.

[21] Keith, Arthur, Geologic map of Dahlonega special area: U. S. Geol. Survey.

[22] Crickmay, G. W., Status of the Talladega series in Southern Appalachian stratigraphy: Geol. Soc. America Bull., vol. 47, pp. 1371–1392, 1936.

[23] Butts, Charles, Geology of Alabama: Alabama Geol. Survey Special Rept. 14, pp. 49–61, 1926.

[24] Larsen, E. S., Geology of Alabama: Alabama Geol. Survey Special Rept. 14, p. 50, 1926.

all the specimens examined a distinct parallel arrangement of the minerals is evident. In some there are well-defined layers, distinguished by difference in grain size and probably due to bedding, and these layers are cut by the foliation planes at angles up to nearly 40°. The phyllite appears to represent both clay and sandy shale.

HILLABEE CHLORITE SCHIST

The Hillabee chlorite schist forms a narrow band, about 2 miles wide at its widest part, that trends northeastward for nearly 100 miles across the western part of the crystalline area of Alabama, lying between the Ashland mica schist on the southeast and the Talladega slate on the northwest. According to Adams [25] the schist is cut off by a fault near Arbacoochee, in southern Cleburne County. In several places along the belt the schist thins considerably, and in some places it is absent.

This formation strongly resembles, and may possibly be equivalent to, parts of the Roan gneiss of Georgia and the Carolinas. Adams [26] believed that it was derived from an igneous rock that had been intruded along a thrust fault between the Ashland mica schist and the Talladega slate.

In some places, as near Coleta and the King prospect at Chulafinnee, the rock is relatively massive and greenish gray. Individual grains of feldspar and quartz can be recognized in the hand specimens, and magnetite grains up to an eighth of an inch in diameter are conspicuous. Where exposures of the Hillabee are relatively narrow, as near Pyriton and Millerville, the rock is generally bright green or grayish green, and is more schistose than elsewhere, so that it breaks into thin sheets. East of Clairmont Springs, contacts between the Hillabee chlorite schist and Talladega slate and between the Hillabee and the Ashland mica schist can be seen in road cuts and washes. These contacts are tight, and there is no evidence of extensive faulting along them. Narrow bands of chloritic schist locally alternate with narrow bands of mica schist and slate.

Ross [27] described coarse-grained specimens collected by Adams 1 mile south of Chandler Springs as follows:

> The original texture of the rock has been partly preserved. Euhedral outlines of plagioclase and albite twinning lamellae are occasionally present. Hornblende crystals are distorted and more or less altered, but parts of them appear to be original. Part of the quartz may be original. The rock is altered, and zoisite has formed at the expense of feldspar and chlorite from hornblende. Veinlets of secondary quartz cut the rock. It has not undergone much recrystallization and much of the original structure has been preserved. The structure and minerals are those of an igneous rock that was possibly a diorite.

This description could well be applied to the coarse-grained rock from the King prospect shaft, except that in this rock epidote and carbonates are abundant. The formation also includes fine-grained, more schistose material, which consists of quartz, chlorite, carbonate, muscovite, epidote, and a very little altered plagioclase. Brooks [28] regarded one specimen studied by him as being probably an altered diabase.

Neither field observation nor petrographic study give conclusive evidence regarding the origin of the Hillabee chlorite schist. It may be either a sheared basic intrusive, as Adams suggests, or, as believed by Jonas,[29] a rock originally of different character, changed to its present habit by retrogressive metamorphism along a fault zone (phyllonite).

The Hillabee chlorite schist is usually more strongly mineralized than the adjacent formations. It contains numerous gold-bearing lodes, and where it occurs in large areas its outcrops were formerly washed for gold. Large bodies of pyrite have been mined from it near Pyriton. The more schistose material is easily eroded, and its line of outcrop is usually marked by a shallow depression.

WEDOWEE FORMATION

The Wedowee formation, which contains many of the gold deposits in Alabama, is exposed in three belts. The longest of these belts passes through the center of the crystalline area, extending from a place on the Coosa River and south of Rockford, Ala., northeastward into Georgia, where it pinches out.[30] This belt attains its maximum width of about 10 miles between Goldville and Wedowee, and narrows southward where it is invaded by the Pinckneyville granite. Another belt, about 2 miles across, trends northeastward through Rockford and pinches out about 3 miles east of Ashland. A third belt, less than 3 miles across, extends northeastward through Jacksons Gap; this belt gradually narrows northward and pinches out in southern Randolph County. At their southward ends all three belts are covered by Coastal Plain deposits. Many small exposures of rocks that probably belong to the Wedowee formation are surrounded by the Pinckneyville granite and the Ashland mica schist, but the relations of the formation to the adjacent rocks are unknown.

The Wedowee formation is thought to be a partly metamorphosed and recrystallized series of shales and sandstones. It consists of slates, phyllites, schists, and quartzites. Near the mineral deposits it is characterized by carbonaceous material, perhaps amorphous graphite, which gives it a black or dark-gray appear-

[25] Adams, G. I., Geologic map of Alabama, 1926.

[26] Adams, G. I., Geology of Alabama: Alabama Geol. Survey Special Rept. 14, pp. 38–39, 1926.

[27] Ross, C. S., Geology of Alabama: Alabama Geol. Survey Special Rept. 14, p. 38, 1926.

[28] Brooks, A. H., in Smith, E. A., A general account of the character, distribution, and structure of the crystalline rocks of Alabama and the mode of occurrence of the gold ore: Alabama Geol. Survey Bull. 5, pp. 192–193, 1896.

[29] Jonas, A. I., Structure of the metamorphic belt of the Southern Appalachians: Am. Jour. Sci., 5th ser., vol. 24, pp. 228–243, 1932.

[30] Adams, G. I., Geologic map of Alabama, 1926. Crickmay, G. W., Manuscript geologic map of Georgia, on file, State Geologist's office, Atlanta, Ga.

ance on weathered surfaces. According to Adams,[31] however, much of the formation contains no graphite but does contain such metamorphic minerals as mica, garnet, staurolite, and kyanite. The parts of the Wedowee formation examined during this survey are generally so fine grained that their mineral constituents can rarely be distinguished in hand specimens. Fine-grained, massive, silky-appearing, black tourmaline has however been found as float in several places, and in the Goldville district small red garnets are common. In some specimens, also, small grains of various metamorphic minerals and of quartz can be recognized. In general, however, the rock is dark gray or black, and is thinly laminated, smooth, and shiny. In many places the bedding is marked by layers of quartzite, less than 1½ inches thick, alternating with finer materials; these layers are particularly noticeable at the Lowe property near Goldville and near the south end of Hog Mountain. In some places the bedding planes are cut at small angles by the schistosity; in others the two are approximately parallel. Near Jackson's Gap a conspicuous ridge, known as the Devils Backbone, is held up by a resistant layer of white to light-gray quartzite 10 to 20 feet thick. Quartzite lenses and layers are widely distributed in this formation but none has been found that is persistent enough to warrant mapping.

When studied under the miscroscope, the black slates and schists are found to consist mostly of rounded grains of quartz and fine flakes of muscovite, and to contain considerable carbonaceous material. A few small grains of greenish-gray tourmaline and red garnet are present, and pyrite crystals are locally abundant. Some specimens contain small rounded nodules of quartz in a finer groundmass. These nodules are cracked, and locally recrystallization has begun along the cracks. In general the minerals are alined and foliation is well developed, but in some specimens narrow alternating layers of roughly sorted grains suggest bedding.

ASHLAND MICA SCHIST

The Ashland mica schist, which contains gold-bearing quartz in many places, forms two broad belts trending northeastward, one on each side of the main mass of the Wedowee formation. The northwestern belt has a maximum width of 12 to 14 miles and passes through Ashland, Ala., the type locality. According to Adams[32] this belt is cut off by a fault near Arbacoochee, in southern Cleburne County, Ala. The southeastern belt lies between two belts occupied by the Wedowee formation, one passing through Goldville and one passing through Jacksons Gap. It is about 5 to 7 miles wide and can be traced for about 100 miles northeastward into Georgia, having been recognized by Crickmay[33] as far north as Dawson County, Ga., where it is not easily distinguished from the Carolina gneiss. The relations of the Ashland to adjacent rocks are not known.

Within the broad belts of schist, thin, more or less regular layers of several kinds of rock alternate with one another. The most abundant rocks in the formation are a garnetiferous biotite schist and a siliceous, coarse-grained, flaky, graphitic muscovite schist.[34] These rocks intergrade, and some of the graphitic schist contains garnet. Quartz is one of the chief minerals in both rocks, and in some areas the schists consist mostly of quartz and mica. In hand specimens the schist usually appears gray and individual minerals can be readily recognized. Foliation planes are generally well developed, but some of the more garnetiferous rock appears massive or rudely banded. Hornblende schist is present locally, and basic and silicic intrusives are common.

Weathered outcrops of the formation usually consist of dark-reddish or pinkish clays that contain large numbers of reddish or bronze-colored mica flakes. Conspicuous in many exposures are roughly diamond-shaped scales or "buttons" of quartz and mica, generally less than three-quarters of an inch in diameter and about an eighth to a quarter of an inch thick; they appear to be bounded by two intersecting sets of foliation planes. In many places the ground is thickly strewn with small partly weathered garnets.

Because of the extremely varied composition of these rocks, their microscopic features cannot be adequately determined by study of the material at hand, which consists of specimens from only a few scattered localities. Some outstanding features may however be mentioned. Near the Franklin mine, northwest of Ashland, is a mineralized zone in which the schist contains exceptionally large quantities of small reddish to lavender garnets, together with considerable quartz, some biotite, muscovite, and highly altered medium to sodic plagioclase, and a little magnetite, chlorite, and apatite. Material from the Franklin mine pits shows partly altered crystals of microcline and orthoclase. Some layers of schist near the mine contain large numbers of graphite flakes, and at the Hobbs prospect kyanite crystals are found in quartz-mica schist. It is a striking fact that, in general, garnet is abundant in the mica schists near the gold-bearing lodes, and that its abundance decreases away from the lodes.

The origin of the schist has been almost totally obscured by metamorphism and recrystallization, but the rocks from which it was derived were probably in part sedimentary and in part igneous.

[31] Adams, G. I., Geology of Alabama: Alabama Geol. Survey, Special Rept. 14, p. 37, 1926.

[32] Adams, G. I., Geologic map of Alabama, 1926.

[33] Crickmay, G. W., Manuscript geologic map of Georgia. On file, State Geologist's office, Atlanta, Georgia.

[34] Adams, G. I., Gold deposits of Alabama: Alabama Geol. Survey Bull. 40, p. 15, 1930.

VOLCANIC SERIES

Rocks of volcanic origin, in which slaty cleavage or schistose structure is more or less prominent, crop out in a belt extending along the southeast border of the Piedmont from southern Virginia to east-central Georgia. These rocks, called "talcose slates" by the early geologists, have been described by later geologists as the Monroe beds or Monroe slates [35] in North Carolina, and as the Virgilina greenstone or the Virgilina volcanic rocks in Virginia,[36] and in various places as the "slate series." In North Carolina the belt lies east of Greensboro and Concord; in South Carolina it crosses Lancaster County and passes under Coastal Plain sediments, but reappears, near Augusta, Ga.[37] On the east the belt is in some places overlain by Coastal Plain deposits and in some places bounded by crystalline rocks. In Georgia, rocks probably to be correlated with the volcanic series are found in three belts, each surrounded by Coastal Plain deposits and crystalline rocks.[38] One belt trends northeastward through Baldwin, Hancock, Warren, Taliaferro, McDuffie, Columbia, Wilkes, and Lincoln Counties; another lies wholly within Oglethorpe County; and a third extends southeastward through Milledgeville, Baldwin County. As the volcanic rocks are less thoroughly metamorphosed than the adjacent schists, they may be younger, but the relations at the contacts are obscure. Many of the larger gold deposits, such as those at the Haile and Brewer mines in South Carolina, are in this series, and for this reason the rocks are described in more detail than some of the other formations.

Most observers have agreed that these rocks originally consisted chiefly of bedded volcanic tuffs, rhyolitic or perhaps dacitic in composition, interbedded with some sandstone and other sedimentary rocks. In many places the original texture and bedding is but little or not at all obscured by later alteration. In Union County, N. C., and in neighboring areas the rock is still recognizable as a fine-grained water-laid tuff, in places resembling a varved clay (see pl. 2, *C*). Along State Highway No. 27, in Stanly County, N. C., just west of the Yadkin River, beds exposed to a thickness of 40 feet or more contain many small cavities whose form shows that they were once occupied by crystals of thenardite, a soluble sodium sulfate of contemporaneous origin. This fact is interpreted to mean that the beds were deposited during a period of arid or semiarid climate.

Farther northeast, in Montgomery, Randolph, and Guildford Counties, coarser-grained tuffs, flows, and volcanic breccias, classified as andesitic, dacitic, and rhyolitic, are abundant (see pl. 3, *A*). Certain massive and resistant layers form prominent ridges, of which Flat Swamp Mountain and the Uwharrie Hills are examples. In places, particularly in Union and Stanly Counties, basic sills and dikes are included in the group.

In the neighborhood of the Haile and Brewer mines the bedding and tuffaceous texture can still be seen, but elsewhere those features are largely or entirely obscured by foliation and other secondary features.

As mapped in Georgia by G. W. Crickmay,[39] the volcanic series consists of quartzite (on Graves Mountain), gray slate, phyllite that is in part chloritic, fine-grained sericite schist, volcanics that are in part amygdaloidal, and tuffs. It is cut by many silicic intrusives. In some places bedding planes are easily recognized; the rocks are generally thin bedded, few individual beds being more than 6 inches thick, and varve-like layers half an inch or so in thickness are fairly common. The amygdules in the volcanics do not appear deformed and, in general, the rocks are but slightly metamorphosed.

Microscopic examination of specimens representing the finer-grained beds, taken in North Carolina, South Carolina, and Georgia, reveal their tuffaceous character and water-laid bedding. All the specimens contain fragments of feldspars, quartz, and micas. Nearly all contain accessory titanite or rutile or both, and several contain devitrified glass and small crystals of an amphibole. Most of the specimens appear to be near rhyolite or dacite in composition. The minerals formed as a result of metamorphism of the volcanic rocks to schists or slate are chiefly epidote, chlorite, carbonates, sericite, and pyrite; several specimens also contain zoisite, and garnet was observed in one specimen.

Similar rocks in the Silver Hill and Gold Hill districts are described by Pogue [40] and Laney.[41] The varieties identified by Pogue at Silver Hill are silicic fine-grained and coarse-grained tuff, silicic volcanic breccia, rhyolitic and dacitic flows, and andesitic tuff and breccia. Descriptions and analyses of hand specimens of the rocks from several mines in eastern Georgia have been published by Jones.[42]

INTRUSIVE ROCKS

In the pages that follow, particular attention is given to those intrusive bodies that are associated with or thought to be directly related to the gold deposits. Many large bodies of granite gneiss and other intrusive rocks not thus related are not described or discussed,

[35] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pp. 36–37, 1896.

[36] Laney, F. B., The geology and ore deposits of the Virgilina district of Virginia and North Carolina: Virginia Geol. Survey Bull. 16, pp. 18–36, 1917. Jonas, A. I., Kyanite in Virginia: Virginia Geol. Survey Bull. 38, p. 24, 1932.

[37] Jonas, A. I., personal communication.

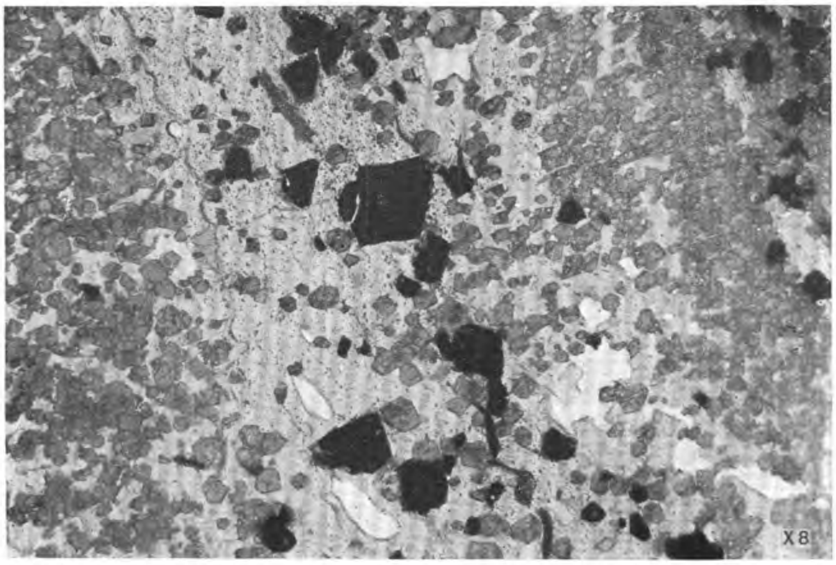
[38] Crickmay, G. W., personal communication, 1935.

[39] Crickmay, G. W., op. cit.

[40] Pogue, J. E., The Cid mining district of Davidson County, N. C.: North Carolina Geol. Survey Bull. 22, pp. 39–68, 1910.

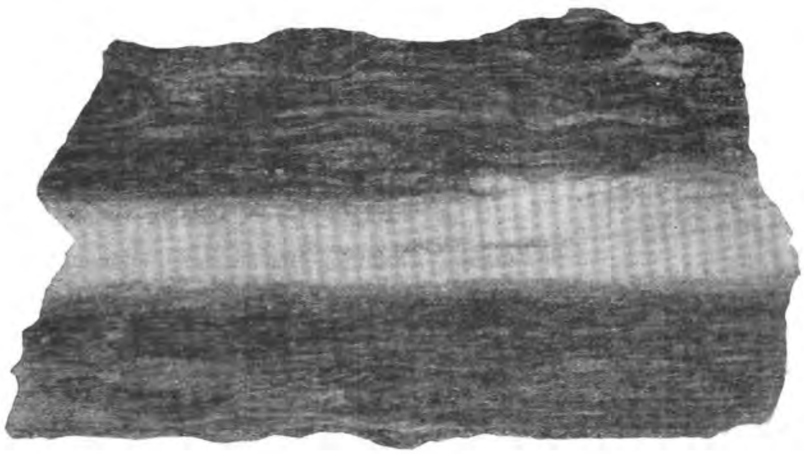
[41] Laney, F. B., The Gold Hill mining district, North Carolina: North Carolina Geol. Survey Bull. 21, pp. 25–45, 1910.

[42] Jones, S. P., Second report on the gold deposits of Georgia: Georgia Geol. Survey Bull. 19, pp. 54–64, 1909.



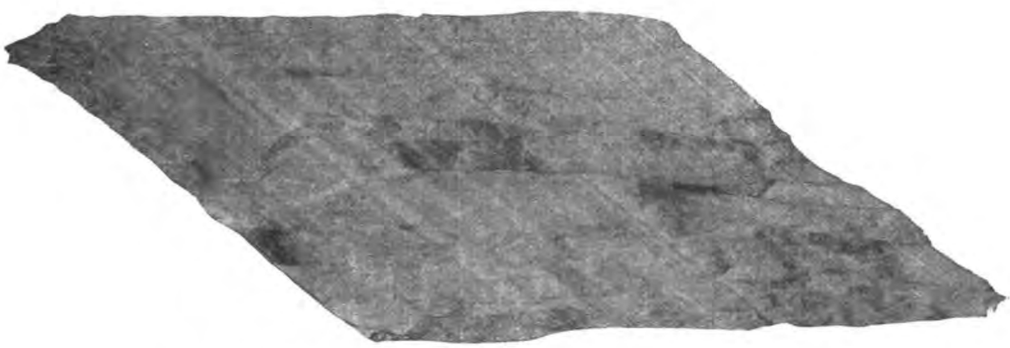
A. GARNET METACRYSTS IN MUSCOVITE SCHIST, CAPPS MINE, MECKLENBURG COUNTY, N. C.

Black grains are pyrite. Photomicrograph by K. E. Lohman.



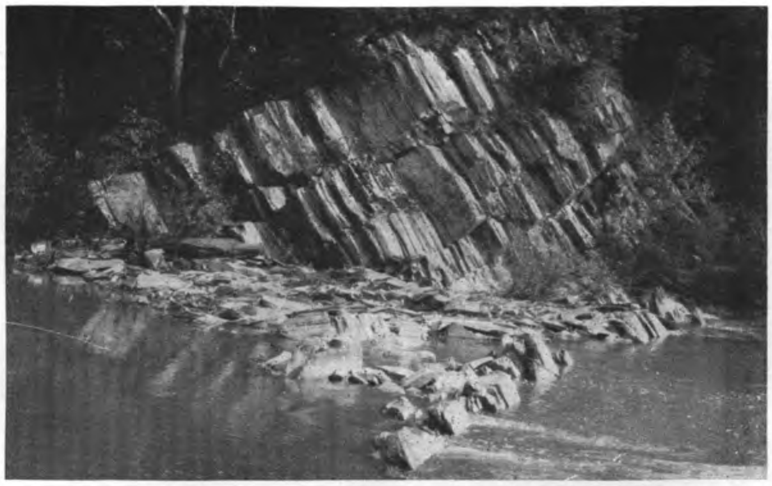
B. MARBLE BAND IN CAROLINA GNEISS, BATTLE BRANCH MINE, LUMPKIN COUNTY, GA.

Nodules in the gneiss consist of garnets and quartz. Polished slab.



C. FINE-GRAINED BANDED TUFF (VOLCANIC SERIES), STANLY COUNTY, N. C.

Bands represent bedding. Cleavage is horizontal, crossing bedding at an angle of 45°.



A. SLATY TUFFS (VOLCANIC SERIES) ALONG UHARIE RIVER, MONTGOMERY COUNTY, N. C.

B. "MUSHROOM" OF GRANITE NEAR MOUNT OLIVE CHURCH, 8 MILES WEST OF CHARLOTTE, N. C.

C. VIEW SHOWING RELATIONS OF SHEARED GRANITE (*G*) TO AMPHIBOLE GNEISS (*R*), BARLOW MINE, LUMPKIN COUNTY, GA.
Photograph by C. B. Reed.

and few generalizations concerning the intrusive rocks are made. The basic dikes of Triassic age are treated in a separate section (see p. 20.)

Individual intrusive masses in the Southern Piedmont have been dated by some writers according to the degree of metamorphism that they have undergone;[43] the more thoroughly sheared and gneissic masses have generally been classified as Ordovician to pre-Cambrian, and the massive undeformed bodies as late Carboniferous. In general the determination of age by difference in degree of metamorphism may hold, but in some particular places it does not. At Hog Mountain in Alabama, for example, the small intrusive body is massive at the mine; but southward it becomes more sheared until finally its igneous texture is lost and it grades into a muscovite schist. Many narrow dikes, such as one at the Barlow mine in north Georgia, have been thoroughly sheared (see pl. 4, *A*). Where mapped on the basis of degree of metamorphism these dikes are included in the older granites; but as they are in general intimately associated with the ores, which are later than the granites, and in places cut across foliation planes in the surrounding schists, the writers of this report believe they were intruded after part of the regional deformation had taken place, and were sheared during later movement. It therefore seems reasonable to include many of these narrow sheared intrusive masses with the late Carboniferous granites. Granite that is elsewhere massive is strongly sheared at the Rudisil mine in North Carolina. Many other examples might be cited of massive granitic intrusive bodies that grade into sheared and gneissic rocks. It is thus evident that although in general the older intrusive rocks are probably more deformed than the younger rocks of similar composition, some of the younger rocks are more sheared and metamorphosed than some of the older ones. Many of the smaller intrusive bodies cannot be shown on the map (pl. 1), and no effort was made to distinguish the intrusives of Paleozoic age in Alabama on the map.

VIRGINIA

Intrusive bodies are widely distributed through the Piedmont region of Virginia, and they are especially common in the areas occupied by the Wissahickon formation and the Peters Creek quartzite. Most of them are elongate in a northeasterly direction, parallel to the regional schistosity. Both gneissic and massive bodies of all sizes are found, and many of them are more than 10 miles long by 3 to 5 miles wide.

As shown by the geologic map of Virginia,[44] most of the intrusive masses in the Piedmont belt consist of granite and granite gneiss, but they include a few bodies of quartz diorite. In the present survey none of the larger intrusive masses was studied, but a little information was obtained about two small ones, one exposed at the Franklin mine in Fauquier County and the other at the United States mine in Spotsylvania County.

The boundaries of the intrusive mass at the Franklin mine have not been traced, the rock being exposed only in old open-cuts and in the underground workings. The rock is light colored, and mottled in greenish gray and white. The outlines of the individual minerals are rarely sharp, but quartz, chlorite, and feldspar can be identified. Near the mineral deposits the rock is a sericite schist, but elsewhere it is massive and only slightly gneissic. In thin section it is seen to consist mainly of quartz, chlorite, and highly altered sodic plagioclase, with less calcite, zoisite, epidote, sericite, and a little altered amphibole. The rock is so much altered that its original character cannot be established with certainty, but it was probably a diorite or quartz diorite.

At the United States mine there are igneous rocks of two types, both probably forming intrusive bodies. These rocks are exposed only in the saprolite zone, and their original composition is therefore uncertain. One has a medium-grained granitoid texture and is massive or slightly gneissic. It contains sparse grains of quartz in a matrix of mottled brown and whitish clay. The other is a fine-grained dense rock showing, at the surface, a few crystals of amphibole, and feldspar, and corroded grains of quartz in a massive fine-grained groundmass. No parallelism of the mineral components was seen. Under the microscope the rock is found to contain large corroded crystals of quartz, bluish to pale straw-colored amphibole, and feldspars, in a fine-grained groundmass of quartz and lath-shaped feldspar. Both albite and orthoclase can be identified, but the rock is badly weathered, iron-stained, and dusty. It may have been originally a dacite porphyry or a rhyolite porphyry.

NORTH CAROLINA AND SOUTH CAROLINA

Within the areas of metamorphic rocks that are chiefly exposed in the Carolinas, there are two principal belts of granites, probably of late Paleozoic age. One belt lies northwest, and the other southeast, of the outcrop of the volcanic series. The northwestern belt extends southwestward from a point north of Greensboro, N. C., to the vicinity of Elberton, Ga., passing through Salisbury and Charlotte, N. C., and York, S. C. The southeastern belt extends from a point north of Petersburg, Va., to the vicinity of Columbia, S. C., where, according to Kesler,[45] it consists of injection gneiss. Outside of these two belts of granites are large bodies of granitic gneiss.

[43] Jonas, A. I., Geologic map of the United States: U. S. Geol. Survey, 1932.

[44] Geologic map of Virginia, Virginia Geol. Survey, 1928.

[45] Kesler, T. L., Granite injection processes in the Columbia quadrangle, South Carolina: Jour. Geology, vol. 44, pp. 32–44, 1936.

West of the volcanic series, in Mecklenburg County, N. C., there is a coarse-grained gray granite that contains black biotite or black amphibole. Dark-gray quartz diorite, rich in amphibole, also occurs abundantly there, and underlies many of the flat areas, covered with dark soils, known as "black-jack lands." In most places the intrusive rocks are gneissic or platy. In eastern Gaston County, N. C., is a large area of the Yorkville granite, which was described by Keith.[46] Parts of this granite crop out in characteristic "mushroom" forms. (See pl. 3, *B*.)

Granite near Salisbury has been described in detail by Laney [47] as being chiefly of a soda-rich variety that contains epidote, chlorite, sericite, and other alteration products. The granite is porphyritic in places and is massive, not gneissic. A quartz diorite, considered older than the lighter granite, also occurs in that area; both rocks cut the volcanic series.

GEORGIA

Many granitic intrusive masses are found in the mineralized region of Georgia. Some, such as granite mass at Hightower, are miles in extent, others are small dike-like bodies. The rocks exhibit a wide range of metamorphism and hydrothermal alteration; some are typical gneisses, others show no obvious foliation. Most are medium grained and light colored. All contain micas, biotite being especially abundant but muscovite fairly common; hornblende granites are rare. Sodic plagioclase is the most common feldspar, though orthoclase or microcline is found in all the granites; some of the larger masses of granite contain feldspar phenocrysts an inch or more across. Carbonates and epidote are widely distributed.

No attempt has been made to map these bodies or to separate them on the basis of degree of metamorphism.

Many of the gold deposits of northern Georgia, particularly those in Lumpkin County, are in sheared granitic dikes. For this reason these rocks were studied with some care, so that the following descriptions are comparatively detailed.

The dikes cut the regional schistosity at small angles. They are irregular in shape and size; one at the Barlow mine, for example, varies in thickness from a few inches to a hundred feet or more (see pl. 3, *C*). These dikes are common in the properties along the strike of the Barlow mineralized zone, on Findley Ridge, and also in the neighborhood of the Singleton and Consolidated properties, north of Dahlonega. The McDonald prospect, about 2 miles northeast of Dahlonega, and the workings on the L. J. Boyd property are in typical sheared granitic dikes. Some of the best exposures of this rock are in the open cuts at the Barlow and Topabri mines; others are on the Dawsonville road, about a mile west of Dahlonega.

The sheared granitic dikes consist of medium-gray rocks, whose gneissic structure is accentuated by streaks of black, gray, and bluish-gray minerals, and which break along rough, grooved, mica-covered surfaces. Small bluish opalescent quartz nodules are conspicuous, and indistinct white spots and sulfides are common. Weathered outcrops of the rock resemble weathered exposures of the mica schist in the Carolina gneiss but are generally more pinkish.

Under the microscope the dike rock is found to be made up of fine-grained quartz, orthoclase, zoned sodic plagioclase, greenish-brown biotite with pleochroic halos around tiny inclusions, muscovite, and chlorite. A few grains of zircon, magnetite, and apatite are generally present, and calcite is abundant in some places. A few feldspar grains are cracked, and small grains of albite and orthoclase have formed along the cracks. A parallel arrangement of the mineral grains is visible in all specimens and is well developed in most of them. The conspicuous nodules or "eyes" of quartz are thought to have been introduced late in the metamorphic history. An "eye" generally consists of several interlocking grains, but it may consist of a single rounded grain, traversed by cracks filled with tiny interlocking grains of later quartz. Plate 4, *A*, illustrates the parallelism of the constituent grains, and also the crushed and partly recrystallized quartz nodules. All the quartz nodules are rounded, and some of them are ellipsoidal, with their long axes parallel to the foliation. Mica plates generally but not invariably bend around the nodules. Except for the undeformed remnants of the bluish quartz nodules and of feldspar, the rock appears to be completely recrystallized.

The dike rock in the Singleton cut, north of Dahlonega, is similar to that exposed at the Barlow mine but is white or light gray. Biotite is rare or absent in the rock; muscovite is more common. A little chlorite is found and carbonates are abundant. In thin sections, many of the small cracked feldspar grains are seen to have their long axes oriented across the schistosity, and most of these grains are spotted with albite that has formed along the cracks.

Similar dikes occur at other properties. Some of them have no quartz nodules, and parts of these dikes are less completely sheared and recrystallized than the rocks described. At several properties the dikes are cut by so many mineralized quartz stringers that the whole mass has been mined as ore. In or near some of the lodes the dikes have locally been altered to fine-grained sericite-quartz schist.

The relation of the sheared granitic dikes to other rocks is not everywhere clear. The sheared dikes north of Dahlonega are similar mineralogically to unsheared intrusive masses nearby, and, though intensely sheared

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[46] Keith, Arthur, and Sterrett, D. B., U. S. Geol. Survey, Geol. Atlas, Gaffney-Kings Mountain folio (No. 222), p. 6, 1931.

[47] Laney, F. B., op. cit., pp. 45–55, 1910.

and almost entirely recrystallized, appear to be less metamorphosed than the rocks that enclose them. In the Barlow cut, foliation planes in the Roan gneiss stop against the sheared dike; elsewhere they appear to continue across the contact. This fact is interpreted to mean that the dikes were intruded during a period of crustal disturbance, or between two periods of disturbance whose resultant movements were approximately parallel.

ALABAMA

In Alabama, as in Georgia, intrusive masses are widely distributed through the mineralized region. Some, typified by the Pinckneyville granite, are light-colored medium- to coarse-grained rocks, which are somewhat gneissic, particularly near the borders of the masses. The Pinckneyville granite extends from southern Clay County southwestward through Tallapoosa County and Coosa County. It occupies a belt 40 miles long by 7 to 8 miles wide, at the southwest end of which, in Elmore County, it passes under Coastal Plain deposits. Many small outlying masses similar to the Pinckneyville granite are shown on the geologic map [48] of the State. Most of the smaller bodies lie northeast of the main mass of Pinckneyville granite, but several of them, near Rockford, for example, lie to the west. Many of the dikes and other bodies are too small to be shown on the map (pl. 1). The silicic intrusives in the Ashland mica schist are particularly difficult to map, because where they are sheared they strongly resemble the schist. This resemblance is especially close in deeply weathered outcrops. In places granitic rocks are intruded as thin sheets between the foliation planes of the enclosing rocks, so as to form typical injection gneisses. In the Pinckneyville granite individual mineral grains are readily distinguished with the unaided eye. The rock consists mostly of feldspar and quartz, which are accompanied by considerable biotite and locally by hornblende also. In some places rounded feldspar grains half an inch or more in diameter give the rock a porphyritic appearance. A few specimens of this granite have been studied microscopically. They consist mostly of quartz and sodic plagioclase, they also contain some microcline, biotite, and hornblende, and a little chlorite, epidote, and apatite. The plagioclase and quartz are locally intergrown in a graphic pattern. The mineral grains are slightly cracked and have a rudely gneissic arrangement.

The quartz-diorite mass at Hog Mountain, in Alabama, is noteworthy because it contains numerous quartz veins. Its outcrops occupy an area 4,800 feet long by 800 to 1,300 feet wide, about two miles northeast of the main body of Pinckneyville granite. The long axis of the body strikes about N. 10° E., approximately parallel to the general strike of the surrounding schists of the Wedowee formation. Detailed examination, however, shows that in places the intrusive body cuts sharply across the foliation planes in the schist. In exceptionally good exposures in mine workings near the northern part of the mass, the quartz diorite is light gray, massive, and not visibly gneissic. It is here rather fine grained, though generally coarse enough to permit individual mineral grains to be recognized with the unaided eye.

Under the microscope this diorite is seen to consist mostly of plagioclase and quartz; biotite is common, and small quantities of muscovite, chlorite, carbonate, zoisite, apatite, epidote, tourmaline, red garnet, kaolin, and pyrite were observed. Muscovite is abundant in places, and locally chlorite is present to the exclusion of biotite. The plagioclase is partly zoned but consists mostly of medium andesine; some of it is dusty and contains many tiny fibers of muscovite oriented approximately parallel to the crystal boundaries.

In places near the southern part of the intrusive mass, the granitoid texture is wholly destroyed, particularly near the border where the rock becomes schistose. The most completely altered rock is a muscovite schist in which individual flakes of mica and small quartz grains can be recognized. Microscopically this rock is seen to consist almost entirely of muscovite with a little quartz. Muscovite schist also occurs in places near the contact of the quartz diorite and the schist of the Wedowee formation.

The gold deposits at the Dutch Bend mine, in Tallapoosa County, are in a quartz diorite dike, somewhat less than 200 feet wide, similar mineralogically to the intrusive body at Hog Mountain. The dike is schistose, and the foliation planes and trend of the dike itself are generally parallel to the foliation in the adjoining Wedowee formation. The intrusive rock of the dike is medium- to fine-grained and consists of dusty feldspar partly altered to muscovite, quartz, biotite bordered with chlorite, and muscovite. The feldspar is oligoclase-andesine and is commonly zoned. Apatite, zircon, magnetite, carbonate, zoisite and garnet are generally present in small quantity. In weathered outcrops the dike is altered to reddish-yellow banded clays, similar to those derived from schist of the Wedowee formation but usually containing a larger proportion of bronze-colored mica flakes.

Much granitoid rock is found on the dumps at the Pinetucky mine, in northern Randolph County.

Brewer [49] reported that granite, alternating with schist, was penetrated in three diamond-drill holes near the ore bodies, but that the relation of the granite to the mineral deposits was not determined. The granite is a light-gray, mottled, medium-grained rock, with notice-

[48] Adams, G. I., Geologic map of Alabama, 1926.

[49] Brewer, W. M., A preliminary report on the upper gold belt of Alabama: Alabama Geol. Survey Bull. 5, pt. 1, p. 54, 1896.

able but not conspicuous gneissoid structure. It consists of quartz, medium to sodic plagioclase, nearly equal quantities of muscovite and a little apatite, magnetite, garnet, zoisite, and chlorite.

A medium- to coarse-grained granitic rock is found on the dump at the Brown prospect, in Clay County. The specimens obtained, which are partly weathered, show an obscurely gneissoid structure and appear to have been silicified. They contain quartz, orthoclase, and a little sodic plagioclase, muscovite, biotite, and garnet. This rock apparently forms one of the intrusive bodies in the Ashland mica schist, but its extent and relations to surrounding materials are not known.

A somewhat different type of intrusive rock has been found near the headwaters of Clear Creek, in the Arbacoochee district, Cleburne County, Ala. This rock was not seen in place, but large boulders of it are common in the old placer workings. It is gray and fine grained, with a very prominent parallelism of the mineral constituents which include quartz, orthoclase, sodic plagioclase, biotite, muscovite, chlorite, magnetite, apatite, epidote, and allanite. Small rounded nodules of bluish quartz can usually be seen. The rock breaks into flat slabs, the surfaces of which are covered with thin layers of mica. It closely resembles some of the dike rocks in Georgia, especially those from the Barlow and nearby properties in Lumpkin County.

Many other intrusive bodies occur in the crystalline belt of Alabama. They have not been studied by the writers of this report, however, and in many places they are difficult to distinguish from the enclosing schists. The small and narrow instrusive masses are in general more schistose than the larger bodies.

YOUNGER ROCKS

TRIASSIC SEDIMENTARY ROCKS

Sedimentary rocks containing fossils of Triassic age are found in the Piedmont region from southern North Carolina northward to Massachusetts. These rocks are mainly conglomerates, sandstones, and shales, which grade into one another. They are predominantly reddish, but in places they are gray or yellow. Locally, as in the Richmond Basin of Virginia and the Deep River Basin of North Carolina, they contain coal deposits. Roberts has described the Triassic deposits of Virginia, and his report includes a bibliography, with abstracts of the principal papers dealing with this subject that had been published up to 1928.[50]

The Triassic rocks are commonly found in downfaulted blocks surrounded by older formations. They are not known to be gold-bearing, but they are of interest in connection with this report because in places they overlie and conceal the gold deposits.

[50] Roberts, J. K., The geology of the Virginia Triassic: Virginia Geol. Survey Bull. 29, 1928.

TRIASSIC DIABASE DIKES

Diabase dikes occur throughout the Piedmont region, from Virginia to Alabama.[51] They range from a foot or less to several hundred feet in width, and from a few rods to many miles in length. The diabase is fine to coarse grained, and dark gray to black; weathered outcrops are characterized by rounded boulders known as "nigger-heads."

The diabase dikes in North Carolina and Virginia and farther north are known to cut sedimentary beds that contain Triassic fossils.[52] In Durham and Granville Counties, N. C., basic dikes and sills intruded into Triassic beds are particularly numerous and extensive,[53] and their relations here as well as elsewhere in the eastern United States indicate that the dikes were intruded well toward the end of the period of Triassic deposition. In other parts of the Southern Piedmont the age of the diabase dikes is not definitely known, but owing to their similarity throughout the region all the dikes are generally regarded as Triassic. Wherever it was seen in association with the gold-bearing lodes, as for instance in the Haile mine pit, the diabase cuts both the country rock and the lodes. Most of the dikes trend northwestward, but at a few places in Virginia they strike northeastward or northward, nearly parallel to the foliation of the enclosing rock.

COASTAL PLAIN DEPOSITS

To the east and south the rocks of the Piedmont region pass beneath the Cretaceous and Tertiary sediments known as the Coastal Plain deposits. These deposits, which are largely covered with light-gray sandy soil, consists of nearly horizontal beds of loosely consolidated sand, gravel, clay, and chalk. Toward the Piedmont they thin out and their border is exceedingly irregular (see pl. 1).

The Coastal Plain deposits are not known with certainty to be gold-bearing, although at the Brewer mine, in South Carolina, beds of gravel that resemble beach deposits and contain detrital gold underlie the Coastal Plain deposits in apparent conformity. Around the New Beguelin pit at the Haile mine, horizontal Coastal Plain sediments 10 to 17 feet thick rest on a layer of clay with fragments of quartz ("flint rock") that represents the soil or mantle of the former surface. Beneath this layer of clay is decomposed schist (saprolite), which was weathered before the sediments were laid down.

[51] Roberts, J. K., op. cit. Keith, Arthur, Geology of the Catoctin belt: U. S. Geol. Survey 14th Ann. Rept., pt. 2, pp. 285–395, 1894. Shannon, E. V., The mineralogy and petrology of intrusive Triassic diabase at Goose Creek, Loudoun County, Va.: U. S. Nat. Mus. Proc., vol. 66, art. 2, 1924.

[52] Prouty, W. F., Triassic deposits of the Durham Basin and their relation to other Triassic areas of eastern United States: Am. Jour. Sci., 5th ser., vol. 21, pp. 473–490, 1931. Roberts, J. K., op. cit., pp. 88–89.

[53] Prouty, W. F., op. cit., pp. 473–490.

GEOLOGIC STRUCTURE

Most geologists who have worked in the Southern Appalachians agree that the region has been subjected to compressive forces directed from the east or southeast toward the west.[54] This conclusion is based on the structure of Paleozoic beds in the mountains, where the western limbs of folds are steeper than the eastern limbs, the folds being even overturned to the west in some places. The thrust faults, also, that extend along the range dip gently to the east.

The rocks now exposed in the Southern Piedmont have probably been subjected to deformation in several epochs, pre-Cambrian or early Paleozoic as well as late Carboniferous, during which they may have been buried to a depth of several thousand feet. Repeated deformation at this depth resulted in folding, faulting, and the development of marked foliation.

FOLDING

With regard to folding in a part of the southern Piedmont, Keith says: "All stages of folding occur, from those in which the strata dip slightly to those in which they are steeply inclined or even overturned. * * * The latest compression that led to extensive mountain building * * * has left a strong impress on the rocks."[55] Graton[56] describes folding in the vicinity of Kings Mountain, N. C., and Jones[57] writes: "When the whole southern Appalachian belt yielded to crustal folding in the late Paleozoic time the area included in the present Piedmont * * * was involved."

The rocks in the Southern Appalachian Piedmont have undoubtedly been much folded, but sufficient data to describe the folds in detail have not been obtained. In parts of Union County, N. C., and in adjacent areas where the rocks are least altered, the beds are plainly seen to be bent into rather open folds that trend northeastward (pl. 4, *B*). A series of large folds, compressed along the sides, are believed by Laney[58] and Pogue[59] to have been formed in the Gold Hill and Cid (Silver Hill) districts. At the Brewer mine, in South Carolina, the structure is interpreted from the attitude and distribution of the beds as a syncline (see pl. 30). In Union and Cabarrus Counties, near the granite bodies in the western part of the volcanic belt, small folds, crinkles, and crenulations are superimposed on the larger folds.

Except in the more massive flows and flow breccias, steep foliation planes that strike northeastward are developed throughout the volcanic series (pl. 3, *A*). Plate 4, *C*, shows a small fold that illustrates the shearing characteristic of many of the folds in the volcanic series.

Bedding planes can be recognized at many places in the schists and gneisses west of the volcanic series. The beds, which are generally thin, differ slightly in mineral composition or are accentuated by differences in size or texture of the mineral particles, particularly of quartz. In a few localities the foliation approximately coincides with the bedding. Near Hog Mountain and at the Lowe mine, in Alabama, bedding planes in the Wedowee formation are cut at small angles by the foliation planes. Similar relations have been observed in Lumpkin County, Ga., where contorted and closely folded beds are sharply cut by the foliation, the strike of which ranges from north-south to about N. 75° E. and averages about N. 45° E.[60] In Alabama the strike varies from north-south to N. 30° E., and in Georgia and the Carolinas it is more nearly eastward. The dips of both bedding (where it has been recognized) and foliation are generally steep, from 45° to vertical; the direction of dip may be either northwest or southeast.

Many of the intrusive masses are sheared, particularly near their borders, or are cut by shear zones or sheeted zones. Toward the granite border in Union and Cabarrus Counties, N. C., shear planes become the dominant structural features, and, similar but on a smaller scale, at Hog Mountain, Ala., the igneous textures are obliterated by shearing in places along the intrusive border. At the Franklin mine in Virginia, there are good exposures of a shear zone that passes through massive quartz diorite and into schist (see pl. 5). The intrusive rock becomes more schistose near the center of the shear zone, and where it is most intensely sheared it is a chlorite-sericite-quartz schist in which igneous textures cannot be recognized.

FAULTING

Faulting as well as folding probably took place late in the regional deformation. Thrust faults that dip at low angles toward the east extend throughout the Appalachian highlands west of the Piedmont. There are few of them in the Piedmont itself, but one has been recognized near Erin, Ala.[61] More common are nearly vertical faults, along many of which the movement is distributed through a shear zone 100 feet or more in width. Two systems of steeply dipping faults are recognized; one strikes northeastward, parallel in general

[54] Keith, Arthur, Outlines of Appalachian structure: Geol. Soc. America Bull., vol. 34, p. 313, 1923. Jonas, A. I., Structure of the metamorphic belt of the Southern Appalachians: Am. Jour. Sci., 5th ser., vol. 24, p. 231, 1932.

[55] Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Gaffney-Kings Mountain folio (No. 222), p. 7, 1931.

[56] Graton, L. C., Gold and tin deposits of the Southern Appalachians: U. S. Geol. Survey Bull. 293, pp. 27–29, 1906.

[57] Jonas, A. I., Structure of the metamorphic belt of the Southern Appalachians: Am. Jour. Sci., 5th ser., vol. 24, pp. 230–231, 1932.

[58] Laney, F. B., The Gold Hill mining district, North Carolina: North Carolina Geol. Survey Bull. 21, p. 66, 1910.

[59] Pogue, J. E., Cid mining district of Davidson County, N. C.: North Carolina Geol. Survey Bull. 22, pp. 81–84, 1910.

[60] Keith, Arthur, Outlines of Appalachian structure: Geol. Soc. America Bull., vol. 34, pp. 309–380, 1923.

[61] Jonas, A. I., op. cit., p. 243.

to the regional foliation, and the other northwestward, across the foliation. Because the faults have notably affected the localization of the gold deposits, they will be discussed in some detail.

Regional distribution of the faults in two well-defined systems must be due to regional agencies, probably associated with the origin and history of the Appalachian Mountains. The pressures from the east or southeast that caused the uplift of these mountains and the folding of their strata would tend to be relieved by rotation of crustal blocks, and to produce shear zones trending northeastward and tension cracks trending northwestward.[62] Such a condition is illustrated in the Melville-Vaucluse shear zone, in Virginia, where all the shear zones trending northeastward that were examined contain fractures of northwesterly trend.

The fact that individual intrusive bodies cut across foliation planes in some places and are sheared in other places indicated that the deformation did not all take place during one epoch. Quartz veins in shear zones are in some places undeformed, but in other places they are broken by fractures that trend either northeastward or northwestward or in both directions.

Faulting that is nearly parallel to the regional trend of foliation is difficult to map, for along such faults the poor surface exposures usually show only a gradation into zones of especially intense shearing. Some of these shear zones are several hundred feet wide, and some have been followed along the strike for as much as 20 miles. As they are approximately parallel to the foliation and as the region is almost devoid of key horizons, the amount and direction of offset along the fault zones is entirely conjectural. Where seen underground the fault zones are nearly vertical, but dips of about 80° either to the northwest or to the southeast, have been recorded. Grooves and striae are generally well developed on the shearing surfaces. Some are horizontal and some pitch to the southwest, but most of them pitch 20° to 35° NE. The best exposures of the wide fault zones are in the mines, yet even there the effects of shearing are not easily distinguished from those due to mineralizing solutions.

In the Gold Hill district of North Carolina, an extensive fault is inferred by Laney[63] from the relations of the different rocks. There, and for 50 miles to the southwest, the boundary between the granites and the volcanic series, instead of the usual irregular line of an instrusive contact, is a nearly straight line. Offshoots from the granite and other contact phenomena are lacking. The boundary trends somewhat more nearly north than the foliation. Although the fault plane is nowhere exposed, parallel fractures along which fault movements have occurred can be seen in the mine workings. In Union County the volcanic series displays, as this supposed fault line is approached, increasing evidence of compression, such as tighter folding (pl. 4, *C*) and more conspicuous foliation. Elsewhere in North Carolina, and also in South Carolina, a few faults of northeasterly strike, none apparently of great magnitude, are exposed in the Brewer Mine (pl. 33) and in some other mines.

The northwestward striking faults, on the other hand, are fairly easy to locate. They displace known horizon markers, so that in some places it is possible to determine approximately the amount of offset. These faults are not as continuous as those of northeasterly trend. Most of them caused less than 500 feet displacement, although some have effected greater movement.[64] Many of the northwest-trending fault fissures are occupied by diabase dikes, and a few by quartz veins. Several have been seen underground; most of these strikes N. 40° to 70° W. and dip steeply to the north. Small northwest-striking fractures with displacements of only a few feet are common. Yeates[65] believes that a fault of northwesterly strike extends along the Yahoola River between the Lockhart mine and the Consolidated mine in Lumpkin County, Ga. He saw no shearing or brecciation, but, as he pointed out and as is shown on the geologic map (pl. 47), the rocks on opposite sides of the stream do not correspond.

IGNEOUS METAMORPHISM

In the greater part of the Southern Piedmont the granitic masses and the rocks they invade have been changed in texture and composition in varying degree by the after effects of intrusion and mountain-building stresses. It is usually difficult to distinguish between the results of these two processes, particularly where they are superimposed. Two types of igneous metamorphism can be distinguished, however: (1) recrystallization with little or no addition of material, and (2) alteration with considerable addition of material, resulting in the formation of (a) hydrous minerals and (b) anhydrous silicates.

RECRYSTALLIZATION WITH LITTLE OR NO ADDITION OF MATERIAL

Much of the rock in the Southern Piedmont has been recrystallized with little or no change in chemical composition. Many geologists attribute this form of metamorphism to regional stresses, minimizing or even disregarding the effects of igneous intrusions and their

[62] Fath, A. E., The origin of the faults, anticlines, and buried "granite ridge" of the northern part of the midcontinent oil and gas field: U. S. Geol. Survey Prof. Paper 128–C, pp. 77–83, 1921. Willis, Bailey, and Willis, Robin, Geologic structures, pp. 143, 220–236, New York, McGraw-Hill Book Co., Inc., 1929. Cloos, Ernst, "Feather joints" as indicators of the direction of movement on faults, thrusts, joints, and magmatic contacts: Natl. Acad. Sci. Proc., vol. 18, pp. 387–395, 1932.

[63] Laney, F. B., op. cit., pp. 68–71.

[64] Geologic map of Virginia, Virginia Geol. Survey, 1928.

[65] Yeates, W. S., McCallie, S. W., and King, F. P., A preliminary report on a part of the gold deposits of Georgia: Georgia Geol. Survey Bull. 4A, pp. 287–288, 1896.

accompanying emanations. But observations made in Lumpkin County, Ga., in Randolph and Anson Counties, N. C., and at the Brewer mine, in South Carolina, indicate that, locally at least, reactions due to igneous intrusion have altered the rocks extensively.

In northern Georgia there are certain lodes that consist of the same minerals as the country rock, which is medium- or fine-grained schist. Many of these lodes are coarse grained but laterally become finer, so that the lode grades into the country rock. Near the Battle Branch mine, transition zones several hundred feet wide are well exposed in the valley of the Etowah River and in cuts along the road leading to the mine. Large crystals of such minerals as garnet, muscovite, biotite, and amphibole are widely distributed in the lodes, and small crystals of the same minerals occur in the country rock. Kyanite, staurolite, tourmaline, and apatite also occur as large crystals in the lodes and as small crystals in the country rock. Mineralogic distinctions between the lode deposits and the metamorphosed country rock cannot be drawn, and no criterion other than texture has been found for distinguishing country rock from lodes. The gradation may be explained in two ways: (1) preexistent crystals in the country rock may have been enlarged in the lodes by circulation of fluids along shear zones during dynamic metamorphism, or (2) the minerals in both the country rock and the lodes may have been formed by the hot fluids, probably magmatic, that later deposited the ore. Under either assumption it is reasonable to suppose that some migration of material has taken place and that a little material was added from the hot fluids. Most of these minerals, however, might well have formed by a rearrangement of the constituents already in the rocks.

The occurrence of large crystals of silicates, particularly garnets, near the lodes, and the small size or absence of such crystals in much of the country rock, in Alabama, is considered significant, especially in view of the fact that similar conditions occur in Lumpkin County, Ga. Such conditions are particularly noticeable also at the Franklin mine and other properties in Clay County, Ala. It is thought that, in these instances at least, hydrothermal solutions may have played an important part in the formation of minerals usually associated with regional dynamo-metamorphism.

ALTERATION WITH CONSIDERABLE ADDITION OF MATERIAL

Most of the large deposits that consist predominantly of one mineral have been formed as a result of action by hot fluids, and these fluids have everywhere added one or more elements to those originally present in the country rock. Sericitic and chloritic deposits, and also many silicified zones, belong in this category. Large bodies of pyrophyllite in North Carolina, described by Stuckey,[66] are considered by most geologists to be of hydrothermal origin. Where tourmaline has been formed in the country rock, boron compounds may have been added. The fluorine in the large mass of granular topaz at the Brewer mine, in South Carolina, must have been added to the rock.

The sources of the added materials are not known in detail. Some substances, such as the boron compounds and fluorine, were probably deposited by emanation from magmas; others may have been leached from rocks traversed by heated fluids, and afterward deposited where conditions were favorable.

ALTERATION WITH ADDITION OF MATERIAL TO FORM ANHYDROUS SILICATES

The most characteristic result of the metamorphism commonly associated with intrusive contacts is the formation of anhydrous silicates, quartz, and micas. Minerals such as quartz and muscovite are generally thought of as crystallizing from hot solutions, yet they are often products of igneous metamorphism. At Hog Mountain, Ala., black schist near the contact with the quartz diorite contains white needles up to three-quarters of an inch in length. These needles consist of muscovite and quartz, but under the microscope they show square cross-sections, indicating that they were probably derived from andalusite (pl. 6, *A*). They have been found only within a few hundred feet of the contact. The schist near the contact is hard and dense, and locally silicified. In several places the quartz diorite is altered at the contact to muscovite in flakes an eighth to a quarter of an inch in diameter. This muscovite may have been formed either by hydrothermal solutions introduced after the quartz diorite had solidified or by solutions introduced at about the time of intrusion. At the Scarlett mine, in Randolph County, N. C., a volcanic tuff has been altered to a typical igneous-metamorphic aggregate of amphibole and other silicates.

PHYSIOGRAPHY

The gently rolling upland of the Piedmont region is generally regarded by geologists as a surface formed during a long period of continuous erosion, and later elevated and dissected.[67] In a general view, when seen from a commanding viewpoint, this surface is readily recognized as a peneplain rising gently westward, broken only by a few residual hills of the more resistant rocks. It cuts across all rocks older than the flat-lying

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[66] Stuckey, J. L., Pyrophyllite deposits of the Deep River region, North Carolina: Econ. Geology, vol. 20, pp. 442–463, 1925.

[67] Hayes, C. W., and Campbell, M. R., Geomorphology of the Southern Appalachians: Nat. Geog. Mag., vol. 6, pp. 63–126, 1894. Johnson, Douglas, Stream sculpture on the Atlantic slope, New York, Columbia University Press, 1931. Stose, G. W., Manganese deposits of western Virginia: Virginia Geol. Survey Bull. 23, pp. 16–24, 1922. Wright, F. J., The older Appalachians of the South: Denison Univ. Bull., vol. 31; Jour. Sci. Lab., vol. 26, pp. 143–269, 1931. Ver Steeg, K., Erosion surfaces of the Appalachians: Pan-Am. Geol. vol. 56, pp. 271–272, 1931.

Coastal Plain beds, including the Triassic sedimentary rocks and dikes and the gold-bearing lodes. The main streams originally flowed southeastward over the gently sloping plain, after the elevation of which they became entrenched in narrow valleys that cross the strike of the rocks; only the smaller tributaries flow northeastward or southwestward conformably with the structure.

From the northwestern border of the Piedmont plateau the mountains rise rather abruptly, presenting in most places a bold eastward-facing front. The nature of this escarpment has not been fully investigated, and its origin is a matter of speculation. West of it there is generally another elevated area with a surface resembling that of the Piedmont.

The geologic history of the Piedmont plateau has an important bearing on the character of the surficial ore deposits. While the peneplain was slowly being developed, a great thickness of rocks with their included gold-bearing lodes was eroded away. Much of the gold remained behind because of its greater density, and was concentrated to form residual deposits in the surface mantle adjacent to the lodes, or placer deposits in the alluvium of nearby streams. The greater part of the gold produced in the Southern Appalachians has come from such placers and near-surface residual deposits.

It is a striking fact, emphasized by the common occurrence of the word "hill" in the names of the mines, that the lodes almost invariably crop out along ridges that are slightly higher than the general surface of the peneplain. This condition has doubtless resulted from the general abundance in the lodes of the mineral quartz, whose superior resistance to weathering retarded the lowering of the surface in the vicinity of the lodes.

PRODUCTS OF WEATHERING

In most places the rocks are weathered to a depth of 50 feet or more; the upper few feet of the weathered zone is composed of soil, which yields little significant information concerning the bedrock geology. The soil is chiefly clay, colored some shade of red, brown, or yellow. The color is usually not diagnostic, as similar rocks may weather to differently colored soils. In some places mica or resistant accessory minerals in the soils help to identify the underlying rocks. Hill creep, however, tends to make the soils migrate down slopes, so that in general the soils give less dependable evidence regarding the underlying rock than the decomposed material below the soils.

SAPROLITE

Below the soil is a zone in which the rock has been partly or completely decomposed. The decomposed material retains more or less distinctly the structure and texture of the rock from which it was derived, and except for a generally small amount of movement of the upper part down slope it remains in place. Becker proposed the name "saprolite" for this decomposed material.[68] Local miners, however, now apply this term only to decomposed rocks that contain gold, and because of this implication several geologists have avoided the term. It is retained in this report, but is used as defined by Becker to mean all decomposed rock that has not been transported except by hill creep and that, therefore, largely retains its original texture. Saprolite, in this original sense, may contain gold, but in most places it does not.

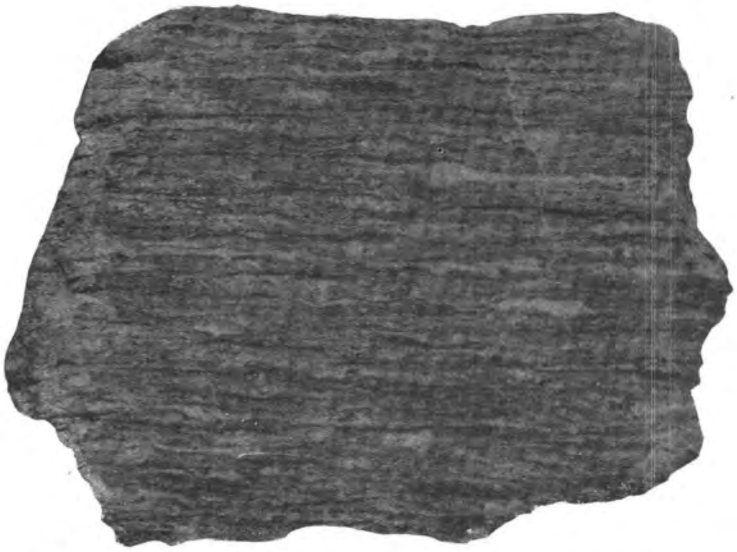
Water level in the Piedmont is generally at a shallow depth; there are but few places in which it is lower than 75 feet, and in most mines and prospects it is within 25 to 50 feet of the surface. Alterations of rock to saprolite is generally complete above water level, and a zone of part-alteration may extend 15 or 20 feet deeper. In the upper part of the zone, unaltered remnants of country rock generally become increasingly numerous; with increasing depth, alteration becomes more and more closely confined to rock near the more open fractures, until it finally disappears altogether. In several mines the transition from saprolite to fresh rock takes place within a zone that is only a few feet, or even less than a foot, in thickness. At the Battle Branch mine, in Georgia, the transition from saprolite to hard rock occurs in a flat-lying fracture zone less than a foot thick. At Hog Mountain, in Alabama, the lower limit of the saprolite is a well-defined undulating surface, dividing porous iron-stained material above from fresh-appearing quartz diorite below. In most places the saprolite is less than 75 feet deep, and at very few properties does it extend more than 150 feet below the surface.

Saprolite is generally a porous aggregate of clay in which the original textures are preserved in detail (see pl. 4, *C*). The rock appears to have settled or shrunk but little as it weathered, although the saprolite contains a few irregularly distributed cracks which are attributed to settling. The colors of the saprolite are extremely varied. They do not always indicate the nature of the underlying rock, but they are more indicative than those of the soil, and in some places, especially when used in connection with other criteria, they are of diagnostic value.

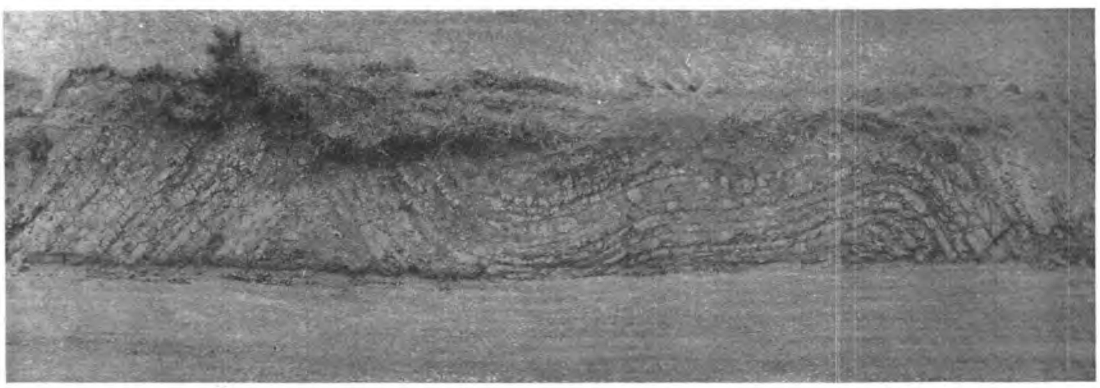
Decomposed Carolina gneiss and to a less extent the decomposed granites commonly contain much bronzy mica. Mica is rare or absent in a great deal of the amphibole gneiss, although chlorite bodies in such gneiss locally form saprolite similar to that derived from mica schist.

Saprolite derived from mica schist commonly breaks into thin sheets or pencil-shaped fragments. The

[68] Becker, G. F., A reconnaissance of the gold fields of the Southern Appalachians: U. S. Geol. Survey, 16th Ann. Rept., pt. 3, pp. 289-290, 1895.



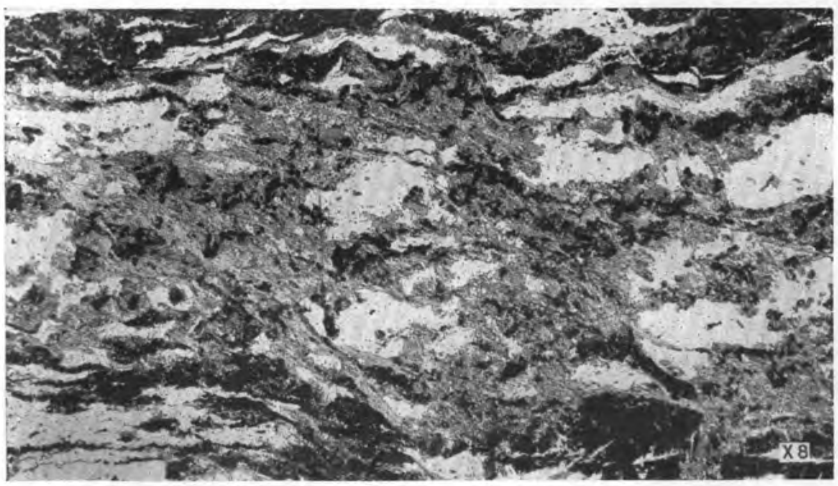
A. POLISHED SLAB OF SHEARED GRANITIC DIKE, BARLOW MINE, LUMPKIN COUNTY, GA.
Note abundance of small quartz nodules.



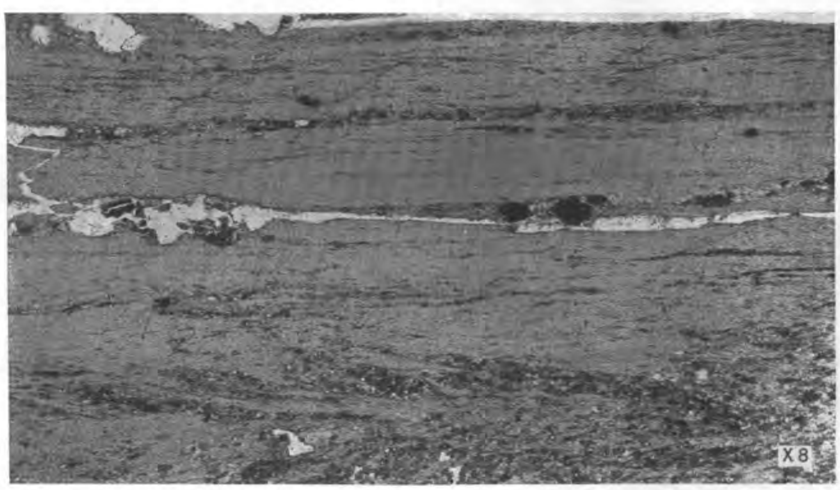
B. FOLDS IN BEDDED TUFF (VOLCANIC SERIES), EAST OF MONROE, UNION COUNTY, N. C.

C. SAPROLITE NEAR WAXHAW, UNION COUNTY, N. C., SHOWING MINUTE SHEARED FOLDS.
Cleavage parallel to axial planes.

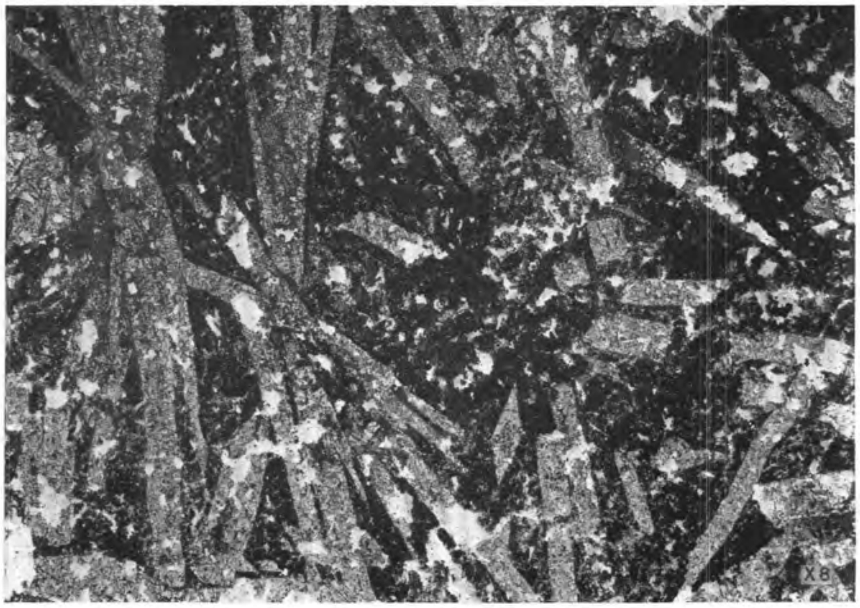
A. UNSHEARED INTRUSIVE ROCK ABOUT 50 FEET FROM LODE, FRANKLIN MINE, FAUQUIER COUNTY, VA.
Photomicrograph by K. E. Lohman.



B. PARTLY SHEARED INTRUSIVE ROCK NEAR LODE, FRANKLIN MINE, FAUQUIER COUNTY, VA.
Photomicrograph by K. E. Lohman.



C. INTENSELY SHEARED INTRUSIVE ROCK ADJOINING LODE, FRANKLIN MINE, FAUQUIER COUNTY, VA
Photomicrograph by K. E. Lohman.



A. SCHIST OF THE WEDOWEE FORMATION NEAR QUARTZ DIORITE CONTACT, HOG MOUNTAIN, TALLAPOOSA COUNTY, ALA.
Pseudomorphs of quartz and muscovite after andalusite (?). Photomicrograph by K. E. Lohman.

B. BARREN VEIN STOPE ABOVE 100-FOOT LEVEL, HOG MOUNTAIN MINE, TALLAPOOSA COUNTY, ALA.
Photograph by S. R. Jones.

sheets are usually colored in different shades of red, brown, and yellow. In contrast, saprolite derived from amphibole gneiss is usually lemon colored or dark-reddish brown, and breaks into angular blocks not more than six inches on a side, known to the local miners as "brickbat." Saprolite derived from granite, particularly that formed by the replacement of narrow sheared dikes, is readily confused with decomposed mica schist. As a rule it is pink near the surface and gray or whitish lower down; some is mottled in pink and white. Many of the decomposed dikes have a dry sandy appearance and are locally termed "sand dikes."

During the spring of 1935 L. M. Prindle and W. A. White spent six weeks collecting and studying residual minerals in soils and saprolites. Their results, together with considerable information collected during the routine investigation, are given in the table below. They tend to indicate that careful examination of residual minerals may often help to identify the underlying rocks, but too little work has been done to show just how useful the method may be.

In Georgia, the saprolites derived from mica schist commonly contain staurolite and kyanite, which are rarely found in the other rocks. Tourmaline and, less abundantly, garnet, are commonest in the mica schists but occur in other rocks also. Zircon has been identified in all but a few samples of the mica schist, where it usually forms well-rounded grains. Saprolite derived from amphibole gneiss contains bluish-green to straw-colored amphibole, and more rutile than that derived from other rocks. It rarely contains zircon, and the few grains found are generally much pitted and etched. Staurolite was found in only one specimen and kyanite in none; tourmaline and garnet are rare. In the saprolite derived from granites and sheared dikes there are few diagnostic minerals: zircon occurs persistently and is etched in some of the sheared dikes, but elsewhere the grains are euhedral; tourmaline, rutile, and staurolite are rare and no kyanite is found. The fourth group of samples listed in the table purportedly represent schist intimately interfingered with granitic dikes, but in the nature of the case the source of some specimens is uncertain, and they probably include material derived from both mica schist and amphibole gneiss, so that the significance of the minerals found in them is uncertain. Saprolites derived from all kinds of rock contain unidentified opaque minerals, mainly iron oxides and clay minerals. Epidote, zoisite, and magnetite are present in all the saprolites and are therefore not diagnostic. Chlorite is rare in the material derived from granitic rocks but fairly common in that derived from mica schist and amphibole gneiss. Quartz and mica are common in most samples and are not entered in the tables.

Minerals found in panned residues of Georgia saprolite

A, Dominant—more than 50 percent of the grains in the average microscopic field.
B, Abundant—several grains appear in every microscopic field.
C, Common—at least one grain in every microscopic field.
D, Sparing—at least four or five grains in a slide.
E, Rare—usually not more than one or two grains in a slide.
a, Angular or euhedral.
e, Etched.
r, Rounded.

NOTE.—Quartz and micas are not recorded but are present in nearly all residues.

No.	Location	Allanite	Amphibole	Apatite	Calcite	Chlorite	Epidote	Garnet	Ilmenite (laths)	Kyanite	Magnetite	Pyrite	Rutile	Staurolite	Tourmaline	Zircon	Zoisite	Other opaque
	MICA SCHIST																	
3	Road cut 1,000 feet east of Clay Creek Falls					D				E		E	D		E			
3a	Hillside east of Clay Creek Falls										D		B		E	Er		
5	Kin Mori mine, northwest cut		E			D	E	C			E				C			A
8	Quarry ¼ mile west of Wimpy's Mill						C				A				E	Er	D	D
9	100 feet west of quarry ¼ mile west of Wimpy's Mill		E			D	B				C		E		D	Er	D	D
13	Fresh rock, quarry ¼ mile west of Wimpy's Mill				B	D	C										D	E
17	500 feet south of road forks on Findley Ridge, near Capps mine						C		C		E		E		D	Er	D	A
18	800 feet south of road forks on Findley Ridge, near Capps mine						C		D		D				E	Er	D	E
19	At road forks on Findley Ridge, near Capps mine	E					C			E	C		D	D	E	Dr	D	B
27	200 feet N. 3° W. from 19						D				D				C	Er		B
28	4,620 feet south of Findley Ridge, along middle of Gainesville road						C				E			B	D	Dr		A
29	3,620 feet south of Findley Ridge, along middle of Gainesville road					D			C		E				D	Dr		A
30	2,320 feet south of Findley Ridge, along middle of Gainesville road		E					E						A	E	Dr+a		B
31	2,020 feet south of Findley Ridge, along middle of Gainesville road						E	E						C	E	Er+e		A
32	1,920 feet south of Findley Ridge, along middle of Gainesville road					D					B			C	E	Dr+e		A
33	1,820 feet south of Findley Ridge, along middle of Gainesville road		D	E		E	E				B				E	Br		A
34	1,420 feet south of Findley Ridge, along middle of Gainesville road					E					E					Br		A
35	1,220 feet south of Findley Ridge, along middle of Gainesville road						E				D					Cr		A
36	1,190 feet south of Findley Ridge, along middle of Gainesville road			E						E	E		E			Dr+e		A
37	990 feet south of Findley Ridge, along middle of Gainesville road							E	C	E	E			B	C	Er		A
38	790 feet south of Findley Ridge, along middle of Gainesville road									D	E			C	E	Dr		A

Minerals found in panned residues of Georgia saprolite—Continued

No.	Location	Allanite	Amphibole	Apatite	Calcite	Chlorite	Epidote	Garnet	Ilmenite (laths)	Kyanite	Magnetite	Pyrite	Rutile	Staurolite	Tourmaline	Zircon	Zoisite	Other opaque
	MICA SCHIST—continued																	
39	690 feet south of Findley Ridge, along middle of Gainesville road							E		E	E		D	C	D	Cr		A
40	390 feet south of Findley Ridge, along middle of Gainesville road													B	E	Dr		B
41	230 feet south of Findley Ridge, along middle of Gainesville road		E					E				E		C	E	Cr		A
42	130 feet south of Findley Ridge, along middle of Gainesville road									D	D		E	C	E	Cr		A
59	Main shaft, Ivy cut			B			B				E							C
61	Adit about 400 feet north (downhill) from 27									E	C				C	Dr		
62	Capps mine powder house		D	E				E			C			D	E	Br		B
63	Soil on spur 280 feet above Chestatee River, south of Findley Ridge					E					E					Br		A
64	2,500 feet south of Crown Mountain, on old road										D		E			Br		A
65	1,550 feet south of Crown Mountain, on old road	E	E				C	E	B	C	C			B	E	Dr		C
66	1,290 feet south of Crown Mountain, on old road							C	C		E		E	E	E	Br	E	B
67	1,090 feet south of Crown Mountain, on old road			E				D		D	D			D	E	Cr+a		A
68	690 feet south of Crown Mountain, on old road		E			E								D	C	Cr		A
69	Top of Crown Mountain						E								D	Cr		A
71	Findley mine, west cut		D								A					Cr+e		C
73	6 inches from amphibole schist, Findley cut						E		B		E				D			A
78	Middle Crown Mountain cut, 3 feet northeast of contact										C		E		B			B
89	Etowah mine, 150 southeast of south open cut		E				E	D	C		C		E		E	E		C
92	Etowah mine, 50 feet south of inclined shaft		D						D	E		C		B	D			A
93	Etowah mine, 100 feet southeast of 92, in drainage ditch		D			E	C			E				A	E	E	E	
94	Etowah mine, 70 feet southeast of 92, in drainage ditch		E			D		E						A	E			
	AMPHIBOLE GNEISS																	
1	Fresh rock at quarry, Clay Creek Falls		B				E					C	B		E			E
2	Similar to 1		A	E			D					C	B		E			D
4	Hillside east of Clay Creek Falls				C	C	C				D					De		B
43	150 feet north of top of Findley Ridge, middle Gainesville road.		E		E	E	C				D		E			De		A
44	30 feet north of 43, along road		D				E		B		C		E		E	Ea		B
70	West Findley cut, 2 feet north of contact		E	E												E		A
72	Findley cut, 6 inches from Carolina gneiss contact		E															A
74	do		E												E			A
75	Ditch just north of West Findley cut		D				D				E		D					A
76	Top of East Findley cut			E				E			D			E				A
77	Middle Crown Mountain cut, 3 feet southwest of contact.		E								D	E						A
82	Road fork about 200 feet north of 44 along road		D								D							A
83	1,230 feet south of 88, along road		D															A
84	1,000 feet south of 88, along road		E	E			E				E							A
85	520 feet south of 88, along road		D				E	D			D					Ee		A
86	340 feet south of 88, along road		B				B				E		C				E	B
87	200 feet south of 88, along road		A				C				E						D	
88	50 feet south of sharp turn, middle Gainesville road, north base of Findley Ridge		B				B				C		E		E	Ee	E	A
90	Etowah mine, 420 feet S. 26° E. from inclined shaft		D			D					E		E					
91	Etowah mine, 540 feet southeast from inclined shaft in drainage ditch		B				B						C				A	
95	Etowah mine, 200 feet S. 25° E. from inclined shaft		C	E		E	A				E		D					
96	Etowah mine, 300 feet southeast from inclined shaft in drainage ditch		A			D					D		D					
	GRANITE AND "SAND DIKES"																	
6	Ivy cut		D								C							A
7	Main road about ½ mile west of Dahlonega		E				D				E		D			Da	E	
10	¼ mile northeast of Wimpy's Mill						A								E	Ea		
11	½ mile northeast of Wimpy's Mill (hillside below ditch)		E				A				B		E			Da	E	E
12	½ mile east of Wimpy's Mill, in road cut						A				E				E	Ca	E	D
14	Fresh rock, quarry ¼ mile west of Wimpy's Mill		E	D	D	D	C				D			D				
20	Powder house in Ivy cut						B				D							A
22	Main "sand dike," northwest arm of Ivy cut		E				D	E			C			E		Ce+a		C
23	Aggregate of three small dikes near 22		D				D				D					Eaer		A
24	100 feet southeast of end of northwest arm of Ivy cut						E				E	D				Da		
52	25 feet northwest of 22		D				D				D		E			Er		A
79	Mouth of adit, White Rabbit mine		D													Da+r		A
80	5 feet east of 22						B				C				D	Dae		
81	Southeast side of same dike as 22; spotted phase		D					E			B					Cae		B
	ROCKS INTERFINGERED WITH "SAND DIKES"																	
21	10 feet west of powder house, east end of Ivy cut			D							E							A
25	6 feet west of 22		C					B			D			E				A
26	Contact with 22		E				D				D					Dr		A
45	35 feet south of "sand dike" at powder house, east end of Ivy cut						B				A						E	D
46	10 feet south of "sand dike" at powder house, east end of Ivy cut		D				B											A
47	10 feet north of "sand dike" at powder house, east end of Ivy cut						B						E				E	A
48	20 feet north of "sand dike" at powder house, east end of Ivy cut		E				C		B		C							A
49	Tunnel 60 feet north of Ivy cut, east side of road		E				B		B		E					Ee		A
50	Composite sample 40 feet northwest of "sand dike", in northwest arm of Ivy cut		E				E				E							A
51	25 feet northwest of 22		D	E	E		B	D							E			A
54	20 feet southeast of 22		C				C	C			E		D					A
56	Gray saprolite; southeast of 22		E			E	D				D	D						A
57	100 feet southeast of 56						D		B		C					Ee		A
58	Northeast wall of Ivy cut, opposite 24		E				C		B		C							A
60	100 feet northeast of Ivy shaft		C								D							A

Becker suggested that silica had been leached from some of the saprolite deposits,[69] and, although quartz is present in all the saprolites studied, evidence was found that tends to confirm Becker's suggestion. In several exposures there are quartz veins that do not continue from the top of the saprolite into the soil, and the upper surfaces of these veins are smooth and pitted (see pl. 8, *B*); a few subrounded and pitted boulders and lumps of quartz are enclosed in the soil above the veins. A striking example of this condition was seen in the Benjamin prospect at Cragford, Ala.

At the Barlow mine, in Georgia, a fresh-appearing sheared granitic dike rock seen underground contains numerous small nodules of bluish quartz (see pl. 4, *A*), but these nodules become progressively scarcer toward the surface, and are not found in the saprolite 10 to 20 feet below the soil. A series of samples was taken from this decomposed dike at 10, 20, 30, and 40 feet below the original surface of the ground and a sample of the fresh rock was obtained from the deepest workings, about 160 feet below that surface. Incomplete analyses of these samples were made in order to determine the silica-alumina ratios. The results, given in the table below, show a gradual decrease in silica and increase in alumina from the 40-foot level to the surface. Density determinations, made by weighing saprolite in the form of loosely tapped powder, are given in the table below. Density was found to decrease toward the surface, and there was an increase in porosity from 45.2 percent of voids in the 40-foot sample to about 53.4 percent of voids in the uppermost sample.

Changes in chemical composition and density of saprolite from Barlow mine at different depths below the surface

Depth of sample (feet)	Partial analyses [1]				Density [2]	
	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	Apparent density	Voids (percent) [3]
10	56.45	24.60	5.38	0.56	1.17	53.4
20	61.02	20.30	5.70	.58	1.19	51.2
30	66.45	18.14	5.40	.42	1.38	47.2
40	68.51	16.18	4.28	.62	1.45	45.2
160	66.94	13.04	4.19	.62		

[1] Analyses by R. C. Wells.
[2] Density determined by weighing loosely tapped powder in a cylindrical dish; determinations by H. C. Spicer.
[3] Percent voids determined on blocks of solid materials.

HISTORY OF MINING

It is generally agreed that a small amount of gold was mined in Georgia, and possibly in North Carolina, by the Spaniards and Indians. Becker has discussed this subject in considerable detail,[70] and it need not be further considered here.

The only known reference to gold in the southern Appalachians published during the 18th century occurs in Thomas Jefferson's notes on Virginia.[71] He described a piece of ore, found in 1782 on the north bank of the Rappahannock River, that yielded 17 pennyweight of gold.

In 1799 a lump of gold, said to have been about as large as a "small smoothing iron" and about 17 pounds in weight, was found on the Reid farm in Cabarrus County, N. C. According to Partz,[72] Conrad Reid, the 12-year-old son of John Reid, the owner of the land, found the nugget while fishing along Little Meadow Creek. Recognizing it as some kind of metal, he carried it home to his father, who did not realize its value but kept it nevertheless as a curious kind of rock, and, on account of its weight, used it for a door stop. In 1802 he took it to Fayetteville and sold it to a jeweler for $3.50. On returning home, Reid, in association with others, searched the creek and found other nuggets and gold-bearing pebbles of various sizes, the largest of which weighed 16 pounds; the gold was distributed along the stream for nearly a mile.

In 1803, according to Partz, a Negro boy named Peter dug a lump of gold that weighed 28 pounds avoirdupois out of gravel on the northwest side of the "lake" on an adjacent plantation, possibly the land of James Love. In the following year, lumps weighing 9, 7, 3, 2, and 1¾ pounds were found, besides a large amount of "grain gold." The smaller particles were recovered by amalgamation in hand rockers.

Soon afterward, gold was discovered in Montgomery County, N. C., and washing for gold in the small streams was carried on there and in Cabarrus County. Drayton mentions a small nugget said to have been found in the Greenville district, near Paris' Mountain in South Carolina, before 1802,[73] but from 1804 to 1827 the only recorded production of gold in this country was made by North Carolina; it amounted to about $110,000. In 1825 the first lode—called Barringer's lode—was discovered in what is now Stanly County, and shortly afterward the people of the Southern Appalachians appear to have become gold conscious, for mining of both lodes and placers suddenly spread throughout the region. Bullion was sent to the mint from Virginia and South Carolina in 1829 and from Georgia in 1830. A real boom was under way, and press reports of the period contain such headlines as "Number of gold mines increasing daily," "Farmers find gold in every hill," "Moneyed men from every quarter of the Union purchasing land at extravagant prices," "Mills are building," "Mine produces 160 pounds of pure metal in one week," "Gold digging amounts to mania."

[69] Becker, G. F., op. cit., p. 290.
[70] Becker, G. F., op. cit., pp. 253–256.

[71] Jefferson, Thomas, Observations sur la Virginie, pp. 64–65, Paris, 1786; Notes on the State of Virginia, 1st Am. ed., p. 38, 1787; 2d Am. ed., p. 32, 1794.
[72] Partz, August, Examinations and explorations on the gold-bearing belts of the Atlantic States: Mining Mag., vol. 3, pp. 162–164, 1854.
[73] Drayton, Joan, A view of South Carolina as respects her natural and civil concerns, p. 15, 1802.

As in many other new gold regions, the slowness and difficulty of transport and communication during that early period, which made the centers of trade and finance seem very remote, resulted in the local use of gold dust as currency and led to the private coinage of gold. This highly unusual activity was first engaged in by Templeton Reid in Lumpkin County, Ga., in 1830, but just how long he continued it is not known. In 1831 gold coinage was begun at Rutherfordton, N. C., by C. Bechtler. It was carried on by him until 1838, and from then until 1857 by his son A. Bechtler. In the meantime (1838) the United States had established mints at Dahlonega, Ga., and at Charlotte, N. C.; yet the private operations of Bechtler were not interfered with, for the reason, it was said, that the Bechtler coins were found to equal or exceed the Federal standards of fineness and weight.

The coinages of Reid and the Bechtlers are of more than ordinary historical interest. The late Joseph Hyde Pratt, in an unpublished manuscript, described the coins minted by them in much detail. It seems inappropriate to publish these descriptions here, but the following general remarks by Dr. Pratt appear pertinent.

> Mr. Adams states[74] that according to Mr. C. Bechtler's books the value of the gold mined from January 1831 to February 1840 was $2,241,840.50, his gold averaging 80 cents to the pennyweight. Evidently no records of the actual amount of gold mined by the Bechtlers and Reid are in existence and therefore nothing definite is known as to the amount of gold that was actually coined in Georgia and North Carolina. The percentage paid by the owners of the gold for its coinage was 2½ percent.

During 1830 deposits were worked in Chesterfield and Lancaster Counties, and in 1830 and 1831 the Brewer mine, in Chesterfield County, was reported to be one of the most productive properties. Between 100 and 200 persons were employed at the Brewer mine, and were supposed to have recovered about $1.50 to $3 each per day. Where the first discovery of gold was made in Georgia is not known; several deposits appear to have been found almost simultaneously in 1829. One of the early discoveries was made on Duke's Creek, in what is now White County but was formerly part of Habersham County, and another at the site of the Calhoun mine in Lumpkin County. Phillips[75] reports that gold was discovered in Alabama in 1830, and Dickson,[76] in a paper read by him in June 1834, stated that "the gold belt extends from the Rappahannock River, Virginia, to the Coosa River, in Alabama." No Mint records of gold from Alabama are known to have appeared until 1838. In Virginia, little attention seems to have been given to gold deposits from Jefferson's time until 1829. During the next decade, however, many short reports were published that indicate a feverish activity in the Southern Piedmont, and many properties were prospected and opened at that time.

Production records indicate that the first boom in the southern Piedmont region reached its height about 1833–34, when the output from the richest placers and surface deposits began to decrease. At about this time agitation for the construction of mints led to the erection of three—one at Dahlonega, Ga., one at Charlotte, N. C., and one at New Orleans, La. All three began operations in 1838, but very little bullion was ever shipped to New Orleans. After 1834, mining history records various degrees of activity, stimulated from time to time and at various places by the development of ore bodies or by the application of improved methods of recovery.

The decline that inevitably followed the boom in placer mining was succeeded by a period of great activity in lode mining, which continued, with a gradual decrease in output, from about 1838 to the beginning of the War Between the States. During this period mining was extended below water level on many of the lodes, and Chilean mills, arrastres, and the like, were largely supplemented by stamp mills. Attempts were made to smelt the sulfide ores of lead and zinc found at Silver Hill, and those of copper found at the Fentress and other mines in North Carolina. Gold Hill, N. C., became a lively mining camp with a population of 2,000. Auraria, Ga., and Goldville and Arbacoochee, Ala., were thriving towns supported by the mining industry. Many discoveries were made; one of the most notable being that of the rich deposit worked at the Dorn mine, in McCormick, S. C., in 1852. A moderate revival of placer mining in McDowell, Burke, and Rutherford Counties, N. C., followed the introduction of hydraulic methods at Janestown in 1856.

During the War Between the States the gold mines were almost completely inactive. The mints at Dahlonega and Charlotte were abandoned at that time, never to be reopened. The ending of the war was followed by moderate activity, which rose to a peak in 1882 and then gradually declined until in 1916 mining had nearly ceased. During this postwar period many of the mines were reopened and deepened; one shaft at Gold Hill, N. C., was sunk to a depth of 820 feet, and the Creighton (Franklin) mine in Georgia was deepened to about 950 feet on the incline of the vein.

In 1868 the Dahlonega method of hydraulic mining was developed to handle large bodies of low-grade saprolite. It consisted of hydraulicking the softened material and sluicing it to the mills, where it was usually reduced by means of stamps and amalgam plates. This method was widely used near Dahlonega, and its de-

[74] Adams, E. H., Adams' Official Premium List of United States Private and Territorial Gold Coins, p. 37, Willett Press, New York, 1909.

[75] Phillips, W. B., Lower gold belt of Alabama in the counties of Chilton, Coosa, and Tallapoosa: Alabama Geol. Survey Bull. 3, 1892.

[76] Dickson, James, An essay on the gold region of the United States: Geo. Soc. Pennsylvania Trans., vol. 1, p. 16, 1835.

velopment gave a considerable impetus to the industry. During this period also, noteworthy amounts of copper and lead ores were smelted. An outstanding mining achievement was the continued profitable operation of the Haile mine, in South Carolina, from 1880 to 1908, as a result of the successful treatment of its low-grade pyritic gold ore by a special chlorination process devised by the operator, Adolph Theis. The gold deposit at the Iola mine, in North Carolina, which was not discovered until 1901, was worked extensively, the ore being successfully treated by cyanidation. In Georgia the most productive lode mine was the Creighton (Franklin), which, except during the War Between the States, was operated almost continuously from 1840 until June 1909, when it was flooded by the Etowah River. A chlorination process similar to that in use at the Haile mine was applied at the Creighton. At Hog Mountain, Ala., systematic mining began in 1893 and continued until 1915.

During World War I and the period of high costs that followed, gold mining almost ceased, and from 1921 to 1932 the industry showed little or no activity. Signs of a revival appeared in 1933, and in 1934 underground development work was done on several lodes.

In North Carolina, the Howie mine was unwatered and sampled, and some diamond drilling and drifting were done there, but late in 1935 the property was closed. At the Rudisil mine, in Charlotte, a 75-ton flotation mill was constructed, and about 2,000 ounces of bullion is said to have been shipped during 1935. Several other properties in North Carolina were unwatered and sampled; among them were the Whitney and the Isenhour at Gold Hill, the Coggins, the Gardner Hill, and the Long Creek. Considerable development work was done also in the Crayton, Portis, and Parker mines.

In South Carolina, the Haile mine was operated continuously and the Terry mine part of the time during 1935. Development work and sampling were done at the Dorn, Bar Kat, and Landrum mines. At Smyrna, in York County, the White Star Mining Co. built and put in operation in 1934 a 50-ton flotation plant designed to treat custom ore, but this mill was idle in 1935.

In Georgia, the Battle Branch mine, at which a small 10-stamp mill was installed late in 1934, has been the only steady producer. In addition to this mine the Barlow, Lockhart, McDonald, Blake, Whim Hill, 301, Etowah, Consolidated, Franco-American, and a few others have been partly opened up and sampled.

In Alabama the Hog Mountain mine was reopened late in 1933; a flotation plant was installed at that time, and the mine was operated continuously to 1936. During 1934 this mine shipped $97,000 worth of bullion to the mint. Mills were operated for short periods at the Dutch Bend and Blue Hill mines, and development work was done at the Alabama King mine and near the Heflin school, west of Ashland.

In Virginia, the Melville mine was opened late in 1933, the Vaucluse in 1934, and the Moss in 1935. All were being operated in 1936 but were abandoned in 1938. After considerable exploratory work, the Franklin, United States, and Laird properties in Virginia were closed. Some work was done at the Tellurium and Liberty mines in 1934 and 1935.

Placer mining was carried on only in desultory fashion during the 1930's, but several dragline scrapers with sluice boxes operated steadily in White County, Ga. Some of the stream gravel at the Etowah mine in Georgia was washed, and saprolite was mined and washed by hydraulic methods at the Topabri (Josephine), Baggs Branch, and Barlow mines in the same state. In Virginia a dragline scraper was being operated in 1935 on the old Collins placer in Goochland County. At many other places scattered throughout the region, more or less interest was being shown in the placer deposits and several were being worked in a small way with rockers or sluices.

PRODUCTION

As with many old mining districts, the records of gold production from the Southern Piedmont region during the early years of activity are scanty and probably far from complete. For these years the best available published sources of information appear to be the reports of the Director of the Mint. For the years since 1880, the statistical reports of the Geological Survey and Bureau of Mines [77] provide a record of the annual output. The accompanying table, giving the annual production of gold, by weight and value, for Alabama, Georgia, South Carolina, North Carolina, and Virginia, has been compiled from these two sources, which were also used in preparing the graphical presentation in States from 1804–1934, inclusive, as $32,066,675, whereas the figure given in the Mineral Resources of the U. S. and the Minerals Yearbook [78] for this period is $51,041,-120. The difference, amounting to $18,975,045, represents an estimate of the early production not recorded by the Mint, and was arbitrarily added to the cumulative total for the first time in 1914.[79] As the amount added is approximately the same as the sum of the Mint figures from 1804 through 1865 ($19,165,551), it seems likely that the addition was made on the basis of an estimate, published by Taylor [80] in 1867, that up to that time an amount of gold equal to that recorded by the Mint had been used in the arts or shipped abroad, or had otherwise escaped the notice of the Mint.

A small proportion of silver, commonly about 10 percent and rarely more than 20 percent by weight, is naturally alloyed with the gold produced in this region.

[77] Mineral Resources, U. S., and Minerals Yearbook.

[78] Mineral Resources, U. S., and Minerals Yearbook, 1914–1934, inclusive.

[79] Mineral Resources, U. S., pp. 139–144, 1914.

[80] Taylor, J. J., Report to the Secretary of the Treasury, p. 15, 1867.

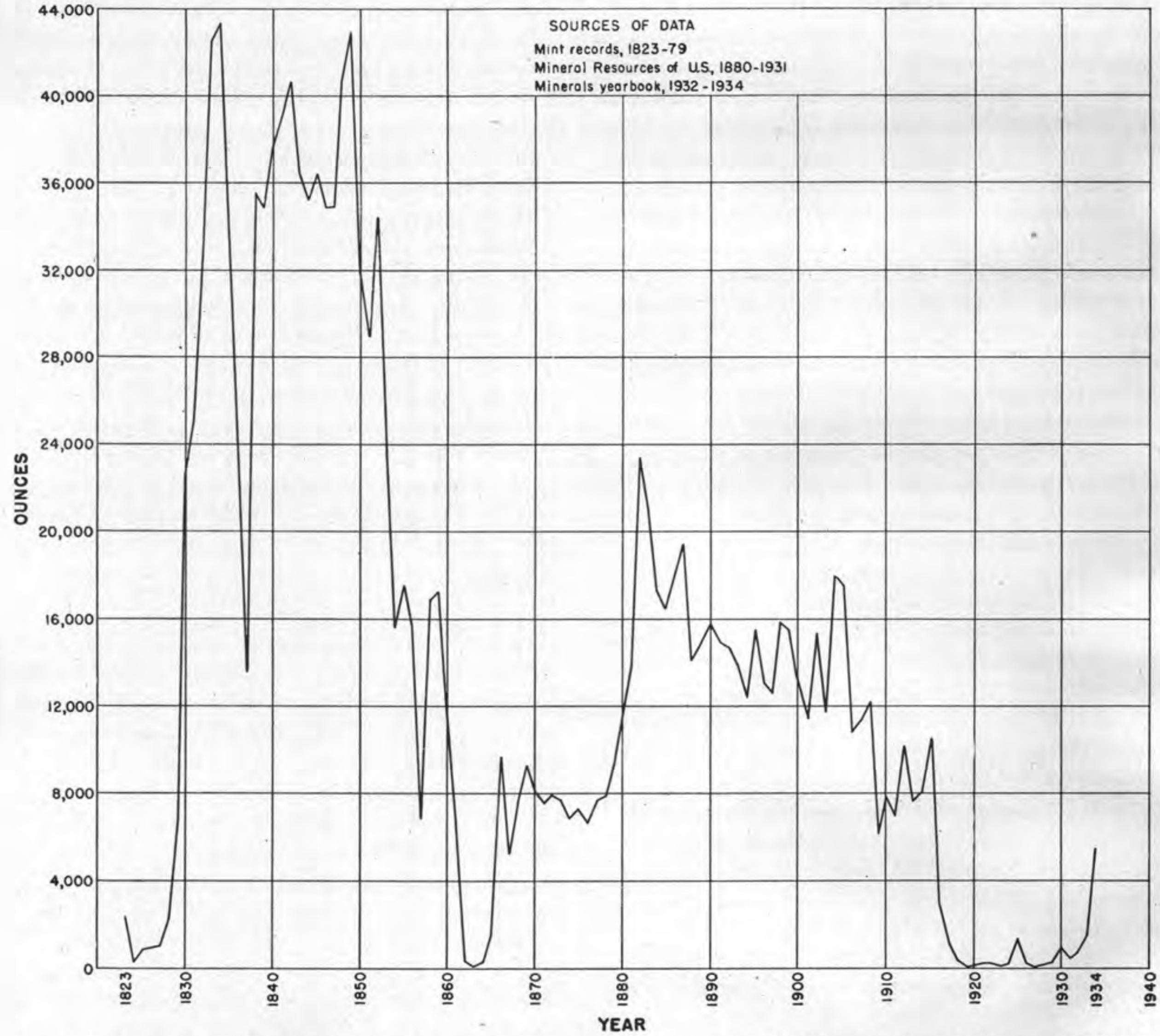


FIGURE 1.—Graph showing total gold produced from Virginia, North Carolina, South Carolina, Georgia, and Alabama, 1804–1934.

Additional silver, not alloyed with gold, has been recovered at times from several of the lode mines. Mineral Resources for 1880–1932, inclusive, credited about 363,000 ounces to North Carolina and about 8,600 ounces to South Carolina. Comparatively little of this silver was derived from the gold ores. Most of it came from base-metal ores, chiefly of copper, produced at mines outside the area here considered, although a considerable part came from copper and lead-zinc ores mined at Gold Hill, Silver Hill, and other places in the Piedmont region of North Carolina. The amount of silver produced in Georgia from 1889 to 1934, inclusive, is given by Mineral Resources as 12,617 ounces, or only 11.6 percent by weight of the amount of gold. This figure includes small amounts of silver from the copper mines in Fannin County (southern Ducktown area) and possibly from other districts; the ratio, however, is thought to be nearly correct for the bullion obtained from the gold deposits. Assuming that all the silver was alloyed with the gold, the bullion produced contained about 895 parts of gold per 1,000. In Virginia considerable silver was being produced in 1935, but most as a byproduct from lead-zinc and copper mines, the amount yielded by the gold mines being insignificant. Alabama production in 1905–34, according to Mineral Resources, was 2,641 ounces of silver and 16,089 ounces of gold—a ratio of 16.4 percent by weight. Practically all this silver came from gold ores, so that the bullion contained about 859 parts of gold per 1,000.

In the period 1900–1910 some 4,870,000 pounds of copper, valued at about $726,000, was produced in the Gold Hill district of North Carolina. In earlier times considerable copper was produced by mines in neighboring districts. Before and after the War Between the States a good deal of lead was produced by the Silver Hill mine, not far from the Gold Hill district. In 1912 this mine was credited with about 283,000 pounds of zinc, worth about $19,550. The Virgilina district, near the boundary between North and South Carolina, has produced a good deal of copper; and the Seminole or Macgruder mine, in Georgia, has yielded appreciable amounts of copper, lead, and zinc. The old Wood's copper mine, in eastern Alabama, is reported to have produced considerable copper during the early days of mining. Many other mines in the Piedmont region contain some copper, lead, and zinc, and many are said to have produced these metals in small quantity. Pyrite, also, has been mined for its sulfur content, and barite and manganese have been produced, particularly in the Cartersville district of Georgia.

Gold production of the Southern States 1804–1934

[Compiled from Mint records, Mineral Resources of United States, and Minerals Yearbook]

Period	North Carolina		South Carolina		Georgia		Alabama		Virginia		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
1804-1823	2,274	$47,000	-----	-----	-----	-----	-----	-----	-----	-----	2,274	$47,000
1824	242	5,000	-----	-----	-----	-----	-----	-----	-----	-----	242	5,000
1825	822	17,000	-----	-----	-----	-----	-----	-----	-----	-----	822	17,000
1826	968	20,000	-----	-----	-----	-----	-----	-----	-----	-----	968	20,000
1827	1,016	21,000	-----	-----	-----	-----	-----	-----	-----	-----	1,016	21,000
1828	2,225	46,000	-----	-----	-----	-----	-----	-----	-----	-----	2,225	46,000
1829	6,483	134,000	169	$3,500	-----	-----	-----	-----	121	$2,500	6,773	140,000
1830	9,869	204,000	1,258	26,000	10,256	$212,000	-----	-----	1,161	24,000	22,544	466,000
1831	14,224	294,000	1,064	22,000	8,515	176,000	-----	-----	1,258	26,000	25,061	518,000
1832	22,158	458,000	2,177	45,000	6,773	140,000	-----	-----	1,645	34,000	32,753	677,000
1833	22,980	475,000	3,193	66,000	10,450	216,000	-----	-----	5,031	104,000	42,454	861,000
1834	18,384	380,000	1,838	38,000	20,077	415,000	-----	-----	3,000	62,000	43,299	895,000
1835	12,724	263,000	2,051	42,400	15,477	319,900	-----	-----	2,922	60,400	33,174	685,700
1836	7,165	148,100	2,671	55,200	9,744	201,400	-----	-----	3,000	62,000	22,570	466,700
1837	5,656	116,900	1,422	29,400	4,045	83,600	-----	-----	2,521	52,100	13,644	282,000
1838–1847	[1] 140,232	[1] 2,898,505	[1] 19,591	[1] 404,938	[2] 145,898	[2] $3,015,717	[2] 5,255	[2] $108,614			[2] 310,976	[2] $6,427,774
1838					1,741	36,000	0	-----	2,661	55,000	4,402	91,000
1839					982	20,300	0	-----	2,787	57,600	3,769	77,900
1840					4,408	91,113	215	$4,431	1,887	38,995	6,510	134,539
1841					6,763	139,796	91	1,863	1,245	25,736	8,099	167,395
1842					7,270	150,276	270	5,579	2,040	42,163	9,580	198,018
1843					2,739	56,619	232	4,786	2,329	48,148	5,300	109,553
1844					1,487	30,739	595	12,298	1,964	40,595	5,046	83,632
1845					838	17,325	314	6,472	4,199	86,783	5,351	110,581
1846					658	13,601	365	7,542	2,687	55,538	3,710	76,680
1847					510	10,547	0	-----	3,277	67,736	3,787	78,283
1848	22,910	473,543	1,963	40,577	12,436	257,063	700	14,462	2,800	57,886	40,809	843,531
1849	23,502	485,793	1,188	24,564	11,434	236,349	518	10,700	6,259	129,382	42,901	886,788
1850	17,200	355,523	941	19,459	10,140	209,587	316	6,538	3,193	65,991	31,790	657,098
1851	15,814	326,883	1,986	41,052	7,606	157,213	192	3,962	3,341	69,052	28,939	598,162
1852	19,512	403,295	6,142	126,962	4,671	96,542	12	254	4,046	83,626	34,383	710,679
1853	13,334	275,622	4,805	99,317	2,849	58,896	-----	-----	2,525	52,200	23,513	486,035
1854	10,018	207,073	1,771	36,604	2,701	55,830	12	245	1,138	23,514	15,640	323,266
1855	10,954	226,416	1,558	32,210	3,460	71,520	45	938	1,513	31,265	17,530	362,349
1856	8,276	171,070	1,730	35,755	4,360	90,119	11	234	1,380	28,535	15,757	325,713
1857	4,058	83,870	644	13,312	1,891	39,091	75	1,545	195	4,036	6,863	141,854
1858	9,325	192,742	2,152	44,483	4,391	90,767	106	2,181	913	18,878	16,887	349,051
1859	10,381	214,574	1,584	32,748	4,449	91,969	29	593	782	16,156	17,225	356,040
1860	7,556	156,182	97	2,004	3,024	62,513	32	661	1,045	21,607	11,754	242,967
1861	536	11,088	3,304	68,295	2,135	44,132	44	911	536	11,069	6,555	135,495
1862	112	2,313	100	2,065	78	1,604	-----	-----	15	316	305	6,298
1863	63	1,309	-----	-----	12	247	-----	-----	3	69	78	1,625
1864	295	6,094	-----	-----	-----	-----	-----	-----	-----	-----	295	6,094
1865	614	12,693	-----	-----	671	13,872	110	2,269	44	911	1,439	29,745
1866	6,818	140,937	34	695	2,343	48,434	55	1,135	503	10,398	9,753	201,599
1867	3,208	66,306	58	1,200	1,391	28,758	21	437	494	10,206	5,172	106,907
1868	4,350	89,906	78	1,607	2,543	52,565	7	153	542	11,205	7,520	155,436
1869	5,645	116,672	308	6,360	2,651	54,801	61	1,259	601	12,426	9,266	191,518
1870	4,892	101,111	414	8,552	2,101	43,430	119	2,457	567	11,716	8,093	167,266
1871	4,633	95,766	225	4,653	2,109	43,597	277	5,721	333	6,891	7,577	156,628
1872	5,557	114,863	149	3,085	1,815	37,515	96	1,989	318	6,562	7,935	164,014
1873	5,822	120,332	8	161	1,714	35,438	29	599	117	2,424	7,690	158,954
1874	5,180	107,070	43	897	1,498	30,962	13	259	105	2,164	6,839	141,352
1875	5,255	108,628	64	1,316	1,871	38,683	18	381	72	1,493	7,280	150,501
1876	4,411	91,181	54	1,125	2,016	41,663	26	531	161	3,323	6,668	137,823
1877	3,872	80,026	45	937	3,507	72,500	120	2,471	133	2,751	7,677	158,685
1878	3,634	75,123	101	2,094	3,689	76,259	85	1,764	357	7,374	7,866	162,614
1879	3,971	82,076	263	5,433	4,354	90,000	91	1,887	708	14,627	9,387	194,023
1880	4,596	95,000	726	15,000	5,806	120,000	48	1,000	556	11,500	11,732	242,500
1881	5,564	115,000	1,693	35,000	6,047	125,000	48	1,000	484	10,000	13,836	286,000
1882	9,192	190,000	1,209	25,000	12,095	250,000	169	3,500	726	15,000	23,391	483,500
1883	8,079	167,000	2,733	56,500	9,627	199,000	290	6,000	339	7,000	21,068	435,500
1884	7,596	157,000	2,758	57,000	6,628	137,000	242	5,000	121	2,500	17,345	358,500
1885	7,354	152,000	2,080	43,000	6,580	136,000	290	6,000	169	3,500	16,473	340,500
1886	8,466	175,000	1,814	37,500	7,378	152,500	194	4,000	194	4,000	18,046	373,000
1887	10,885	225,000	2,419	50,000	5,322	110,000	121	2,500	706	14,600	19,453	402,100
1888	6,580	136,000	1,887	39,000	5,031	104,000	271	5,600	363	7,500	14,132	292,100
1889	7,102	146,795	2,267	46,853	5,206	107,605	128	2,639	199	4,113	14,902	308,005
1890	5,733	118,500	4,838	100,000	4,838	100,000	105	2,170	314	6,496	15,828	327,166
1891	4,596	95,000	6,047	125,000	3,870	80,000	109	2,245	324	6,699	14,946	308,944
1892	3,801	78,560	5,968	123,365	4,583	94,734	117	2,419	242	5,002	14,711	304,080
1893	2,593	53,600	5,999	124,000	4,702	97,200	308	6,362	299	6,190	13,901	287,352
1894	2,330	48,167	4,759	98,366	4,772	98,652	198	4,092	370	7,643	12,429	256,920
1895	2,622	54,200	6,212	128,400	6,192	128,000	224	4,635	305	6,303	15,555	321,538
1896	2,143	44,300	3,062	63,300	7,305	151,000	314	6,495	215	4,435	13,039	269,530
1897	1,674	34,600	4,098	84,700	6,192	128,000	409	8,455	207	4,280	12,580	260,035
1898	4,064	84,000	5,041	104,200	6,221	128,600	318	6,578	246	5,075	15,890	328,453
1899	1,669	34,500	7,746	160,100	5,466	113,000	231	4,766	374	7,729	15,486	320,095
1900	1,379	28,500	5,854	121,000	5,644	116,700	127	2,618	172	3,558	13,176	272,376
1901	2,685	55,500	2,259	46,700	6,023	124,500	183	3,773	313	6,465	11,463	236,938
1902	4,388	90,700	5,897	121,900	4,730	97,800	142	2,938	208	4,295	15,365	317,633
1903	3,411	70,500	4,872	100,700	3,000	62,000	237	4,894	216	4,465	11,736	242,559
1904	5,994	123,900	5,893	121,800	4,688	96,900	1,417	29,288	186	3,853	18,178	375,741
1905	6,081	125,685	4,601	95,111	4,688	96,910	2,009	41,530	241	4,982	17,620	364,218
1906	3,973	82,131	3,820	78,959	1,146	23,700	1,206	24,921	718	14,832	10,863	224,543
1907	3,976	82,193	2,649	54,765	3,135	64,800	1,257	25,982	401	8,288	11,418	236,028

[1] Records for separate years not available, 1838–47.
[2] Undistributed production 1838–47, additional to distributed production shown.

Gold production of the Southern States 1804–1934—Continued

Period	North Carolina		South Carolina		Georgia		Alabama		Virginia		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
1908	4, 716	97, 480	2, 598	53, 701	2, 719	56, 200	1, 994	41. 208	119	2, 451	12, 146	251, 040
1909	1, 946	40, 230	535	11, 053	2, 099	43, 400	1, 415	29. 239	181	3, 750	6, 176	127, 672
1910	3, 292	68, 045	1, 854	38, 324	1, 161	24, 000	1, 622	33, 533	43	888	7. 972	164, 790
1911	3, 400	70, 282	987	20, 408	1, 548	32, 000	915	18, 916	148	3, 064	6, 998	144, 670
1912	8, 032	166, 014	818	16, 915	526	10, 900	809	16, 724	11	218	10, 196	210, 771
1913	6, 117	126, 448	236	4, 881	730	15, 108	537	11, 094	29	604	7, 649	158, 135
1914	6, 344	131. 141	356	7, 360	787	16, 270	579	11, 970	21	429	8, 087	167, 170
1915	8, 321	172, 001	183	3, 789	1, 732	35, 821	254	5, 243	26	534	10, 516	217, 388
1916	1, 269	26, 237	15	320	1, 090	22, 539	418	8, 650	43	885	2, 835	58, 631
1917	590	12, 187	52	1, 083	333	6, 889	109	2. 262	65	1, 343	1, 149	23. 764
1918	79	1, 631			218	4, 500	39	797	19	400	355	7, 328
1919	5	101			37	767					42	868
1920	72	1. 479			35	732	14	296			121	2, 507
1921	156	3, 229			49	1. 022			37	763	242	5, 014
1922	95	1, 971			155	3. 224			34	706	284	5, 901
1923	68	1. 415			25	529	6	114			99	2, 058
1924	220	4, 540			24	500			6	116	250	5, 156
1925	897	18, 540			460	9, 500			3	68	1, 360	28, 108
1926	79	1, 631	15	313	140	2, 900			11	220	245	5, 064
1927	49	1, 015			15	300					64	1, 315
1928	114	2, 366	10	197	34	700					158	3. 263
1929	245	5, 054			58	1, 200	10	203			313	6, 457
1930	705	14, 582			203	4, 200	22	450			930	19, 232
1931	368	7, 598	23	470	88	1, 827	20	407			499	10, 302
1932	367	7, 591	71	1, 468	256	5, 300	69	1, 423	31	637	794	16, 419
1933	725	18, 522	235	5, 996	558	14, 273	4	101	32	824	1, 554	39, 716
1934	509	17, 779	642	22, 439	970	33, 898	2, 781	97, 186	667	23, 315	5, 569	194, 617
	696, 436	14, 406, 025	185, 074	3, 835, 896	541, 508	11. 209, 952	32, 886	719, 337	91, 208	1, 894, 865	1, 547, 902	32, 066. 075
		[3]23, 735, 826		[3] 5, 212, 312		[3]17, 903, 248		[3] 866, 516		[3] 3, 323, 218		[3] 51, 041. 120

[3]Total from records of Mineral Resources and Mineral Yearbook, which include estimates of earlier years.

GOLD DEPOSITS

DISTRIBUTION

Most of the gold of the five Southeastern States—Virginia, North Carolina, South Carolina, Georgia, Alabama—is found in the Piedmont province. In fact the only places in these Southeastern States outside the Piedmont from which production of gold has been reported are in western North Carolina, extreme northern Georgia, and eastern Tennessee. Gold has been recovered in Maryland near the Great Falls of the Potomac, but only in small amount, and the Potomac River has therefore been taken as the northern boundary of the region considered in this report.

Plate 7 shows the relative concentration of the gold-bearing areas in the Piedmont, and it also shows their relations to areas yielding other minerals, to areas of granitic rocks, and to the blanket of Coastal Plain sediments.

The predominant structural features of the rocks throughout the area especially the faults and the foliation, are parallel to the mountains that border the Piedmont on the west, and with a few local exceptions they trend northeastward. The mineral deposits are nearly all in wide zones or belts that parallel this trend or "grain" of the country rocks, although a few veins and lodes trend northwestward. The gold deposits are most widely distributed in North Carolina, but large mineralized areas are found in Georgia and South Carolina; those in Virginia and Alabama are relatively small.

CLASSIFICATION

As in many gold-bearing regions elsewhere, the gold deposits in the Southern Piedmont province comprise two main groups, lodes and placers, each of which may conveniently be subdivided. Many of the placers worked in times past were alluvial deposits transported and concentrated by streams. In places, however, it was found that gold continued beyond the limits of the stream-worked gravel and into the soil and saprolite that mantled the adjacent slopes. This material, which remains in its place of origin except as it may be slowly shifted by hill creep, is a residual product of rock weathering. Although in some places alluvium and saprolite grade into each other, their boundaries are usually distinct. Between residual placers and the lodes from which they were derived, on the other hand, there is commonly no very definite separation, and whether a given deposit should be called a lode or a placer may depend on the method by which it is worked.

Perhaps the most convenient and useful classification of the gold-bearing lodes in the Piedmont region is based on differences in their general form and relation to the country rock. Some of the lodes have the distinct boundaries and tabular forms implied by the term "veins." Others have indefinite limits and less regular forms, and these, for want of a better term, may be called "mineralized zones." The mineralized zones can be further subdivided into stringer leads and indefinite bodies, both of which are generally of irregular form.

LODE DEPOSITS

GENERAL FEATURES

The veins and mineralized zones have many features in common. Lodes of either class may trend either northeastward or northwestward. In both classes all the lodes are gold-bearing, most of them contain pyrite, many contain small quantities of other sulfides, and several have been mined for copper, silver, lead, and zinc.

One feature common to many lodes is the rifting of the schist walls and the formation of quartz layers between schist layers. The schist layers may be partly replaced, leaving thin sheets of chlorite and sericite schist oriented parallel to the walls. This structure is exemplified at the Franklin mine in Virginia (see figs. 2 and 3). More rarely the ores contain irregular layers of amphibole or garnet. Horses of country rock are commonly included in the lodes; they are generally silicified, but their contacts with the lodes are either gradational or sharp. In many lodes there is a narrow conspicuous border of ankerite between the quartz and the sericite schist.

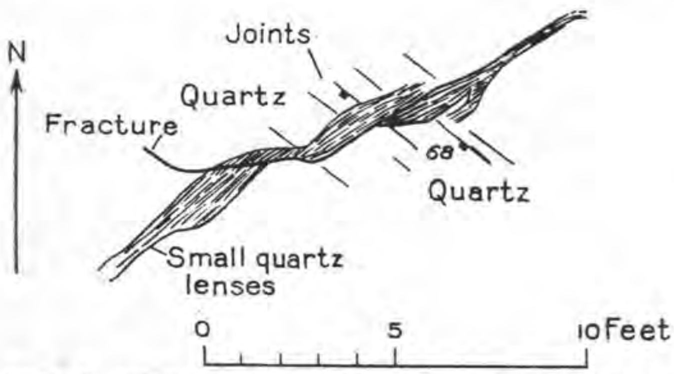


FIGURE 2.—Detailed sketch of a band of sericite schist in quartz and plan of stope above 50-foot level, Franklin mine, Fauquier County, Va.

The lodes are generally fractured, but the displacements usually amount to only a few feet and are of minor economic significance. Brecciation and offset of gold-bearing quartz by cross breaks were seen at the Melville mine in Virginia and at the Battle Branch mine in Georgia. Both normal and reverse faults are found, the reverse faults being apparently the more common. At the Vaucluse and Franklin mines, in Virginia, post-ore movement approximately parallel to the schistosity has taken place in the lodes, as a result of which the ore is broken, fragments of it are rolled, and grains of pyrite are smoothed and polished.

Throughout the Southern Piedmont region the form of the lodes is largely determined by the physical properties of the enclosing rocks. The stronger lodes—that is, the better-defined veins and the larger replacement bodies—are in or near the harder and more brittle rocks, a fact commented on by Taber in his discussion of the James River Basin of Virginia.[81] Conversely, the more diffuse lode deposits are generally in the more schistose rocks, which yield, under stress, more readily by bending and slipping than by fracturing. Exceptions may be explained by the fact that in some deposits originally weak, schistose rocks were probably made brittle by silicification before the metallic minerals were deposited. Such a relationship is suggested in several of the deposits in Virginia.

The lodes are generally not far from granitic intrusive bodies, several authors have concluded that the ores were derived from the granitic magmas.[82] At some places, such as the Haile and Brewer mines in South Carolina, the deposits are in schistose rocks near the borders of granitic masses (pl. 32). Some deposits in northern Georgia and Alabama lie within irregular bodies of granite or gneiss. Lodes are absent from a large part of the slate belt in eastern Union County and southern Stanly County, N. C., in which the rocks show little or no evidence of alteration by intrusive magmas. In the Carolinas, most of the lodes are either within or near granitic masses or in slates or schists that, though distant from exposures of intrusive masses, show metamorphism suggesting that they may be underlain by intrusive rocks. On the other hand, the Vaucluse deposit, in Virginia, and some others are

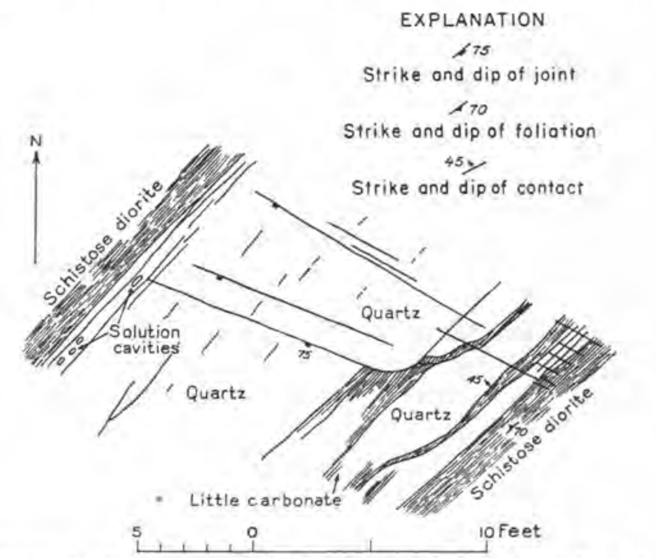


FIGURE 3.—Sketch across Franklin lode, 120 feet northeast from the shaft, Franklin mine, Fauquier County, Va. Shows relation between quartz and schistose diorite.

[81] Taber, Stephen, Geology of the Gold Belt of the James River Basin, Va.: Virginia Geol. Survey Bull 7, p. 231, 1913.

[82] Graton, L. C., Reconnaissance of some gold and tin deposits of the southern Appalachians: U. S. Geol. Survey Bull. 293, p. 69, 1906. Lindgren, Waldemar, the gold deposits of Dahlonega, Ga., in U. S. Geol. Survey Bull. 293, p. 125, 1906. Taber, Stephen, Geology of the gold belt of the James River Basin, Va.: Virginia Geol. Survey Bull. 7, pp. 216–221, 1913. Laney, B. F., The geology and ore deposits of the Virgilina district of Virginia and North Carolina: Virginia Geol. Survey Bull. 14, p. 91, 1917; The Gold Hill Mining district, North Carolina; North Carolina Geol. and Econ. Survey Bull. 21, p. 98, 1910. Adams, G. I., Gold deposits of Alabama: Alabama Geol. Survey Bull. 40, p. 52, 1930.

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in areas in which no granitic rocks have been found; these deposits, so far as field evidence shows, are merely associated with zones of regional shearing. Many granitic areas, moreover, do not contain lodes. The ores and the granitic intrusives may however have come from the same sources.

Gradation of the lodes into pegmatite dikes was observed by Taber[83] in the James River Basin, and Laney[84] states that in the Gold Hill district of North Carolina, "the barren portions of a few veins strongly resemble pegmatites, consisting for the most part of quartz and pink feldspar." Jones[85] says "at certain localities auriferous veins are closely associated with, and in some cases appear to grade into, pegmatite dikes." At the Franklin mine and Brown prospect, in Alabama, some of the quartz stringers grade into veinlets that resemble pegmatite dikes, for, in addition to quartz, they contain coarse biotite and muscovite, and white clay that may have been formed by the weathering of feldspars. The lodes that grade into or resemble pegmatite dikes are not numerous, however, and represent the exception rather than the rule. They were probably formed at somewhat higher temperatures and pressures than most of the deposits.

At the White County mine, in Georgia, a pegmatitic facies of the granite locally seems to grade into larger, finer-grained masses, which in some places are cut by mineralized quartz stringers; but elsewhere in this vicinity, as previously noted by Nitze and Wilkins,[86] the pegmatitic dikes cut the mineralized bands (fig. 40). This locality is the only one seen by the writers of this report in which mineralized quartz bodies are definitely cut by granitic intrusives.

VEINS

Veins are most numerous in granite or granitic gneiss (pl. 6, *B*), where they outnumber the mineralized zones. The veins in these rocks include those that trend northwest and some of those that trend northeast. They range from mere stringers to bodies 2,000 feet or more in length and as much as 20 feet in greatest thickness, but long, continuous, well-defined veins are generally rare except in certain areas of granite, such as those in Mecklenburg County, N. C. In texture the veins are generally so coarse that their minerals can be identified without microscopic aid, and garnet, pyrite, and carbonate grains an inch or more across are not uncommon.

Many of the veins show evidence of postmineral movement, although in some the movement was negligible. At the Franklin mine, in Virginia, much of the vein material is loose and porous; locally there are nodules of quartz that appear to have been rolled and partly recrystallized, some pyrite crystals are smoothed and polished, and some of the quartz has a "mortar structure," moderate-sized fragments of quartz being embedded in a groundmass of fine-grained recrystallized quartz.

Thin curved lenses, sheets, partings, and irregular inclusions of sericite schist are common in many of the veins. They are generally oriented nearly parallel to the planes of schistosity in the wall rock, and in many places they fade into the quartz (figs. 2, 3, and pl. 8, *A*).

Crustified vein material from the Moore mine, Union County, N. C., was illustrated by Nitze and Hanna,[87] but during the recent investigation textures or structures that indicate open-fissure filling were rarely seen.

Many lodes are classified as veins even though they split and in places form disconnected lenses. Such lodes are exemplified at Hog Mountain, Ala. There the quartz is bounded in places by seams coated with chlorite or sericite, but near premineral shear-zone crossings it fades irregularly into the wall rock.

BARREN QUARTZ VEINS

Veins of coarse-grained barren white quartz, locally called bull quartz, are common throughout the gold-bearing region. They range from stringers to bodies 20 feet or more in thickness and hundreds of feet long. Many are exposed in road cuts, and some have been quarried extensively for road metal or concrete aggregate (pl. 8, *B*). Their disintegration during the general weathering and erosion of the region has produced a large part of the rubble of "flint rock" fragments that clutters many fields.

In some of the mines, veins of bull quartz cut across the lode quartz, but at many places where the two varieties are exposed close together their relations are not shown. As a rule the bull-quartz veins consist almost entirely of coarse-grained white quartz. Some are locally stained with iron oxide, a few enclose stray crystals of pyrite, and one, exposed in the tanyard pit at the Brewer mine, in South Carolina, contains coarse plates of ilmenite intergrown with the quartz.

MINERALIZED ZONES

The mineralized zones consist of quartz, sericite, chlorite, and small amounts of other minerals, arranged in and along zones of shearing. Two intergrading classes of mineralized zones are recognized, namely (1) stringer leads and other lodes in which the boundaries between quartz and country rock, though irregular, are sharply

[83] Taber, Stephen, Geology of the gold belt of the James River Basin, Virginia: Virginia Geol. Survey Bull. 7, pp. 217–219, 1913.

[84] Laney, F. B., The Gold Hill mining district of North Carolina: North Carolina Geol. Survey Bull. 21, p. 98, 1910.

[85] Jones, S. P., Second report on the gold deposits of Georgia: Georgia Geol. Survey Bull. 19, pp. 50–51, 1909.

[86] Nitze, H. B. C., and Wilkens, H. A. J., Gold mining in North Carolina and adjacent south Appalachian regions: North Carolina Geol. Survey Bull. 10, p. 22, 1897.

[87] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, fig. 1, p. 50, 1896.

defined, and (2) indefinite bodies in which the quartz fades gradually into the country rock. The character of the quartz in the mineralized zones varies considerably: At the Haile mine, in South Carolina, the quartz is dense, fine grained, and light gray; at the Vaucluse mine, in Virginia, it is milky white and somewhat glassy; at the Battle Branch mine, in Georgia, it is coarse, granular, and of a watery light-gray color; and at the Howie mine, in North Carolina, it is dense, fine-grained, and dark bluish-gray. In quartz of all these kinds irregular remnants and shadows of country rock are common and many structures inherited from the country rock can be seen; such features are shown by ore from the Howie mine (pl. 9, *A*).

Stringers of white, vitreous, barren quartz, similar to that described above under "Barren quartz veins" are widely distributed in the mineralized zones.

WELL-DEFINED IRREGULAR BODIES

The well-defined irregular bodies consist of many unconnected lenses, stringers, and irregular masses of quartz erratically distributed along shear zones. Lenses in steplike arrangement but apparently with no regular direction of offset are common. Many of the larger quartz masses pass on all sides, within a few feet, into a few small silicified bands and stringers. In some deposits the abruptness of this change is striking. Bastin [88] cites an example at the Gold Log mine, in Alabama. There at the bottom of a 320-foot incline, was an exposure 5 feet wide of material that was about two-thirds quartz, but only 6 feet away along the strike nearly all the quartz had pinched out and the face consisted almost entirely of sericite schist. Many other similar examples might be given. Figure 4 shows three notebook sketches of the lode at the Laird prospect in Virginia,[89] and similar excellent illustrations of discontinuous lenses at the Young American mine, also in Virginia, are given by Taber.[90]

Where the wall rocks are schistose as is usually the case, the quartz tends to follow the strike of the schist in general, but here and there it crosscuts the foliation planes (see pl. 10). Near the quartz the schist is generally sericitized, and in some places it is also silicified. The sericite schist grades laterally into chloritic schist, and that in turn grades into typical country rock. As in the other lode deposits, schist partings and irregular remnants and shadows of schist are common in the quartz, and fragments of partly altered country rock are found in the sericitized and silicified schist. As stated on p. 47, the constituents of the rocks adjoining some of the lodes, particularly in north Georgia and Alabama, become coarser near the lodes, so that sharp boundaries between country rock and lode material cannot be drawn. In some of the deposits, particularly in northern Georgia—for example at the Lockhart mine—the ores are rudely banded (see pl. 9, *B*).

"Stringer leads" (or "lodes") is a term introduced by Becker [91] to apply to a system of "many associated small fissures, each bearing lenticular quartz masses." In the stringer leads the elongate lenses are in general parallel to the trend of the enclosing schist, although individual stringers can usually be found that break across the foliation. In many deposits, such as those at the White County and Cherokee mines, in Georgia, the alternating stringers of quartz and sericite schist are so closely spaced as to give the exposures a ribbonlike appearance (pl. 9, *C*). Generally the wall rock is sericitized and grades, away from the lode, into chloritic schist, and the sericite schist within the lodes is usually silicified. In some places the stringer leads coalesce and form large workable bodies; the Findley Ridge deposits of northern Georgia belong in this category. In many places, however, the stringers remain separate or become discontinuous and the quartz bodies are erratic in shape and distribution. Deposits such as that in the Shuford mine, in Catawba County, N. C., in which irregular veinlets of gold-bearing quartz are described as cutting the schist in all directions, may be classifiable as stringer leads.

INDEFINITE BODIES

The indefinitely bounded bodies consist of silicified and otherwise intensely altered rock that grades into less altered rock, the limits of the ore being commonly determined by assay. Although they appear to have been formed along sheared zones, these deposits are generally in massive brittle rock, or in schistose rock made brittle by premineral silicification. The largest known deposits of this type, at the Haile and Brewer mines in South Carolina, are both in tuffs that are but slightly foliated.

Deposits of this class are exceedingly fine grained, and their chief constituents are quartz and sericite. The texture of the lode rock might be described as flinty. The pyrite and other sulfides may be perhaps a little coarser grained than the quartz, though few individual grains are larger than a pinhead. Crystals of enargite as much as an inch or so in length were noted at the Brewer mine, and a few crystal-lined vugs were seen at the Haile mine. Textures and structures of the original rock are abundantly preserved in the lodes and, as in other types of deposits, remnants of partly replaced country rock are found.

[88] Bastin, E. S., The Gold Log mine, Talladega County, Ala.: U. S. Geol. Survey Bull. 640, p. 161, 1916.

[89] Sketches by mine engineer A. L. Fentress, unpublished data.

[90] Taber, Stephen, op. cit. Figures 6, 7, 8, 9, and 11 are especially noteworthy.

[91] Becker, G. F., A reconnaissance of the gold fields of the Southern Appalachians: U. S. Geol. Survey 16th Ann. Rept., pt. 3, pp. 282–283, 1895.

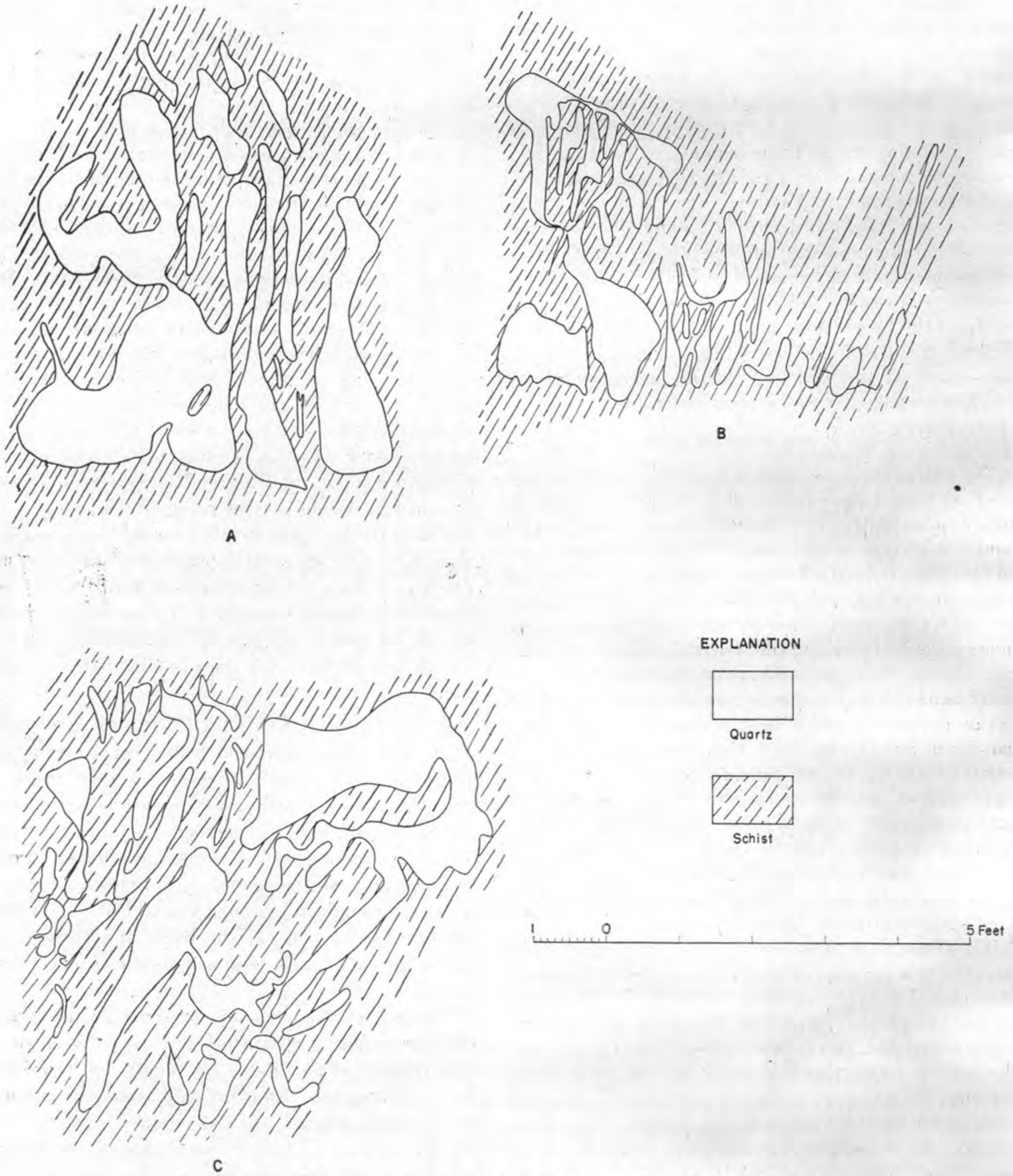


FIGURE 4.—Types of quartz bodies (sections), Laird prospect, Va. After A. L. Fentress.

MINERALOGY

In general the mineralogy of the Southern Appalachian gold deposits is simple; some small areas, however, contain unusual minerals, and the complete list of minerals is long. A few of the minerals are common in all parts of the region. The gangue minerals are quartz, muscovite (sericite), biotite, carbonates (ankerite, calcite) and chlorite, but locally include garnet, amphiboles, and tourmaline. The chief ore minerals are pyrite, pyrrhotite, and gold. Chalcopyrite, galena, sphalerite, and arsenopyrite are minor constituents of many of the deposits and are abundant in a few.

The minerals of the gold belt and their localities are listed in the following table. The minerals are listed, and later described, in the order adopted by Dana. Many of the minerals collected during the present survey were identified by either W. T. Schaller, J. J. Fahey, or Jewell J. Glass of the Geological Survey.

Tabular summary of minerals of the gold belt and their localities

[Asterisks indicate mines seen by writers]

Mineral	Mine	County	State	Original authority
Sulfur, S	Birdsone pits*	Tallapoosa	Alabama	This report.
	Brewer*	Chesterfield	South Carolina	Do.
	Brown	York	do	Graton, 1906.
	Dutch Bend *	Tallapoosa	Alabama	This report.
	Haile	Lancaster	South Carolina	Do.
	Hog Mountain*	Tallapoosa	Alabama	Do.
	Jones pits*	do	do	Do.
Tellurium (?), Te	Morrow	Buckingham	Virginia	Henwood, 1817.
	Tellurium	Goochland	do	Credner, 1868.
Gold, Au	All mines			
Silver (native), Ag	Silver Hill	Davidson	North Carolina	Genth, 1875.
	Virgilina district		North Carolina and Virginia	Laney, 1917.
Copper (native), Cu	Nott	Union	South Carolina	Graton, 1906.
	Orange Grove	Orange	Virginia	Rept. Orange Grove M. C. 1847.
	Virgilina district		North Carolina and Virginia	Laney, 1917.
Bismuthinite, Bi_2S_3	Gold Hill	Rowan	North Carolina	Genth, 1853.
Tetradymite, $Bi_2(Te,S)_3$	Allen	Davidson	do	Genth, 1891.
	Asbury	Gaston	do	Do.
	Battle Branch*	Lumpkin	Georgia	This report.
	Beck	Davidson	North Carolina	Genth, 1875.
	Boger	Cabarrus	do	Do.
	Cullen	do	do	Do.
	Drake	Polk	do	Little, 1874.
	Field	Lumpkin	Georgia	Shepard, 1859.
	Gold Hill	Rowan	North Carolina	Shepard, 1853.
	J. C. Mills	Burke	do	Genth 1875.
	Kirksey	McDowell	do	Do.
	Pheonix	Cabarrus	do	Do.
	Tellurium	Fluvanna	Virginia	Do.
Molybdenite, MoS_2	Franklin*	Fauquier	do	This report.
	Haile	Lancaster	South Carolina	Graton, 1906.
	Pioneer Mills	Mecklenburg	North Carolina	Genth, 1875.
	Vaucluse*	Orange	Virginia	This report.
Galena, PbS	In small amount at many properties. Abundant at Battle Branch.	Lumpkin	Georgia	Do.
Argentite, Ag_2S	Blue Wing	Granville	North Carolina	Laney, 1917.
	Durgy	Person	do	Do.
	Reynolds	Montgomery	do	Emmons (?).
	Silver Hill	Davison	do	Genth, 1875.
Altaite, PbTe	Kings Mountain	Gaston	do	Do.
Chalcocite, Cu_2S	Buckingham	Buckingham	Virginia	Henwood, 1871.
	Cid	Davidson	North Carolina	Pogue, 1910.
	Franklin *	Fauquier	Virginia	This report.
	Gold Hill	Rowan	North Carolina	Laney, 1910.
	London and Virginia	Buckingham	Virginia	Henwood, 1871.
	Phoenix *	Guilford	North Carolina	Dickeson, 1860.
	Pioneer Mills	Cabarrus	do	Genth, 1891.
	Silver Hill	Davidson	do	Do.
	Virgilina district (all mines)		Virginia and North Carolina.	Laney, 1917.
Sphalerite, ZnS	Common in many mines. Rare or absent in northern Georgia.			
Covellite, CuS	Brewer	Chesterfield	South Carolina	Becker, 1895.
Pyrrhotite, Fe_7S_8	In small quantities in many mines. Common in Alabama and North Georgia.			
Bornite, Cu_5FeS_4	Gold Hill	Rowan	North Carolina	Laney, 1910.
	Virgilina district		Virginia and North Carolina.	Laney, 1917
Chalcopyrite, $CuFeS_2$	In small amount at most properties.			
	Abundant at:			
	Cornfield No. 2	Granville	North Carolina	Laney, 1917.
	Gold Hill	Rowan	do	Laney, 1910.
	Pontiac	Halifax	Virginia	Laney, 1917.
Pyrite, FeS_2	All mines. Rare at Hog Mountain	Tallapoosa	Alabama	This report.
Marcasite, FeS_2	Common in many mines below the water level.			
Leucopyrite, Fe_3As_4	Asbury	Gaston	North Carolina	Genth, 1875.
Arsenopyrite, FeAsS	Widely distributed*			
	Abundant at Cragford, Ala.*			
Sylvanite, (Au, Ag)Te_2	Reynolds	Montgomery	do	Emmons, 1856.
Nagyagite	Carter	do	do	Do.
Sulfo-telluride of lead and gold	Kings Mountain	Gaston	do	Devereaux, 1881.
Klaprothite (?), $3Cu_2S.2Bi_2S_3$	Virgilina district		Virginia and North Carolina.	Laney, 1917.
Tetrahedrite, $3Cu_2S.Sb_2S_3$, or tennantite, $3Cu_2S.As_2S_3$.	Eldridge	Buckingham	Virginia	Genth, 1855.
	Kings Mountain	Gaston	North Carolina	Devereaux, 1881.
	Ludwick	Cabarrus	do	Dana, 1892.
	McMakin	do	do	Genth, 1853.
Enargite, $3Cu_2S.As_2S_5$	Brewer*	Chesterfield	South Carolina	Lieber, 1856.
Fluorite, CaF_2	Kings Mountain	Gastop	North Carolina	Devereaux, 1881.
Quartz, SiO_2	All mines			
Bismite, Bi_2O_3	Asbury	do	do	Genth, 1891.
	Brewer	Chesterfield	South Carolina	Tuomey, 1848.
	Kings Mountain	Gaston	North Carolina	Genth, 1875.
Cuprite, Cu_2O	Hodges Hill	Rowan	do	Emmons, 1856.
	McGinn	Mecklenburg	do	Genth, 1891.
	Silver Hill	Davidson	do	Pogue, 1910.
	Virgilina district		North Carolina and Virginia.	Laney, 1917.
Tenorite, CuO	Silver Hill	do	North Carolina	Pogue, 1910.
Melaconite, CuO	Gillis	Person	do	Laney, 1917.
	Gold Hill	Rowan	do	Shepard, 1853.
	McGinn	Mecklenburg	do	Genth, 1875.
	Silver Hill	Davidson	do	Do.
Hematite, Fe_2O_3	Conrad Hill	do	do	Pogue, 1910.
	Dunn	Mecklenburg	do	Emmons, 1856.
	Virgilina district*		North Carolina and Virginia.	Laney, 1917

Tabular summary of minerals of the gold belt and their localities—Continued

Mineral	Mine	County	State	Original authority
Ilmenite, $FeTiO_3$	Battle Branch*	Lumpkin	Georgia	This report.
	Capps*	do	do	Do.
	Ferguson	York	South Carolina	Graton, 1906.
	Field	Lumpkin	Georgia	Shepard, 1859.
	Fisher Hill	Guilford	North Carolina	Genth, 1891.
	Franco-American*	White	Georgia	This report.
	Hog Mountain*	Tallapoosa	Alabama	Do.
	Ivy*	Lumpkin	Georgia	Do.
	Lockhart*	do	do	Do.
	Scotia	Fluvanna	Virginia	Taber, 1913.
	Standard	Lumpkin	Georgia	Lindgren, 1906.
	Young American	Goochland	Virginia	Taber, 1913.
Leucoxene, iron-titanium oxide	do	do	do	Do.
Gahnite, $ZnAl_2O_4$	Standard	Lumpkin	Georgia	Lindgren, 1906.
Magnetite, Fe_3O_4	Battle Branch*	do	do	This report.
	Benning	do	do	Lindgren, 1906.
	Bertha and Edith	Goochland	Virginia	Taber, 1913.
	Bowles	Goochland and Fluvanna	do	Do.
	Findley*	Lumpkin	Georgia	This report.
	Gold Hill	Rowan	North Carolina	Shepard, 1853.
	Lockhart*	Lumpkin	Georgia	This report.
	Young American	Goochland	Virginia	Taber, 1913.
Cassiterite, SnO_2	Brewer	Chesterfield	South Carolina	Chatard, 1895.
Rutile, TiO_2	Blackman*	Lancaster	South Carolina	This report.
	Haile*	do	do	Graton, 1906.
Hydrous iron oxides (limonite)	All mines			
Hydrous manganese oxides	Common in oxidized ores			
Calcite, $CaCO_3$	Common mineral in many deposits			
Ankerite, $CaCO_3$ (Mg, Fe, Mn) CO_3	Battle Branch*	Lumpkin	Georgia	This report.
	Capps*	do	do	Do.
	Franklin*	Fauquier	Virginia	Do.
	Ivy*	Lumpkin	Georgia	Do.
	Lockhart*	do	do	Do.
	Melville*	Orange	Virginia	Do.
	Vaucluse*	do	do	Do.
Siderite, $FeCO_3$	Barlow	Lumpkin	Georgia	Becker, 1895.
	Conrad Hill	Davidson	North Carolina	Genth, 1891.
	Cross	do	do	Pogue, 1910.
	Field	Lumpkin	Georgia	Credner, 1867.
	Flowe	Mecklenburg	North Carolina	Genth, 1859.
	Haile	Lancaster	South Carolina	Graton, 1906.
	Hodges Hill	Rowan	North Carolina	Emmons, 1856.
	Moore	Union	do	Becker, 1895.
	Peters	Davidson	do	Pogue, 1910.
	Phoenix	Cabarrus	do	Becker, 1895.
	Rudisil	Mecklenburg	do	Do.
	Silver Valley	Davidson	do	Do.
Rhodochrosite, $MnCO_3$	Flowe	Mecklenburg	do	Booth and Garrett, 1866.
Cerusite, $PbCO_3$	Battle Branch*	Lumpkin	Georgia	This report.
	Silver Hill	Davidson	North Carolina	Pogue, 1910.
Malachite, $CuCO_3.Cu(OH)_2$	Cid district	do	do	Do.
	Virgilina district		North Carolina and Virginia	Laney, 1917.
Azurite, $2CuCO_3.Cu(OH)_2$	Holloway	Granville	North Carolina	Do.
	Pontiac	Halifax	Virginia	Do.
Bismutite, $Bi_2O_3.CO_2H_2O$	Asbury	Gaston	North Carolina	Genth, 1891.
Feldspar silicates of potassium, sodium, calcium, and aluminum.	Common in many mines. Abundant in James River Basin, Va. (Taber 1913).			
Hornblende complex silicate	Found in many deposits. Abundant in northern Georgia.			
Actinolite calcium-magnesium-iron silicate.	London and Virginia	Buckingham	Virginia	Partz, 1854.
	Parish	Randolph	North Carolina	Becker, 1893.
	Silver Hill	Davidson	do	Pogue, 1910.
Garnet complex orthosilicate	Found in many deposits. Abundant in northern Georgia and in Alabama.			
Topaz, $(AlF)_2SiO_4$	Brewer*	Chesterfield	South Carolina	This report.
Kyanite, Al_2SiO_5	Battle Branch*	Lumpkin	Georgia	Do.
	Moss*	Goochland	Virginia	Do.
	Young American	do	do	Taber, 1913.
Zoisite, $HCa_2Al_3Si_3O_{13}$	Battle Branch*	Lumpkin	Georgia	This report.
	Silver Hill	Davidson	North Carolina	Pogue, 1910.
Epidote, $HCa_2(Al, Fe)_3 Si_3O_{13}$	Franklin*	Fauquier	Virginia	This report.
	Kings Mountain	Gaston	North Carolina	Graton, 1906.
	Moore	Union	do	Becker, 1895.
	Schlegelmilch	York	South Carolina	Graton, 1906.
	Valley River	Cherokee	North Carolina	Becker, 1895.
	Virgilina district		North Carolina and Virginia	Laney, 1917.
Allanite, cerium, epidote	Chestatee River 301*	Lumpkin	Georgia	Shepard, 1859.
		Cherokee	do	This report.
Calamine, H_2ZnSiO_5	Silver Hill	Davidson	North Carolina	Pogue, 1910.
Tourmaline, complex silicate of boron and aluminum.	Battle Branch*	Lumpkin	Georgia	This report.
	Bowles	Goochland and Fluvanna	Virginia	Taber, 1913.
	Calhoun	Pickens	South Carolina	Tuomey, 1848
	Dutch Bend*	Tallapoosa	Alabama	This report.
	Hedwig	Lumpkin	Georgia	Becker, 1895.
	Hog Mountain*	Tallapoosa	Alabama	This report.
	Kin Mori*	Dawson	Georgia	Do.
	King*	Cleburne	Alabama	Do.
	Moss	Goochland	Virginia	Taber, 1913.
	Topabri*	Lumpkin	Georgia	This report.
	United States	Spottsylvania	Virginia	Maury, 1837.
	Young American	Goochland	do	Taber, 1913.
Staurolite, $HFeAl_5Si_2O_{13}$	Battle Branch*	Lumpkin	Georgia	This report.
Muscovite (sericite), (H, K) $AlSiO_4$	Common in nearly all mines			
Chrome mica, chromium-bearing muscovite.	Battle Branch*	Lumpkin	Georgia	Do.
	Topabri*	do	do	Do.
	Vaucluse*	Orange	Virginia	Do.
Biotite, $H_2K(Mg, Fe)_3 Al (SiO_4)_3$	Abundant in many deposits			
Chlorite, magnesium-aluminum silicate	Nearly all mines			
Talc, $H_2Mg_3 (SiO_3)_4$	Emmons	Davidson	North Carolina	Pogue, 1910.
	Peters	do	do	Do.
Pyrophyllite, $H_2Al_2(SiO_3)_4$	Brewer*	Chesterfield	South Carolina	Graton, 1906.

Tabular summary of minerals of the gold belt and their localities—Continued

Mineral	Mine	County	State	Original authority
Chrysocolla, $CuSiO_3.2H_2O$	Barlow*	Lumpkin	Georgia	This report.
	Gardner Hill	Guilford	North Carolina	Genth, 1891.
	Gillis	Person	do	Laney, 1917.
	Pioneer Mills	Cabarrus	do	Genth, 1891.
Sphene, $CaTiSiO_5$	Steele	Montgomery	do	Genth, 1859.
Apatite, $(CaCl)Ca_4(PO_4)_3$	Battle Branch*	Lumpkin	Georgia	This report.
	Ferguson	York	South Carolina	Graton, 1906.
	Haile	Lancaster	do	Do.
Pyromorphite, $(PbCl)Pb_4(PO_4)_3$	Battle Branch*	Lumpkin	Georgia	This report.
	Buckingham	Buckingham	Virginia	Henwood, 1871.
	Dorne	Abbeville	South Carolina	Dana, 1892.
	London and Virginia	Buckingham	Virginia	Henwood, 1871.
	Moss*	Goochland	do	This report.
	Parsons Mountain	Abbeville	South Carolina	Toumey, 1848.
	Silver Hill	Davidson	North Carolina	Genth, 1875.
	Silver Valley	do	do	Do.
	Singleton	Lumpkin	Georgia	Yeates, 1896.
	Snead	Fluvanna	Virginia	Credner, 1869.
	Stewart	Union	North Carolina	Genth, 1875.
	United States	Spottsylvania	Virginia	Maury, 1837.
	Vein Mountain	McDowell	North Carolina	Becker, 1895.
Vanadinite, $(PbCl)Pb_4(VO_4)_3$	Moss*	Goochland	Virginia	This report.
	United States	Spottsylvania	do	Maury, 1837.
Scorodite, $FeAsO_4.2H_2O$	Cragford district*	Randolph and Clay	Alabama	This report.
	Ludwick	Cabarrus	North Carolina	Dana, 1892.
Wavellite, $4AlPO_4.2Al(OH)_3 9H_2O$	Silver Hill	Davidson	do	Genth, 1875.
Barite, $BaSO_4$	Flowe	Mecklenburg	do	Genth, 1859.
	Lincoln	Lincoln	do	Jackson, 1854.
	London and Virginia (?)	Buckingham	Virginia	Partz, 1854.
	Phoenix	Cabarrus	North Carolina	Emmons, 1856.
	Rocky River	do	do	Darlington, 1894.
	Tucker	do	do	Kerr and Hanna, 1887.
Anglesite, $PbSO_4$	Silver Hill	Davidson	do	Genth, 1875.
Linarite, $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$	do	do	do	Pogue, 1910.
Selenite(?), $CaSO_4.2H_2O$	London and Virginia	Buckingham	Virginia	Henwood, 1871.
Goslarite, $ZnSO_4.7H_2O$	Silver Hill	Davidson	North Carolina	Pogue, 1910.
Wolframite, $(Fe,Mn)WO_4$	Flowe	Mecklenburg	do	Genth, 1859.
Scheelite, $CaWO_4$	Bangle	Cabarrus	do	Do.
	Cullen	do	do	Dana, 1892.
	Flowe	Mecklenberg	do	Genth, 1859.
	Gold Hill	Rowan	do	Shepard, 1853.
Stolzite, $PbWO_4$	Silver Hill	Davidson	do	Genth, 1891.

LODE MINERALS

Sulfur was reported by Graton (1906) in the oxidized ores of the Brown mine, in South Carolina, and it was seen by the writers in the Haile and Brewer pits. Sulfur is also a fairly common constituent of the oxidized ores at Hog Mountain and at several properties along the Goldville belt, in Alabama, where it has been formed by decomposition of sulfides, especially pyrrhotite.

Gold is the most valuable constituent of the lodes throughout the Piedmont region except in the silver-lead-zinc deposits of the Cid or Silver Hill district, in North Carolina, and perhaps in a few ore bodies elsewhere that are rich in copper. In 1935 it was the only metal being recovered. Most of it is bright yellow, but in a few places it is alloyed with enough silver to be pale-yellow, and bright-red gold, which owes its color to a thin coating of red iron-oxide, is found in a few places.

The gold from different mines ranges in fineness from about 750 to about 950 parts per thousand, but is commonly between 850 and 900. Eldridge [92] quoted T. R. Lombard, a former operator at the Battle Branch mine, Ga., as saying that, "In the pockets of the upper part of the mine the upper parts of the lenses were the richest, both in quantity and quality." Gold near the surface is generally finer than that obtained in depth. Specimens collected from the upper workings of the Battle Branch mine, in Georgia, had a fineness of 908.9; specimens from the 173-foot level were only 742.8 [93] fine but according to mint returns most of the gold from this level is finer. Becker [94] states that some of the gold at the Davis mine, in Union County, N. C., is only 450 fine.

Below the weathered layers part of the gold is in free metallic particles and part is apparently locked within the sulfides. Grains and masses of metallic gold weighing from a fraction of a pennyweight to several pounds have been found in the weathered zone, and a few such masses of free gold have been found below the zone of oxidation. Throughout the lodes much of the gold forms minute grains and flakes locally called "flour gold"—a term used by mine operators to indicate both its fine subdivision and its tendency to float and thus escape recovery when the ore is washed. *A* and *B*, plate 11, show finely divided gold in peculiar graphic or wormy (myrmekitic) patterns in quartz from the Battle Branch mine, Georgia. At this mine, however, and at a few others, most of the ore mined has contained coarse gold, readily visible in hand specimens.

The gold is usually the last ore mineral deposited, possibly excepting galena. It is found in fractures that cut through other minerals, in cleavage cracks, around grain boundaries, and in small blebs within other minerals. At the Howie mine, in North Carolina, minute particles of gold tend to occur in thin seams, together

[92] Eldridge, G. H., Field notes on file at U. S. Geol. Survey, 1879.

[93] Fineness determined by E. T. Erickson, U. S. Geol. Survey.

[94] Becker, G. F., op. cit., p. 268.

with equally fine-grained shreds and particles of sericite, chlorite, and biotite that represent former rock structures. When the rock is split along these seams, the surfaces exposed generally show a glistening, somewhat greasy lustre, and specks of gold may be abundant enough in places to give these surfaces a yellow sheen. At the Haile mine, in South Carolina, gold flakes seem to have a particular affinity for local patches of molybdenite; at the Hog Mountain mine, in Alabama, the gold is generally in pyrrhotite; at the Battle Branch mine, in Georgia, it is closely associated with galena and ankerite. In many deposits the gold is enclosed in pyrite, which when concentrated may contain 1 to 3 ounces of gold to the ton. The unweathered ore at the Iola mine, in North Carolina, consisted essentially of gold in quartz, and at a few other mines, such as the Howie and Crayton, in North Carolina, sulfides are rarely found. Tetradymite and other tellurides have been reported as occurring in very small quantity at many properties throughout the region.

Sphalerite and silver-bearing galena constitute workable ore bodies in the Silver Hill district of North Carolina, and small quantities of them occur in some other mines, such as the Dorn mine of South Carolina. In some lodes, considerable gold is associated with these minerals just below the weathered zone. In northern Georgia, sphalerite is rare but galena is widely distributed and is a common associate of the gold.

Chalcocite is widespread but nowhere abundant. It has been formed by the action of descending ground water on chalcopyrite or other copper-bearing minerals.

Pyrrhotite is particularly abundant in the mines of northern Georgia and of Alabama. At Hog Mountain and Dutch Bend mines, in Alabama it is by far the most common sulfide in the ore, pyrite being scarce or absent. Pyrrhotite is one of the most abundant minerals in the ores at the Lockhart and Battle Branch properties, in Georgia. In South Carolina, North Carolina, and Virginia pyrrhotite is comparatively rare, but it has been reported from several mines in those States, and a little was seen by the writers in polished specimens of ore from the Melville and Vaucluse properties in Virginia.

Chalcopyrite is almost as widespread in the region as pyrite but is generally much less abundant. At the Haile mine in South Carolina, the Iola mine in North Carolina, and a few others, it is rare or absent. It is particularly abundant in several lodes that lie in a belt extending from Mecklenburg County, N. C., northeastward into Randolph and Guilford Counties. Bornite, chalcocite, and chalcopyrite occur in the Virgilina district of Virginia and North Carolina. In all these localities the copper-bearing sulfides are comparatively poor in gold.

Pyrite is the most widespread and abundant sulfide in the ores, and in many mines it is so closely associated with the gold that a concentrate of pyrite will contain most of the gold. Most of the pyrite is in small crystals, disseminated through the quartz or through the mineralized schist adjacent to quartz bodies. Large crystals an inch or more in length have been seen by the writers, and in a few places larger pockets and irregularly shaped nodules have been found. Small well-formed crystals are widely distributed in the chloritic wall rocks of many of the deposits; these crystals generally contain little or no gold. At the Melville mine in Virginia, layers of tiny pyrite crystals, probably formed by circulating ground waters, fill thin cracks. These crystals are so small that a mass of them has a greenish-black color.

Marcasite is common below water level, where it forms thin layers in the country rock and fills cracks in the lodes. It was probably deposited by circulating ground water.

Arsenopyrite is a constituent of many deposits in the Piedmont region. In most places it is rare, but a deposit near Cragford, Ala., contained so much that it was a source of arsenic during World War I.[95] Crystals about 1½ inches long have been seen in ore from the Etowah mine, in Georgia.

Antimony and arsenic minerals, other than arsenopyrite, are rare; a little enargite is found at the Brewer mine, and tetrahedrite-tennantite has been reported from several properties.

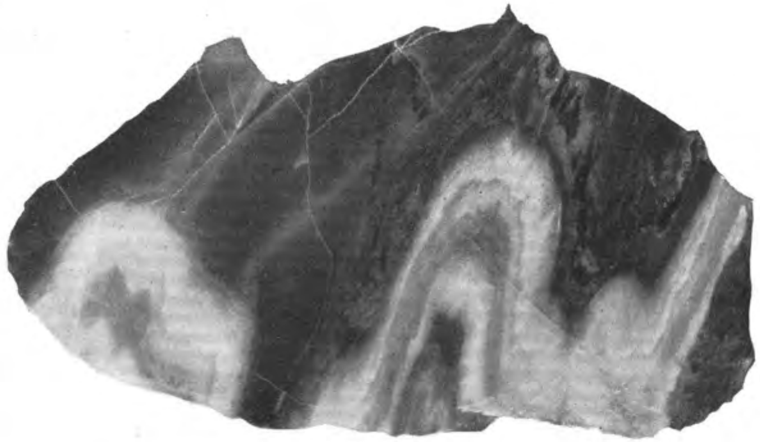
Quartz is by far the most abundant gangue mineral and is abundant in all the deposits. In most places it forms aggregates of interlocking grains and has a massive, greasy appearance. Much of the quartz is banded, because it encloses partly replaced fragments of country rock and long, thin layers of muscovite and biotite. Its color varies widely; at Hog Mountain, Ala., it is dark bluish or yellowish gray to nearly black; at the Vaucluse mine, in Virginia, it is milky white. Probably in most deposits the quartz is bluish gray, as it is, for example, at the Haile mine in South Carolina and the Howie mine in North Carolina. Microscopic vacuoles and inclusions are abundant in the dark quartz, and the dark color probably depends, at least in part, upon the abundance and character of the inclusions. Weathering gives much of the lode quartz a sugary texture and alters its appearance in other ways. These changes are described under "Oxidation," pp. 47–49.

Ilmenite, magnetite, and hematite are of common occurrence throughout the gold-bearing region, both in the country rocks and in the lodes. Ilmenite is frequently seen in the quartz bodies, where it forms thin curving plates, some of them half an inch or more in diameter. Magnetite generally occurs in small grains, and is thought to be in part residual from the original rock.

[95] Mansfield, G. R., Mineral Resources U. S., pt. 1, p. 170, 1924.

A. GOLD ORE, CRAYTON MINE, CABARRUS COUNTY, N. C.
Quartz (light) introduced along fractures in "slate" (dark) of volcanic series.

B. LARGE VEIN OF BARREN (BULL) QUARTZ ENCLOSED BY SAPROLITE, PINE HILL QUARRY, MECKLENBURG COUNTY, N. C.
Excavated for road metal.



A. GOLD ORE FROM 250-FOOT LEVEL, HOWIE MINE, UNION COUNTY, N. C.
Quartz (light) introduced along deformed bedding plane.

B. BANDED ORE FROM LOCKHART MINE, GEORGIA.
White, quartz; gray, amphibole; black, garnet and chlorite. Polished slab.

C. LODE IN PILLAR, BLACK SHAFT AT 167-FOOT DEPTH, CHEROKEE MINE, CHEROKEE COUNTY, GA.
A typical stringer lead. Photograph by R. A. Newton.

Gahnite, the zinc spinel, is an unusual mineral in the lodes. It was recognized by Lindgren in specimens from the Standard mine in northern Georgia.[96]

Rutile is a constituent of the ore at the Haile mine, where it occurs in vugs and in clusters and nodules of small yellowish-brown crystals. Bright-red rutile is conspicuous in the concentrates at the Blackmon mine, in South Carolina.

Carbonates are common in most of the deposits. Previous reports have usually identified the carbonate mineral in the gangue as calcite, but it now appears that ankerite, $Ca(Fe.Mg)(CO_3)_2$, is equally abundant. Pink calcite has been found on the 300-foot level of the Franklin mine, in Virginia, and colorless crystals of calcite line open cracks in the ore at Hog Mountain, Ala., and form seams in many other deposits. Calcite is found at the Battle Branch mine, in Georgia, in thin sheets nearly parallel to the schistosity, and it is common in the ores from the Lockhart and other mines of Findley Ridge, Ga., particularly in association with straw-colored amphibole.

Milky-white ankerite is more plentiful than calcite in much of the ore. An analysis of the white ankerite from the Capps mine, in Georgia, is given below. This 30.28 percent $MgCO_3$, and 15.90 percent $FeCO_3$.
30.28 percent $MgCO_3$, and 15.90 percent FeCO.

Analysis of ankerite, Capps Mine, Ga.
[J. G. Fairchild, analyst]

	Percent
FeO	9.25
MgO	14.42
CaO	30.08
CO_2	45.24
MnO	.63
Insol	.34
Total	99.96

Specimens from seven localities each gave an ordinary index of refraction (ϖ) varying from 1.70 to 1.72. At the Battle Branch mine ankerite is a common associate of the gold, and fragments of the mineral are there cemented with gold-bearing quartz (pl. 11, *C*). In many other places, however, ankerite was deposited after the gold-bearing quartz. Ankerite is often found between quartz bodies and sericite schist, where the carbonate follows the contacts and locally gives the ores a banded appearance (fig. 5). The prevalence of this relation suggests that the carbonate may have been formed by a reaction between silicia-bearing fluids and the adjacent schist, and some support is given to this view by the fact that inclusions of sericitic country rock in the quartz are in many places coated with ankerite. A similar relation between quartz and carbonated wall-rock has been observed in two California gold deposits and has been fully discussed by Knopf[97] and Ferguson.[98] In both these California deposits the ankerite is later than the quartz.

Siderite is said to occur in a few of the lodes, particularly those rich in chalcopyrite.

Feldspars occur as gangue minerals in widely scattered properties. They include orthoclase, microcline, and sodic plagioclases. According to Taber, plagioclase (albite-oligoclase to andesine) is particularly common in the lodes of the James River Basin of Virginia.[99] He writes: "Feldspar is the second gangue mineral in relative abundance, having been identified in all veins that are well exposed, and in places constitute as much as 10 percent of the gangue material." Thin sections of ore from the Howie mine, in North Carolina, show orthoclase, microcline, and albite-oligoclase in the quartz. Here the feldspar appears to be contemporaneous with the quartz, but other deposits contain much feldspar that appears to be residual from the wall-rock. Fresh

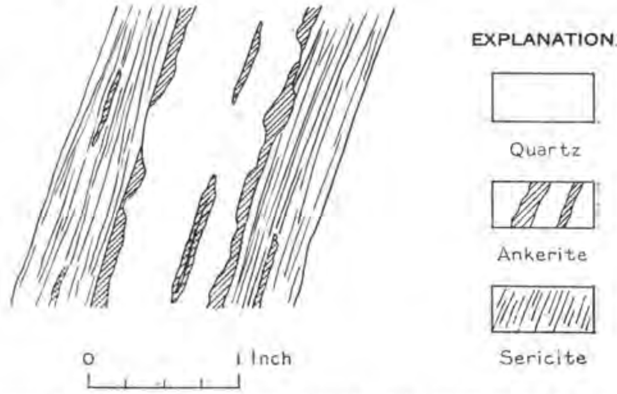


FIGURE 5.—Sketch of quartz veinlet bordered by ankerite, Melville mine, Orange County, Va.

feldspars are found in otherwise highly altered lode material, and it is likely that they are recrystallized and have undergone changes of composition.

Amphiboles are found in many deposits and are especially common in northern Georgia. Actinolite had previously been reported from Randolph and Davidson Counties, N. C., and from Buckingham County, Va. Dark-green hornblende is abundant in the deposits in the Roan gneiss and Hillabee chlorite schist. It is fairly common in the Buckingham-Fluvanna-Goochland Counties area of Virginia, but is generally scarce or absent in many of the deposits in North and South Carolina. The amphibole in the lodes is similar to that in the country rocks, though some of it is intimately associated with sulfides and gold. It was probably formed at least in part by recrystallization of the

[96] Lindgren, Waldemar, The gold deposits of Dahlonega, Georgia, in U. S. Geol. Survey Bull. 293, p. 123, 1906.

[97] Knopf, Adolph, The Mother lode system of California: U. S. Geol. Survey, Prof. Paper 157, pp. 41–42, 1929.

[98] Ferguson, H. G., and Gannett, R. W., Gold quartz veins of the Allegheny district, California: U. S. Geol. Survey, Prof. Paper 172, pp. 74–75, 1932.

[99] Taber, Stephen, Geology of the gold belt of the James River Basin, Va.: Virginia Geol. Survey Bull. 7, 1913.

original constituents of the country rocks. Small groups of radiating crystals of pale-straw-colored amphibole are found in the ores of northern Georgia (pl. 9, *B*). Optical properties of this amphibole are: Z C 25° maximum; $\alpha=1.648$, $\beta=1.659$; $\gamma=1.676$; optical character positive; optic-axial angle large (90°–105°). The dark-green hornblende has almost the same extinction angle and refractive indices, but its optic-axial angle is less than 90° and its sign is negative. Several groups of the radiating straw-colored crystals have nuclei of corroded dark-green hornblende—a relation suggesting that the pale amphibole was formed by recrystallization of the darker mineral. An analysis of green hornblende from a quarry near Clay Creek Falls, about 2 miles west of Dahlonega, Ga., is given below.

Analysis of green hornblende from a quarry near Clay Creek Falls, Georgia

[J. G. Fairchild, analyst]

SiO_2	43. 50
Al_2O_3	14. 14
Fe_2O_3	2. 59
FeO	11. 38
MgO	10. 93
CaO	11. 66
Na_2O	1. 73
K_2O	. 28
H_2O	1. 77
TiO_2	1. 40
F	None
MnO	. 34
Total	99. 72

The ratio of alumina to silica, it will be noted, is unusually high.

Garnet is abundant in much of the ore in northern Georgia and Alabama, and it occurs, though less abundantly, in many prospects and mines in the Carolinas and Virginia. Throughout the Southern Piedmont region the garnets show similar variations in character and have nearly uniform optical properties. Garnet of three types from the Battle Branch mine, Georgia, was sampled and analyzed. That of the first type was in the pink or red nodules which are widely distributed through the Carolina gneiss. That of the second type formed bright-red, well-developed crystals in veinlets, which crosscut the foliation and are closely associated with the ore. That of the third type, which graded into the second, was an unusual black garnet. All the garnet contained many tiny inclusions of magnetite and ilmenite, but these inclusions were particularly abundant in the black garnet and probably caused the black color. The nodules containing the garnet of the first type showed a rudely concentric banding, due to the distribution of inclusions of magnetite and quartz in the garnet, which also enclosed numerous grains of pyrite (pl. 12, *A*).

The results of the analyses are given in the table below. The calculated compositions, which are also given, indicate that by far the larger part of the garnet is almandite. The analysis of sample No. 1 shows an excess of silica amounting to 5.67 percent which has not been satisfactorily explained, very little quartz being found in the sample under the microscope. The garnet in some deposits has a noticeable violet hue, and probably contains more manganese than the specimens analyzed.

Garnet from the 85-foot level, Battle Branch mine, Georgia

Analyses

	1	2	3
SiO_2	39. 79	36. 18	36. 32
Al_2O_3	19. 59	20. 10	20. 04
Fe_2O_3	2. 38	1. 27	2. 22
FeO	28. 38	33. 06	33. 09
MgO	2. 36	2. 09	2. 33
CaO	5. 72	5. 52	5. 32
TiO_2	. 88	1. 26	. 85
Cr_2O_3	None		. 02
MnO	1. 02	. 39	. 27
Total	100. 12	99. 87	100. 46

Mineral composition

	1	2	3
Almandite	65. 24	76. 19	76. 19
Grossularite	15. 33	11. 28	10. 37
Pyrope	8. 08	6. 87	7. 68
Spessartite	2. 48	. 99	. 50
Andradite		2. 04	2. 04
Uvarovite			. 50
Quartz (?)	5. 67		
Hematite	2. 40	. 64	1. 60
Rutile	. 88	1. 28	. 80
Total	100. 08	99. 29	99. 68
Excess CaO		. 67	. 73

1. Discoidal garnet in wall 20 feet east of lode; analyzed by R. E. Stevens.
2. Red garnet from ore; analyzed by R. C. Wells.
3. Black garnet adjacent to quartz; analyzed by R. E. Stevens.

Topaz in extremely small grains is scattered through parts of the Brewer lode, in South Carolina, and at one place it forms a large mass that is virtually pure. This unique material looks somewhat like the "flinty" quartz rock which occurs elsewhere in the lode, but may easily be distinguished by its relatively greater weight.[1]

Kyanite was noted in the ores at the Moss mine, in Virginia, and crystals up to 3 inches in length were seen in the Battle Branch mine, in Georgia, at the bottom of two ore shoots (see pl. 12, *B*). Kyanite has been reported from veins in Virginia.[2]

Epidote and zoisite are abundant throughout the region, commonly in the country rock and rarely in the ores. Epidote seems to be particularly common in and

[1] Pardee, J. T., Glass, J. J., and Stevens, R. E., Massive low-fluorine topaz from the Brewer mine, South Carolina: Am. Minerologist, vol. 22, pp. 1058–1064, 1937.

[2] Taber, Stephen, op. cit., pp. 27, 128–129.

near quartz bodies, including many that are not gold bearing. Allanite has been reported from the Chestatee River placer, in Georgia, and was seen by the writers in the ore from the 301 mine, also in Georgia.

Tourmaline in dark greenish-brown or black crystals is widely distributed, generally as small isolated crystals or groups. Nodules of silky fine-grained black tourmaline are scattered over the surface near Hog Mountain, in Alabama, and tiny crystals are found in the ores at some localities. Tourmaline is a constituent of the sericitized wall-rock at the Franklin mine, in Virginia, and crystals and nodules of it occur in the veins and their wall-rocks of many deposits in northern Georgia.

Staurolite is a common constituent of the Carolina gneiss in northern Georgia, but in this region as elsewhere it rarely occurs in lodes. Crystals of pale yellowish staurolite up to about 1 centimeter in length are found, however, in ore from the Battle Branch mine, in Georgia.

Mica, especially muscovite, is abundant in all the deposits. Fine-grained muscovite (sericite) generally forms masses in the wall rock next to quartz bodies or inclusions in the quartz. At some properties, such as the Howie and Whitney, in North Carolina, and the Vaucluse-Melville, in Virginia, the mica in the dense, bleached wall-rock is so fine-grained that individual flakes cannot be distinguished by the unaided eye. At the Haile, Brewer, and several other properties fine-grained muscovite, intimately mixed with quartz, occurs in an unusual schist that weathers to a soft, white, crumbly mass in the zone of oxidation. At some properties, particularly in northern Georgia and Alabama, the muscovite is coarse-grained, forming flakes as much as three-quarters of an inch across.

An analysis of typical coarse-grained muscovite from the Battle Branch mine, in Georgia, is given below. CaO is a little higher, and K_2O slightly lower, than in most muscovites.

Analysis of muscovite from Battle Branch mine, Georgia

[R. E. Stevens, analyst]

	Percent
SiO_2	45.42
Al_2O_3	33.52
Fe_2O_3	1.47
FeO	1.11
MgO	1.22
CaO	1.12
Na_2O	1.34
K_2O	8.06
H_2O	5.89
TiO_2	.39
MnO	None
Total	99.54

In several mines the muscovite has a greenish tint, and at a very few localities it is apple green. Greenish mica from the Battle Branch and Topabri mines in Georgia and the Vaucluse in Virginia contains small percentages of chromium. J. A. Dresser [2a] has reported chromium micas from low-grade Southern Piedmont gold deposits. Biotite occurs in large quantity at many properties, but on the whole it is not so abundant as the white mica. It is an essential constituent of most of the country rock but locally appears to be related to the ore deposits. Some of the biotite flakes are as much as three-quarters of an inch in diameter; large flakes are exceptional, however, and much of the biotite is of microscopic fineness. In color the biotite is most commonly a clear, rich brown, but some of it is greenish brown, and a pale-brown or nearly colorless mica, possibly phlogopite, occurs locally. Under the microscope the biotite usually appears fresh, although in places chlorite has formed around the borders of the flakes.

Chlorite is another widespread and abundant gangue mineral. It is most common in the wall-rock next to the more intensely sericitized and silicified parts of the lodes, but some chlorite is enclosed in quartz. In many localities the chlorite is pale green or colorless, elsewhere it is dark green and bluish green. Although it is generally fine-grained, plates a quarter of an inch or more in diameter are not uncommon. Specimens of lode material from the Ivy mine dump, in Georgia, show chlorite veinlets half an inch or less across, bordered on either side by an inch of bleached biotite schist. Similar bleaching of the country rock next to chlorite veinlets was seen in several other places, and it suggests that the constituents of the chlorite may have been derived at least in part from the wall-rocks. Garnet is generally accompanied by chlorite. In some places chlorite has evidently been derived from amphibole and biotite.

Pyrophyllite is abundant in the wall-rocks at the Brewer mine in South Carolina. Though not known to occur in direct association with the gold deposits at other mines, it has been found at several localities in the Piedmont region of North Carolina by Stuckey, who believed that the mineral was deposited by ascending thermal solutions.[3]

Apatite is found in ores of northern Georgia, and a crystal of chlor-apatite 0.6 by 0.4 by 0.2 inch in size was obtained from the Battle Branch lode.

Pyromorphite occurring in tiny greenish-yellow crystals and filling thin seams was found near the bottom of the saprolite zone at the Moss mine in Virginia and at the Battle Branch mine in Georgia, and it had previously been reported from many properties. Clusters of small crystals of vanadinite are associated with pyromorphite at the Moss mine.

[2a] Dresser, J. A., Mining and Metallurgy, vol. 16, p. 136, 1935.

[3] Stuckey, J. L., The pyrophyllite deposits of the Deep River region of North Carolina: Econ. Geology, vol. 20, pp. 420–463, 1925.

ORE SHOOTS

The ore in the lodes is concentrated in shoots; some lodes, indeed, are mineralized throughout, but a very small percentage of the mineralized material constitutes ore. The ore shoots are so erratically distributed in the lodes that it is rarely possible to predict where they will be found. The shoots in the larger sheared zones have an irregular echelon or steplike arrangement. Wherever one shoot dwindles to a stringer or disappears one or more others may continue the trend, offset, in either the hanging wall or the footwall.

Practically speaking, an ore shoot, in this region as elsewhere, is a part of the vein that can be profitably mined. Some shoots are minable, even though small, because of exceptional richness, and parts of some veins are minable because they are exceptionally wide though only moderately rich. In some places a vein is both wide and rich; a vein may also be richer where it widens out than it is in adjacent narrower parts.

In size and tenor the ore shoots range from small high-grade pockets to large bodies such as those at the Haile mine, in South Carolina, where shoots were mined that contained about 40,000 tons of ore and averaged about $3 (0.15 ounce) per ton. In some places where the ores are unusually rich, seams of gold extend from the lode into the nearby country rock (pl. 12, *C*). Ore shoots that do not crop out at the surface have been found in several mines. At the Gold Hill mine in North Carolina some of the ore was discovered at a depth of 800 feet and at the Battle Branch mine in Georgia, several pockets were found well below water level.

LOCALIZATION

Ore shoots have been localized to a great extent by structural features including tension cracks, crests of rolls in shear planes and foliation planes, and grooves and other linear elements. The evidence of structural control is obvious in many mines, but obscure in others.

Ore shoots are most likely to be found at places where the lodes cut brittle or rigid rock masses, and they are also found alongside the lodes in the most disturbed and pervious parts of those masses. As a rule the chemical composition of the country rock seems to have had little effect in localizing the ores, except in so far as silicification has imparted brittleness to the rock. Where schistose rocks are intruded by silicic dikes or sills, the ores are likely to be concentrated in the more easily shattered intrusive rock (fig. 6).

Tension cracks transverse to the direction of elongation are developed in many of the shear zones. Individual tension cracks generally die out within a few hundred feet, although zones or groups of cracks persist for greater distances. Individual cracks generally differ in strike and dip from the group as a whole. Mineral-bearing solutions have circulated along the lode and have tended to follow the easiest paths, such as would be furnished by these groups of cracks. As a result, wall-rocks along the fissures have been replaced by ore, and locally the fissures have been sealed by ore. Small pods or lenses of the ore thus follow individual tension cracks and the main ore shoot follows a fracture zone whose general trend may be nearly normal to that of the individual cracks. In some shear zones there are tension cracks only a few inches apart, and where this condition prevails continuous ore shoots may develop along the fracture zones. At the Melville mine, in Virginia, ore is concentrated where a fracture zone crosses the lode, although grooving in the walls at this place has also influenced deposition. Figure 7 shows a small fault, on a reopened tension crack, in a stope in the Melville mine. At the Battle Branch mine, in Georgia, ore is clearly localized at the intersections of fractures with the lode, and at Hog Mountain, in Alabama, some ore shoots were formed where zones of closely spaced fractures cut the veins.

In several mines, rolls and folds can be seen to have played an active part in controlling solution, circulation, and ore deposition; ore is localized where the lodes bend, either on the strike or on the dip, particularly near the crests of such bends, where fracturing was most thorough. Ore shoots of this type were found at Hog Mountain, in Alabama, and also at the Rudisil mine, in North Carolina, at places where the dip of the lode flattened.

Grooves have determined the localization of ore shoots in many localities. Particularly in the lodes trending northeastward grooves that probably represent axes of small tight folds are found in the enclosing schists and slates. The grooves generally pitch 30° to 60° northeastward and southwestward, horizontal grooves being uncommon. There was relatively free circulation of solutions along the grooves, and in many places the ore shoots are elongated parallel to the grooves. Such elongate shoots are unusually well exposed at the Findley mine, in Georgia (see pl. 48). Shoots that resemble saddle reefs can be seen in many other deposits, and are particularly well shown in the Vaucluse and Melville mines in Virginia. Laney[4] found that the ore shoots in the Gold Hill district, in North Carolina, were approximately parallel to the grooves, but Laney, and also Nitze and Hanna[5] depict ore shoots in the Union Copper mine and Gold Hill mine as pitching to the southwest, although the grooves there pitch northeast. Becker[6] states that in the Creighton (Franklin) mine, in Georgia, sharply incised grooves pitch northeastward, as the ore pipes do, but that the pitch of the

[4] Laney, F. B., The Gold Hill mining district, North Carolina: North Carolina Geol. and Econ. Survey Bull. 21, p. 95, 1910.

[5] Nitze, H. B. D., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pl. 7, 1896.

[6] Becker, G. F., Reconnaissance of the gold fields of the southern Appalachians, U. S. Geol. Survey 16th Ann. Rept. pt. 3, p. 294, 1895.

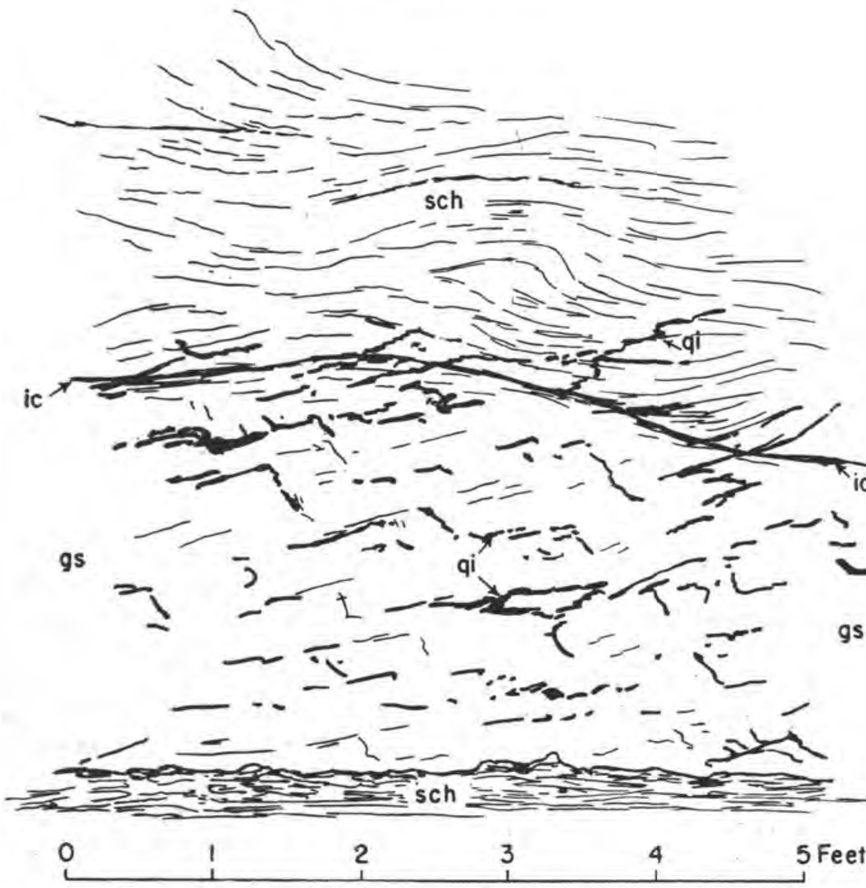


FIGURE 6.—Mineralized sill, Portis mine, Franklin County, N. C. Exposure in side of adit. *sch*, Schist; *ic*, intrusive contact; *gs*, "white belt," a hydrothermally altered intrusive granite sill; *gi*, veinlets of quartz and iron oxides.

grooves is 27° less than that of the pipes. Other examples of this lack of parallelism probably exist.

Few ore shoots that formed under impermeable cover and behind dams of impermeable rock have been recognized in the Southern Piedmont lodes. One shoot, however, at Hog Mountain, in Alabama, was found in a vein at the contact of quartz diorite and graphitic shale of the Wedowee formation.

Many ore shoots, such as those in the Haile and Brewer mines in South Carolina, the Howie in North Carolina, and the Franklin in Virginia, were localized by conditions that are not now apparent. It would seem that the ore-bearing solutions entered rifted schists or slates, and that the larger ore bodies replaced brecciated masses or were formed where disturbance was most intense.

FORM AND SIZE

In form the ore shoots in the Southern Piedmont exhibit much variety. Most of them belong to one of two types—tabular or lenslike and cylindrical or cigar-shaped—but many deposits of unusual shape are found.

Tabular or lenslike shoots have generally been considered the prevailing type in the Southern Piedmont, and they are in fact very numerous. They are well illustrated by the large indistinctly bounded lenses at the Haile mine, in South Carolina, and by many of the vein deposits, such as those at Hog Mountain in Alabama, Gold Hill in North Carolina, and Virgilina in Virginia. Many of the smaller veins, such as those at the Terry mine in South Carolina and the Moss mine in Virginia, have tabular ore shoots.

Cylindrical or cigar-shaped ore bodies have not hitherto been recognized as common in the Southern Piedmont. They are, however, nearly as abundant as the tabular shoots, and a realization of this fact would have saved much needless and expensive exploration. Shoots of this type are well exposed at the Franklin, Melville, and Vaucluse properties in Virginia, and on Findley Ridge in Georgia. These cylindrical bodies commonly have two short, nearly equal dimensions and one much longer dimension. In many shoots the long dimension is parallel to grooving or fluting in the walls. The ends of several of the cigar-shaped bodies have been carefully examined, and it has been found that some of these bodies have smooth rounded ends, while others fray out into a mass of stringers. In several places the stringers were followed until they again widened into a shoot.

Another elongate type of shoot, not parallel to the grooving in the walls and having less well defined boundaries than the cylindrical shoots, is developed where transverse fractures cut a lode. Such elongate shoots were found at the Battle Branch mine Georgia, where they are small and tend to pinch and swell down the pitch.

In size the ore shoots range from small pockets to bodies 200 or more feet in strike length by several hundred feet in pitch length. Tabular ore shoots are easier to follow and cheaper to mine than the cylindrical ones, and the larger and better-known mines have generally worked tabular shoots. The most continuous ones explored were in the Creighton (Franklin) mine in Georgia, where several were mined to a depth of about 950 feet measured on the plane of the lode.[7] A somewhat similar shoot was mined to a depth of 800 feet on the Randolph vein in Gold Hill, N. C., and tabular shoots extending to a depth of several hundred feet were

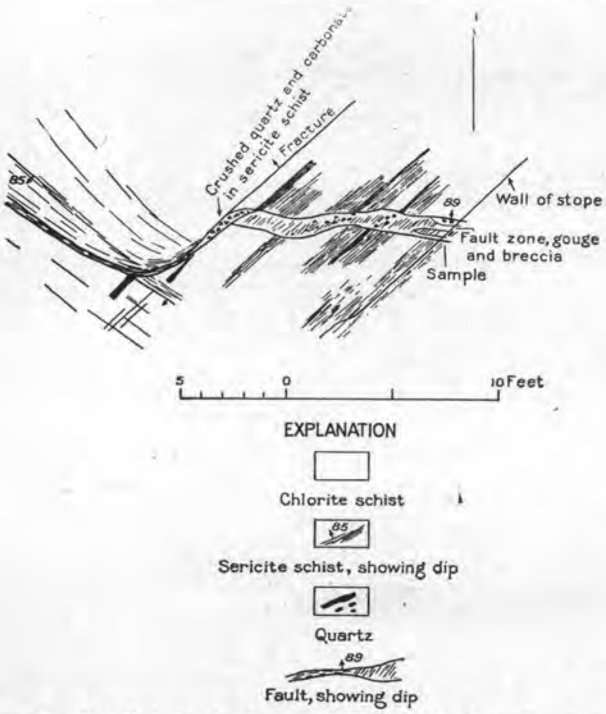


FIGURE 7.—Detailed sketch of small fault in back of southwest stope, 220-foot level, Melville mine, Orange County, Va.

worked in the Silver Hill, Phoenix, Howie, Coggins, and Iola mines, all in North Carolina. The thickness of the ore bodies mined ranged from about 15 inches at the Phoenix to 30 feet or more at the Coggins.

Lenslike bodies of much greater thickness have been found in some of the indefinite bodies of replacement ore. The shoots at the Haile mine in South Carolina were as much as 80 to 200 feet wide and 400 or 500 feet long. An even larger irregular shoot, consisting of lower-grade ore, occurs at the Brewer mine, also in South Carolina. Smaller lenses, however, are much more common. A typical example is the "Bull Face" shoot in the Howie mine of North Carolina, which was 20 feet by 40 feet and was mined to a depth of 350 feet.

[7] McCallie, S. W., Private report on the Franklin gold mine, 1907.

Rich ore has been mined from pockets and small shoots. The high-grade shoots at the Battle Branch mine, in Georgia, are typical. They had maximum horizontal dimensions of 3 or 4 feet by 10 feet and extended 10 feet or somewhat more down the dip. They were generally connected by stringers to adjoining pockets above or below.

Only a few cylindrical or cigar-shaped shoots have been mined out; many have been partly developed. They are generally small, their horizontal dimensions hardly exceed 10 by 40 feet, and their maximum pitch length is not much over 100 feet. On Findley Ridge, Ga., few of the cigar-shaped ore shoots are more than 1 by 1 foot in plan, but locally they are grouped closely enough together to permit profitable sluicing.

ORE

To distinguish ore in the shoots from the adjacent lode material is generally difficult, and in many places it can be done only by sampling and assaying. The shoots, however, do have certain distinctive characteristics. Their most abundant constituent is quartz, and the proportion of quartz to other minerals is generally greater in the shoots than elsewhere in the lodes. In many rich shoots and pockets galena is plentiful and ankerite not uncommon. In parts of Alabama and Georgia an abundance of coarse garnet is a favorable though not infallible sign. Most ore shoots contain pyrite, pyrrhotite, and chalcopyrite, but except in a few places there is no close correlation between the abundance of these sulfides and the gold content of the ore. Sericitization is more widespread and intense, as a rule, near the ore shoots than in poorer parts of the lodes.

Except in rich oxidized ore, worked out long ago from the superficial parts of the lodes, and in a comparatively few rich shoots that were found below, the gold content of the ores mined has ranged from about 0.1 ounce to a little less than 1 ounce to the ton. The general average is probably less than half an ounce.

Grade of ore seems to be in most places independent of the size or form of the ore shoots. The smaller bodies must attain a higher minimum grade than the larger ones if they are to be mined profitably. The lowest-grade ores handled in the Southern Piedmont—those containing 0.1 ounce of gold or less to the cubic yard—were profitable only when they occurred in lodes softened by weathering, or in saprolites, which could be sluiced on a large scale at very low cost. Such mining was carried on in many places, but most extensively on Findley Ridge, near Dahlonega, Ga.

So far as known, the lowest-grade unoxidized ore profitably mined was taken from the Haile mine, in South Carolina, where large tonnages averaged about 0.15 ounce ($3) of gold per ton. Most of the ore shoots, however, are smaller than those at the Haile, and in very few instances have ores averaging less than 0.3

ounce of gold to the ton yielded a profit. Ores containing but little more than this have been profitably mined at the Creighton (Franklin) mine in Georgia, where ore produced in 1896 was reported to average 0.35 ounce to the ton; at Gold Hill, N. C., 7,500 tons are said to have yielded a little more than 0.5 ounce to the ton; at the Iola mine, in the same State, the average recovery of gold from all ore bodies, according to the operators, was slightly over 0.5 ounce to the ton.

Most of the highest-grade ore shoots are small. For example, about 1,000 tons of hand-picked ore from the Battle Branch mine, in Georgia, averaged a little more than 0.9 ounce to the ton, and small pockets were of much higher grade.

ALTERATION OF WALL ROCKS

Two kinds of wall-rock alteration along the lodes can be distinguished on the basis of mineralogic and textural differences in the products of alteration. One kind produces a fine-grained rock that consists principally of silica, sericite, and chlorite; the other produces a rock that contains the same minerals as the original country rock but is much coarser grained near the lode than away from it.

Where the alteration of the first kind has occurred, the wall-rock next to a lode is a fine-grained aggregate, consisting mainly of quartz and sericite, commonly separated from the lode by crystals and thin irregular layers and nodules of ankerite. The sericitized rock is generally only a few feet thick, even in the most intensely altered parts of the lodes. Where mineralization has been feeble, sericite forms only a few thin layers or pinches out entirely. Away from the lodes, sericitic rock grades into chloritic rock, which in turn gives way, though in some places only at a distance of 100 feet or more, to typical country rock. The sericitic and chloritic rocks are generally schistose and are unrelated to the adjacent rocks in texture and composition. In a few places sericite and chlorite extend outward from the lodes along seams that break across the schistosity of the wall-rock. The sericite-chlorite alteration is thought to have been caused by ore-bearing solutions that filtered through the wall-rocks along the lodes.

Silicification has been the dominant type of alteration in a few of the indefinite ore bodies, such as those at the Haile and Brewer mines. Near such ore bodies schistosity is weak or absent. Small, well-formed pyrite crystals, which are not gold-bearing, are widely disseminated through the chlorite. These crystals contrast with the coarse-grained, gold-bearing pyrite that occurs in the ankerite, in the sericite or coarse-grained rock, and in the lode quartz. This type of alteration is particularly well shown in certain shear zones, such as those exposed in the Howie, Whitney, and Gold Hill mines of North Carolina and the Franklin, Vaucluse, and Melville mines of Virginia.

Such alteration is well exemplified at the Battle Branch mine, in Georgia, where the wall-rocks were unusually well exposed. Here the discoidal garnet nodules near the lode may be ¾ to 1½ inches in diameter while a quarter of a mile away they average less than ⅛ inch in diameter and as many as 12 or more may be seen in a square foot of rock surface. Granular aggregates of garnet form thin cylindrical shells around the higher-grade ore shoots. Kyanite in large crystals is concentrated near the bottoms of at least two ore pockets and is elsewhere scattered through the lode. Muscovite, biotite, and hornblende in large grains are widely distributed in association with quartz, gold, and ankerite.

The coarse-grained minerals in the lodes are thought to be of hydrothermal origin,[8] even though the same minerals may have been formed in the country rock by regional dynamo-metamorphism.[9] The evidence at hand does not clearly show whether the aggregates of coarse-grained minerals are recrystallized country rock or whether the minerals in the country rock and in the coarse-grained wall rocks were both formed by the same fluids that later deposited the ores. The close association of the ore minerals with garnet, hornblende, kyanite, micas, and, in smaller amounts, with staurolite and tourmaline, appears to indicate, however, that the solutions that deposited the ore minerals deposited or recrystallized the other minerals.

OXIDATION AND ENRICHMENT

The gold-bearing lodes, as well as the rocks that enclose them, are greatly changed in the process of weathering. Sulfide minerals and carbonates are removed in solution, and locally even quartz is dissolved. The lodes are eventually altered to masses of iron-stained clay containing fragments of quartz. During this process the gold is released from its matrix and accumulates in increasing quantities as the surficial layer is worn away. Part of the gold moves downward a short distance into the lodes, either mechanically by settling or washing, or in solution; and part is transported away from the lode by stream action, rain wash, or hill creep. As a result, concentrations of free gold are found in the upper parts of the lodes, under the soil of adjoining downhill slopes, and in the alluvium of nearby streams.

Solution and redeposition of the gold (supergene enrichment) in the Southern Piedmont lodes cannot perhaps be proved, but certain features of the enriched zone

[8] Brewer, W. M., A preliminary report on the upper gold belt of Alabama: Alabama Geol. Survey Bull. 5, p. 59, 1896. Taber, Stephen, op. cit., pp. 27, 128–129, 228, 1913. Bayley, W. S. Geology of the Tate quadrangle, Georgia: Georgia Geol. Survey Bull. 43, p. 73, 1928. Stuckey, J. L., Cyanite deposits of North Carolina: Econ. Geology, vol. 27, pp. 661–674, 1932; Origin of cyanite, idem, pp. 444–450, 1935. Dunn, J. A., Andalusite in California and kyanite in North Carolina: idem, pp. 692–695, 1933. Prindle, L. M., Kyanite and vermiculite deposits of Georgia: Georgia Geol. Survey Bull. 46, p. 37, 1935.

[9] Jonas, A. I., Geology of the kyanite belt of Virginia: Virginia Geol. Survey Bull. 38, p. 12, 1932.

strongly suggest that some such process has been effective. There can at least be no doubt that the near-surface weathered ores have been enriched by the mechanical settling of particles of gold.

A specimen of diabase, reported to be from a Triassic dike near Gold Hill, N. C., was seen by the writers that has one surface plastered with a thin film of gold. As the diabase dikes are later than the lodes, this relation indicates that secondary solution, migration, and redeposition of the gold has occurred. The reported occurrence of especially rich ore next to the dikes in the Haile and some other mines may be explained by the commonly observed fact that the margins of the dikes are generally waterways. Enrichment may have been caused by meteoric water, or by thermal water that circulated at the time the dikes were intruded.

Several veins of coarse-grained white quartz similar to the barren quartz described on page 34 contain narrow seams of limonite and flakes of gold near the surface. This gold does not persist downward and is probably of supergene origin.

Enrichment might explain the reported occurrence of coarse gold in the upper workings of mines, such as the Reed and Parker mines in North Carolina, in which only fine-grained gold is known to occur at depth. The evidence is not entirely convincing, however, for at many mines that have yielded large numbers of nuggets near the surface there has been little or no exploration at depth. It is worth considering, however, that small but sufficient amounts of manganese oxides, which according to Emmons's formula [10] are needed in the solution of gold, are widely distributed at the Reed and Parker mines (pp. 69–93), and are scarce or absent at mines where, as at the Haile, few or no nuggets have been found.

Adams,[11] quotes T. H. Aldrich, Sr., as saying that at Hog Mountain, Ala., the oxidized ore averaged about 0.25 ounce per ton and the sulfide ore beneath assayed about 0.3 to 0.45 ounce per ton and that the ore in the zone of gradation from oxidized ore to sulfide ore was richer than that above or below. None of the enriched ore was available for study, but as the water level at Hog Mountain is in places as much as 50 feet below the surface, some gold probably migrated downward in solution along the veins.

At the Melville mine, in Virginia, on the other hand, a study of the limited but good exposures of mineralized rock afforded no evidence of secondary downward enrichment. On the 220-foot level two stopes were worked where the ore zone widened. Both stopes expose faults that offset the ore a few feet (fig. 7) and furnish paths of easy movement for circulating waters. Small fractures in and near the main breaks contain marcasite and, more rarely, finely divided pyrite, both of which are believed to have been deposited by downward circulating waters. The mine assay maps show no change in gold content in the ore as the faults are approached. Assays of three samples are given in the table below. Sample 1 consisted of fine-grained pyrite from a fracture favorably situated to be enriched by waters circulating along the adjacent fault zone. Sample 2 was from a small pocket of coarse pyrite isolated in a mass of quartz; no fracturing was seen and the pyrite was regarded as being most likely of primary origin. Sample 3 was of marcasite from the fault zone in the north heading of the drift on the western wall of the shear zone. The evidence obtained, though inconclusive because of the small extent of the workings available for study, indicates that the deeper Melville ores have not been appreciably enriched.

Assays of samples from 220-foot level of the Melville mine, Virginia, in ounces to the ton

[Assayer, E. T. Erickson, U. S. Geological Survey]

Sample No.	Au	Ag
1	0. 01	None
2	2. 96	0. 44
3	. 01	None

1. Quartz and fine-grained pyrite from crack in east wall parallel to and south of small postmineral fault, southwest stope.

2. Isolated mass of coarse pyrite in a pocket of quartz in west wall, northeast stope.

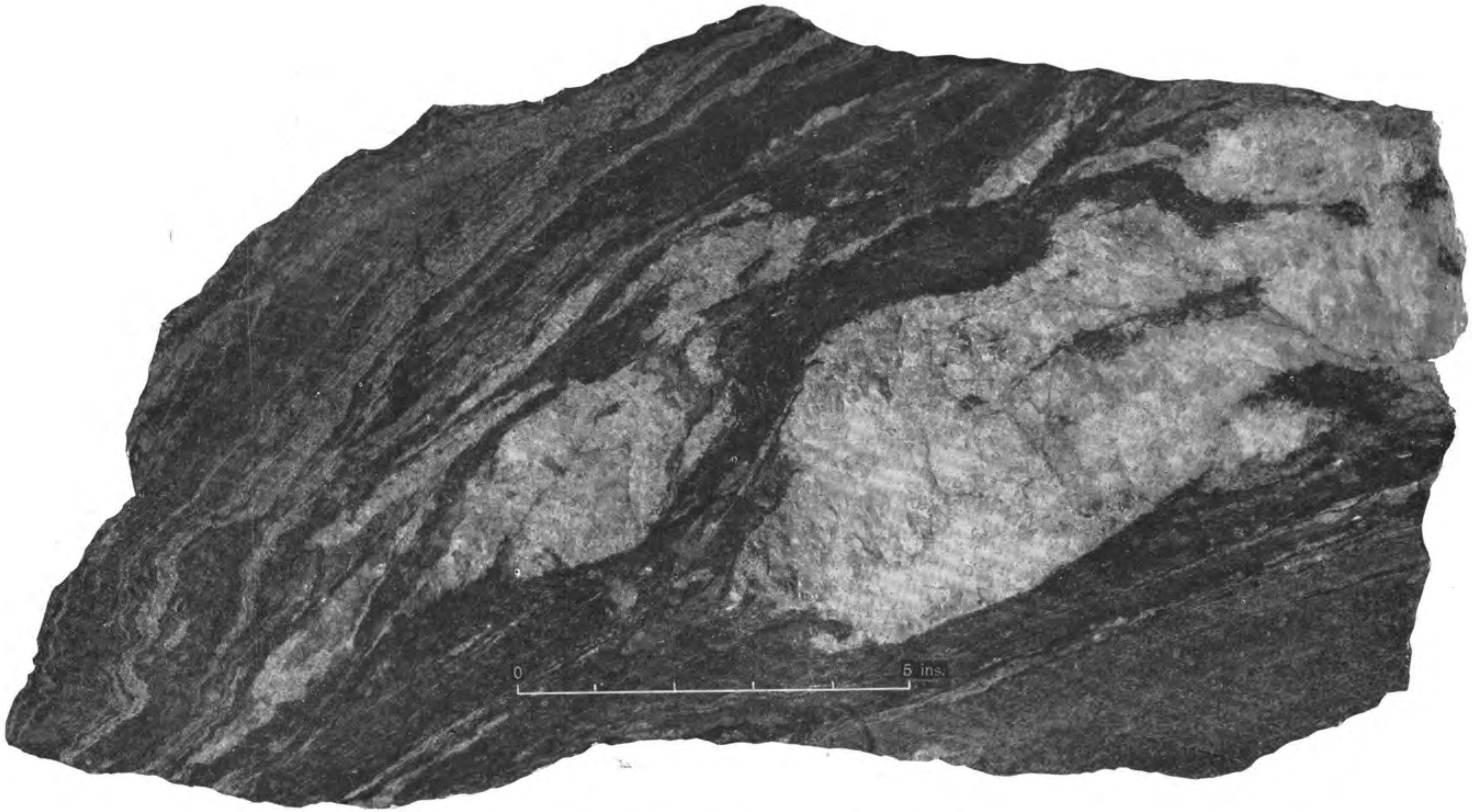
3. Marcasite from stringers near north fault in drift on western wall of the sheared zone.

Lode quartz in weathered outcrops generally resembles quartzite or sandstone, being for the most part a loosely coherent, sugary-appearing aggregate of grains that, though small, may be distinguished with the unaided eye. In many places a layering of the original lode material has been brought out by removal of the more soluble constituents. The quartz is commonly white, although in some places, especially near ore bodies, thin films of iron oxide give it a red or brown tinge. The sugary texture is well shown at the Hog Mountain (pl. 13) and Dutch Bend mines in Alabama, and on Findley Ridge in Georgia; at all three places the completely weathered rock is so friable that it easily breaks into a fine-grained white sand. In several properties, such as the Howie mine in North Carolina, the sugary texture is microscopic and the lode quartz near the surface resembles porcelain.

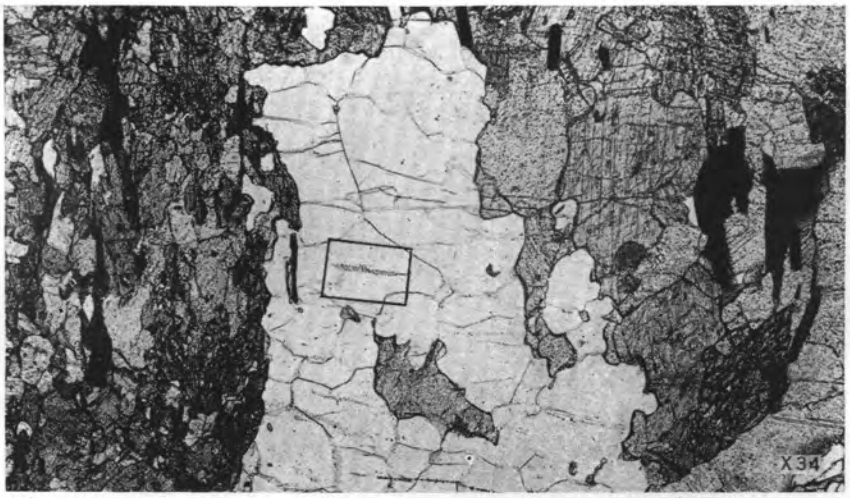
The sugary lode quartz appears to have been produced by weathering of bluish-gray quartz that contained numerous vacuoles and inclusions. In the process of weathering the vacuoles were destroyed and countless tiny cracks were formed. These cracks, and

[10] Emmons, W. H., The enrichment of ore deposits: U. S. Geol. Survey Bull. 625, pp. 305–324, 1917.

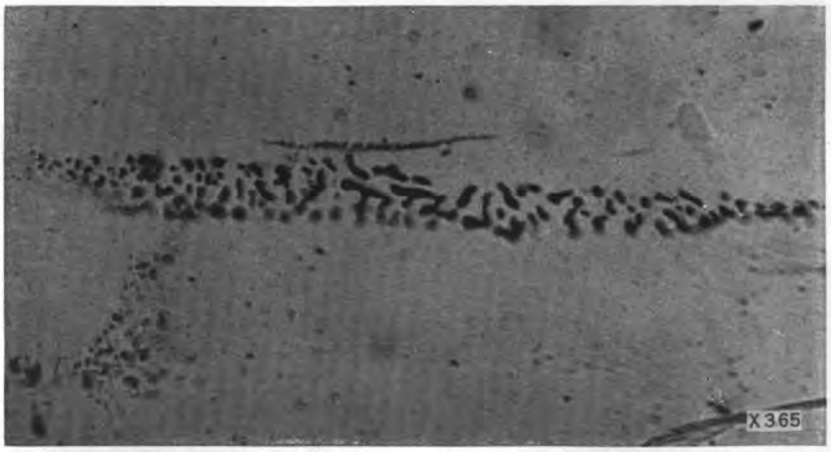
[11] Adams, G. I., Gold deposits of Alabama: Alabama Geol. Survey Bull. 40, p. 50, 1930.



QUARTZ LENSES IN CAROLINA GNEISS, IVY CUT, GEORGIA.
Polished slab.

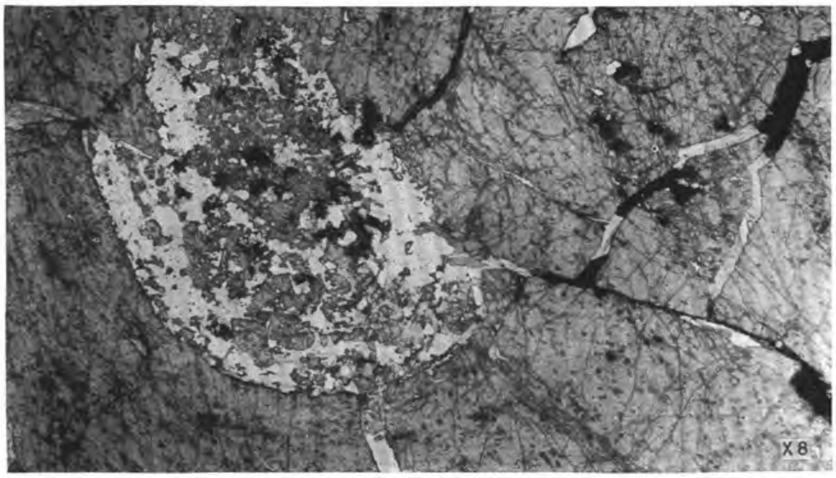


A. WORMY (MYRMEKITIC) PATTERN OF GOLD IN QUARTZ, BATTLE BRANCH MINE, LUMPKIN COUNTY, GA.
Many of the dusty particles and inclusions are gold and galena. Area outlined is shown in *B*. Photomicrograph by K. E. Lohman.



B. GRAPHIC PATTERN OF GOLD IN QUARTZ, BATTLE BRANCH MINE, LUMPKIN COUNTY, GA.
Enlargement of small rectangular area shown in *A*. Photomicrograph by K. E. Lohman.

C. ANKERITE BRECCIA CEMENTED WITH QUARTZ, BATTLE BRANCH MINE, LUMPKIN COUNTY, GA.
Polished slab.



A. CONCENTRIC ARRANGEMENT OF MAGNETITE INCLUSIONS IN GARNET NODULE, BATTLE BRANCH MINE, LUMPKIN COUNTY, GA.

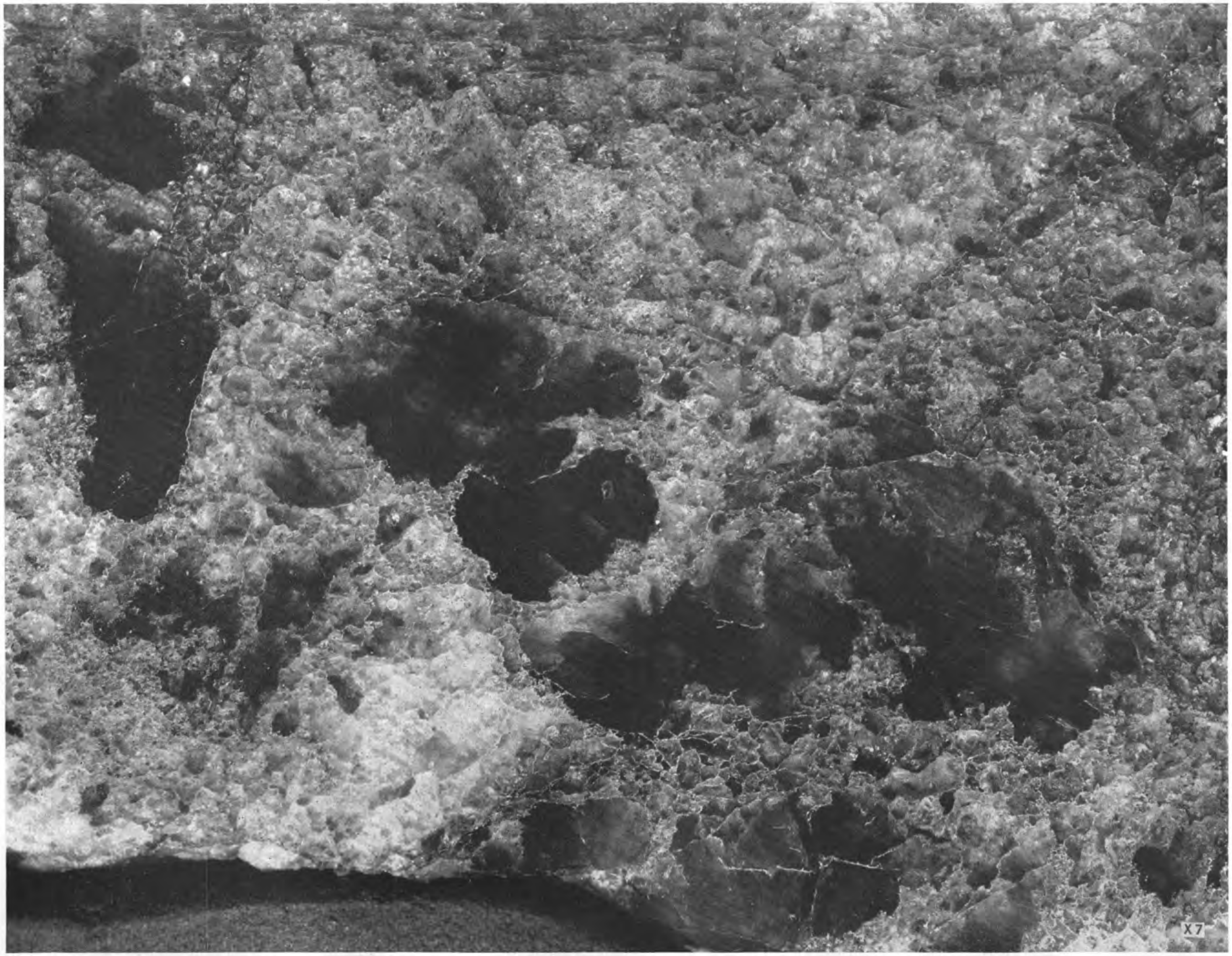
Quartz and sulfides fill cracks and center of nodule. Photomicrograph by K. E. Lohman.

B. KYANITE IN VEIN QUARTZ, BATTLE BRANCH MINE, LUMPKIN COUNTY, GA.

Photograph by G. W. Crickmay.

C. GOLD VEINLETS (WHITE) IN CAROLINA GNEISS, BATTLE BRANCH MINE, LUMPKIN COUNTY, GA.

Polished slab.



SUGARY QUARTZ, WEATHERED FROM BLUISH QUARTZ AND CONTAINING REMNANTS OF MASSIVE BLUISH QUARTZ, BLUE VEIN, HOG MOUNTAIN, TALLAPOOSA COUNTY, ALA.

also the boundaries of the grains, were further accentuated by solution of quartz along them.

At several properties the sugary quartz has disintegrated to a white or brownish fine-grained sand that generally contains small white mica plates. Sand of this character is conspicuous at the Brewer mine, in South Carolina, where it forms large bodies.

Quartz that has been dissolved near the surface may have been redeposited below water level, although no chalcedony, the form of silica generally deposited under these conditions, was seen. Vugs lined with well-formed quartz crystals, in places an inch or more in length, are found in the upper parts of several lodes. These crystals, which are thought to have been deposited in open cavities by circulating ground waters, are generally clouded with particles of brown iron oxide arranged in layers parallel to the crystal faces. They are not known to contain gold.

ZONING

The metalliferous deposits fall naturally into four overlapping belts that trend in general northeastward. These belts are, from east to west, 1, a poorly defined copper-gold belt that includes the Virgilina district, in Virginia and North Carolina, the Gold Hill district, in North Carolina, and the Seminole mine, in Georgia; 2, the belt that contains the principal gold deposits; 3, a western copper-pyrite-pyrrhotite belt, which includes such well known mines as those at Ducktown, in Tennessee, the Ore Knob, in North Carolina, and the Gossan Lead, in Virginia; and 4, a lead-zinc-barite belt that includes the Pulaski area in Virginia, the Mascot mine in Tennessee, and the Cartersville district in Georgia. The distribution of the deposits, together with that of granitic rock, is shown in plate 7, which is based on the geologic map of the United States (pl. 1). In compiling plate 1, the known deposits were plotted and lines were drawn around the mineralized areas. Several interesting things are brought out by this map Although the granitic rocks of the region are of several ages, the general distribution of these rocks resembles that of the gold deposits. Where the areas of granitic rocks are elongate, as in Alabama and northern Georgia, the gold-bearing areas are likewise elongate; and where, as in central and eastern North Carolina, the granitic rock exposures are broad and irregular, the gold-bearing areas also are broad and irregular.

The distribution of the four metalliferous belts implies a lateral zoning of regional extent.[12] The central core of intrusive and metamorphic rocks contains gold-bearing deposits. This core grades outward into an area containing few intrusive masses, and in this area the ore deposits are characterized by chalcopyrite, pyrite, and pyrrhotite. Farther west, far from any known intrusive bodies, are zinc, lead, and barite deposits that have replaced limestone and dolomite.

The implications of this regional zoning are many. The ore bodies were probably formed during a single period of metallization, and the gold deposits are presumably younger than the Paleozoic beds replaced by the zinc, lead, and barite deposits. Deep-seated fluids probably worked upward and outward from the zone of granitic intrusion. The gold deposits, together with their suite of such high-temperature minerals as garnet and kyanite, were deposited in the granitic zone. As the solutions spread, temperature and pressure decreased and the copper-pyrrhotite-pyrite deposits were formed. Still farther from the source the lower-temperature galena-sphalerite-barite deposits replaced carbonate beds.

The four recognized metalliferous belts converge northward toward a point north of the Potomac River near Great Falls, and a few miles north of this point the line of continuation of these belts, and of the granites, is covered by Coastal Plain sediments. The reason for this convergence is not evident.

ORIGIN

Generalizations concerning the age and origin of deposits as far apart as Alabama and Virginia may seem unwarranted. Despite their wide distribution, however, the deposits of the Southern Piedmont are within the same geologic province and are of generally similar structure and mineralogy, and it is therefore probable that they were formed at about the same time and by similar causes.

The source of the gold is of course conjectural, but the similar distribution of the gold and the granites, shown on plate 7, indicates that they have probably tapped a common deep-seated source. The gold-bearing fluids, and in many places the granites as well, rose along the numerous shear zones until they reached levels where conditions were favorable for emplacement. Where the shear zones crossed brittle rocks they formed breccias that permitted greater ease of circulation than was possible in the more schistose materials.

In mode of origin the Southern Piedmont lodes, especially those of Dahlonega, Ga., are thought by Lindgren to resemble the gold quartz lodes of California and Australia but, owing to physical causes some features of their development differed.[13] Replacement is believed to have been the dominant process in all the lodes of the Piedmont, although such processes as filling of open fissures and injection caused by solu-

[12] Newman, M. H., The Mascot-Jefferson City zinc district of Tennessee, in Mining districts of the Eastern States, 14th Internat. Geol. Cong. Guidebook 2, p. 161, 1933. Emmons, W. H., in Ore deposits of the Western States (Lindgren volume), p. 348, Am. Inst. Min. Met. Eng., 1933.

[13] Lindgren, Waldemar. The gold deposits of Dahlonega, Georgia, in U. S. Geol. Survey Bull. 293, p. 125, 1906.

tion pressure may have been active in some places.[14] The fact that all the rocks penetrated by the solutions were replaced impartially indicates that deposition was chiefly controlled by structure. The chemical nature of the wall-rocks, however, played an indirect part, inasmuch as the physical properties of these rocks are closely correlated with the relative abundance in them of quartz and mica, which is determined by chemical composition.

The lodes of the Southern Piedmont probably were formed at depths and temperatures ranging from those characteristic of the deep-vein (hypothermal) zone to those characteristic of the middle-vein (mesothermal) zone.[15] That the deposition took place at considerable depth is suggested by the irregular lenticular form of many of the mineralized bodies, particularly in the more schistose rocks. The ores were deposited at depths where these relatively weaker rocks were plastic rather than brittle, and therefore would not break freely. The largest northeast-trending lodes and many of the northwestward-trending veins are in the stronger rocks, which did not flow under conditions existing at the time of deposition. The mineral suite gold-quartz-ankerite, accompanied by such minerals as garnet, kyanite, tourmaline, and topaz, indicates high temperatures and pressures. It should be emphasized, however, that gold and galena were apparently the last minerals to be deposited and may have formed at appreciably lower temperatures and pressures than most of the minerals in the lodes. The presence of barite in several properties and of fluorite at Kings Mountain, together with the wide though sparse distribution of tellurides, may indicate mesothermal or even shallower conditions. These minerals have been described as occurring in deep vein zones, but they are more common at shallower depths.[16]

Lindgren[17] estimates that the deep-vein zone deposits were formed at temperatures of 300° to 500° C. and at widely varying depths, both temperature and depth depending on several factors. For deposits of the middle-vein type (mesothermal) he[18] estimates the temperature of formation at 175° to 300° C. and the depth as 4,000 to 12,000 feet. Becker[19] estimates the depth of formation of the Southern Piedmont deposits as possibly 15,000 to 20,000 feet, and Lindgren,[20] although he makes no definite statement on this point, appears to agree.

[14] Graton, L. C., Reconnaissance of some gold and tin deposits of the Southern Appalachians: U. S. Geol. Survey Bull. 293, p. 60, 1906.

[15] McLaughlin, D. H., Hypothermal deposits: Ore deposits of the Western States (Lindgren volume), pp. 557–560, 562–566, Am. Inst. Min. Met. Eng., 1933. Lindgren, Waldemar, Mineral deposits, pp. 637–643, 660–684, McGraw-Hill Co., 1933.

[16] Emmons, W. H., The principles of economic geology, pp. 50–51, New York, McGraw-Hill Book Co., Inc., 1918.

[17] Lindgren, Waldemar, Mineral deposits, pp. 640–641, McGraw-Hill Co., 1933.

[18] Lindgren, Waldemar, idem., p. 529.

[19] Becker, G. F., op. cit., p. 183.

[20] Lindgren, Waldemar, The gold deposits of Dahlonega, Georgia, in U. S. Geol. Survey Bull. 293, p. 124, 1906.

AGE

The formation of sheer zones striking northeast and of tension cracks striking northwest, followed by granitic intrusion and later by the deposition of ore, are regarded as parts of a continuous orogenic process that took place near the end of the Carboniferous period.

In many places lodes were formed after regional deformation had been accomplished, for mineralized quartz replaces deformed layers (pl. 9, *A*) and mineralized veinlets and other bodies of quartz commonly cut sharply across foliation planes. In some places the ore is broken and shattered, but elsewhere it is tightly frozen to the wall rocks, and in most places there is little evidence of extensive postmineral deformation. The deposits at Hog Mountain, Ala., are in quartz diorite, regarded by Adams[21] as of post-Carboniferous age. Although this rock shows almost no deformation near the ore bodies, the southern part of the mass has been sheared, being reduced to muscovite schist at some places near its borders. This deformation probably was produced during the late Carboniferous period of mountain building, and the ore deposits are apparently later than the deformation.

In Clay County, Ala., the Erin shale of Carboniferous age, is faulted against the Talladega slate[22] on what has been named the Erin fault. The numerous fractures near and parallel to this fault are mineralized, and as the mineral deposits are not greatly broken they probably were formed later than the fault.

As pointed out on page 49, under "zoning," the gold deposits are thought to have been formed during the same period of mineralization as the copper, lead, and zinc deposits farther west, which replace Paleozoic rocks.

No Triassic sedimentary beds in this region are known to contain gold, and the diabase dikes, probably of late Triassic age, which are common throughout the gold belt, were intruded after the ore deposits were formed.[23] The gold deposits are therefore probably late Paleozoic or early Triassic.

RESERVES AND FUTURE POSSIBILITIES

Like other regions where operations are scattered and relatively small, the Southern Piedmont contains but few properties in which ore is fully developed in advance of mining. Among the exceptions are the Haile, Howie, and Brewer mines, but at the end of 1935 none of these properties had known reserves of more than a few thousand tons of ore, containing about 0.3 to 0.5

[21] Adams, G. I., op. cit., p. 40.

[22] Park, C. F., Jr., Notes on the structure of the Erin shale of Alabama: Washington Acad. Sci. Jour., vol. 25, p. 279, 1935.

[23] Roberts, J. K., The geology of the Virginia Triassic: Virginia Geol. Survey Bull. 29, pp. 61–62, 1928. Graton, L. C., op. cit., p. 74.

ounce of gold to the ton. For most of the region, therefore, estimates of future production must be based on geologic evidence and past performance.

In the lodes thus far explored, the ore shoots are lenticular, both laterally and in depth, and it therefore seems reasonable to hope that other lenses will be found. There is no evidence that present workings have generally reached the lower limits of the gold-bearing lodes, and statements—frequently heard among mining men and engineers—to the effect that the deposits in this region are "only the roots of once mighty veins" [24] are unfounded. Available evidence indicates that the present surface, apart from the enrichment previously described, gives a fair average section through the lodes, representative of their deep-lying unexplored remnants as well as of the parts that have been eroded away. Outstanding examples of shoots mined in depth occurred at the Gold Hill mine in North Carolina, where ore was mined continuously to the 800-foot level, and at the Creighton (Franklin) mine in Georgia, where the ore bodies persisted more than 900 feet down the dip. But although some lodes may continue to great depths, only the richest of them would, under present conditions, bear the cost of mining below the depths already attained. The rich shoots found in the upper part of the Battle Branch mine in Georgia, could indeed be mined profitably to several times the present depth of the workings, but deep mining of ore that has yielded only a small profit near the surface is not likely to be profitable.

It has been asserted many times, in the course of the years, that large bodies of workable saprolite remain unmined, particularly in northern Georgia. The information obtained during this investigation, though not conclusive, tended to show that these reports were exaggerated. The gold content of the saprolite mined, as estimated from the many assays given by Yeates [25] and from reports, both private and published, by other investigators, ranged from 0.01 to 0.05 ounce of gold to the cubic yard. Some bodies of about average tenor may still exist, but the richest have probably been mined out.

Dumps afford the only direct information as to the character of many of the deposits, and a number of dumps were accordingly sampled during the recent investigation. The samples were assayed in the laboratory of the United States Geological Survey, with the

[24] Anderson, C. S., Gold mining in Georgia: Am. Inst. Min. Met. Eng. Trans., vol. 109, p. 62, 1934.

[25] Yeates, W. S., McCallie, S. W., and King, F. P., A preliminary report on a part of the gold deposits of Georgia: Georgia Geol. Survey Bull. 4-A, 1896.

Assays of samples from mine dumps in North Carolina

[Assayer, E. T. Erickson, U. S. Geological Survey]

Mine	County	Description of material	Extent of body sampled (tons)	Assay (ounces per ton)	
				Gold	Silver
Smart	Union	Ore pile	20	0.69	0.25
Do	do	Average	625	.03	.0
Black	do	Ore pile	30	.12	.12
Stewart	do	Fines	250	.08	.24
Do	do	Coarse	750	.02	.07
Moore (dump at No. 2 vein)	do	Average	600	.15	.03
Moore (dump at No. 1 vein)	do	do	365	.0	.0
Crump	do	do	1,500	.0	.0
Lemmonds (dump at lead shaft)	do	do	15	.07	3.21
Grady Rogers	do	do	150	.0	.0
Davis	do	do	800	.05	.0
Lewis (dumps around northern workings)	do	do	2,500	.06	.0
Lewis (dumps around southern workings)	do	do	1,400	.05	.0
Dunn (east end)	Mecklenburg	Ore pile	16	.13	.0
Dunn (center)	do	do	20	.22	Trace
W. L. Dunn	do	do	4	.07	.0
Wilkes	do	do	10	.05	.0
Do	do	Coarse	260	.04	.0
Do	do	Fines	780	.01	.0
McCombs (south dump)	do	Coarse	600	.015	.0
Do	do	Fines	200	.01	.0
McCombs (north dump)	do	Coarse	1,600	.17	.0
Do	do	Fines	1,100	.07	.0
Alexander (southwest dump)	do	Coarse	750	.05	.25
Do	do	Fines	250	.04	.0
Capps Hill (dump at shaft No. 1)	do	Coarse	300	.06	.0
Do	do	Fines	300	.05	.0
Allen Furr	Cabarrus	Ore pile	130	.27	1.49
Reimer (dump at northwest shaft)	Rowan	Coarse	1,100	.11	.0
Do	do	Fines	700	.13	.0
Reimer (dump at southeast workings)	do	Coarse	400	.06	.0
Do	do	Fines	400	.05	.0
Crowell	Stanly	Average	50	.03	.0
Hearne	do	do	125	.05	.0

results given above. These samples, though obtained by boring or digging in each dump at sufficiently numerous and well distributed points to indicate the average tenor of the dump with reasonable accuracy, were not large enough to be used as a control for metallurgical or other exacting operations. The results are of qualitative value, however, and the sizes of those dumps in which appreciable amounts of gold or silver are indicated give a rough idea of the minimum extent of the vein or mineralized zone that was explored. The material sampled includes some relatively small piles that apparently had been culled from the dumps or set aside as ore.

Some of the dumps consisted almost wholly of fine-grained material. Others contained large fragments more or less abundantly, and the samples from these dumps were classified with a screen of ¼-inch mesh into coarse and fine parts, which were assayed separately and whose relative weight was computed for each dump.

PLACER DEPOSITS

Some of the placer deposits in the Southern Piedmont are concentrated from weathered rock by streams, and some consist of undisturbed saprolite that happens to be rich enough to work. Deposits of these two kinds commonly grade into each other. Intermediate between the residual deposits and the lodes is material that may be classified as either lode or placer according to the method employed in working it. The possible occurrence of a third kind—beach placers—is suggested by certain features of the Tanyard deposit at the Brewer mine in South Carolina.

So far as is known separate records of placer and lode production were not kept until about 1880, and only a very general idea can be obtained of the amount of gold washed from placers since 1880. However, practically all of the gold reported (3,338 ounces) for the region to the end of 1825, the year in which the first lode was found, came from placer deposits, and much of the total reported production (about 280,000 ounces) before the end of 1840 probably should be credited to placers. After 1840, however, the lodes contributed the greater part of the production, although for a time noteworthy amounts still came from the placers of the South Mountain region in North Carolina and a few districts elsewhere. Since the war of 1861–65 the saprolite deposits of Findley Ridge, at Dahlonega, Ga., have been worked, but elsewhere the placer production has been comparatively small.

Although placer mining declined to small proportions long ago, it has never ceased entirely. Even during the period after World War I, when lode mining stopped completely, a small but steady gold production was maintained by small-scale operations at several places, and a small or moderate production of placer gold may be expected to continue indefinitely.

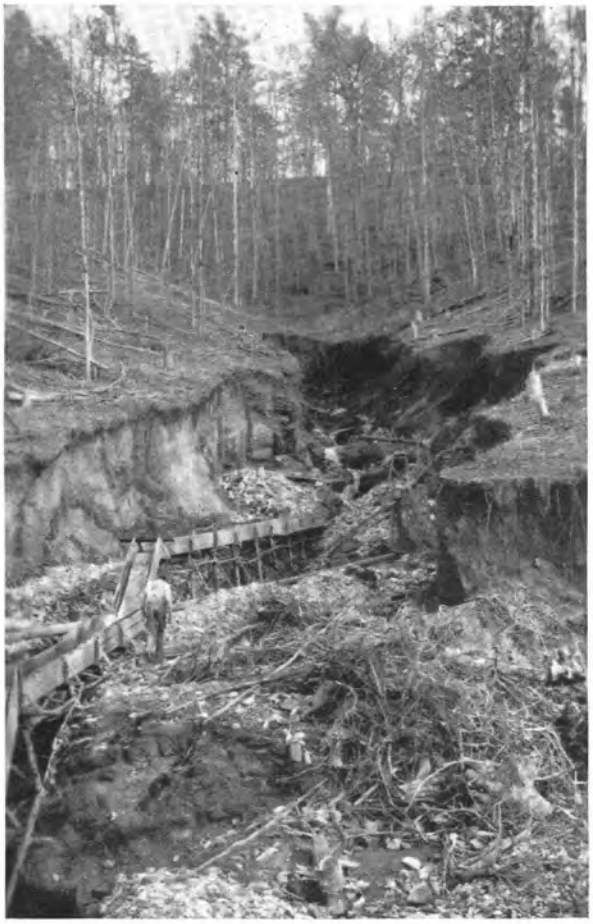
ALLUVIAL PLACERS

Gold-bearing stream gravel has been found along most of the water courses throughout the belt of gold-bearing lodes. Locally, as in the South Mountain region of Burke, Rutherford, and McDowell Counties, N. C., and in parts of northern Georgia, the placer deposits extend downstream beyond this belt.

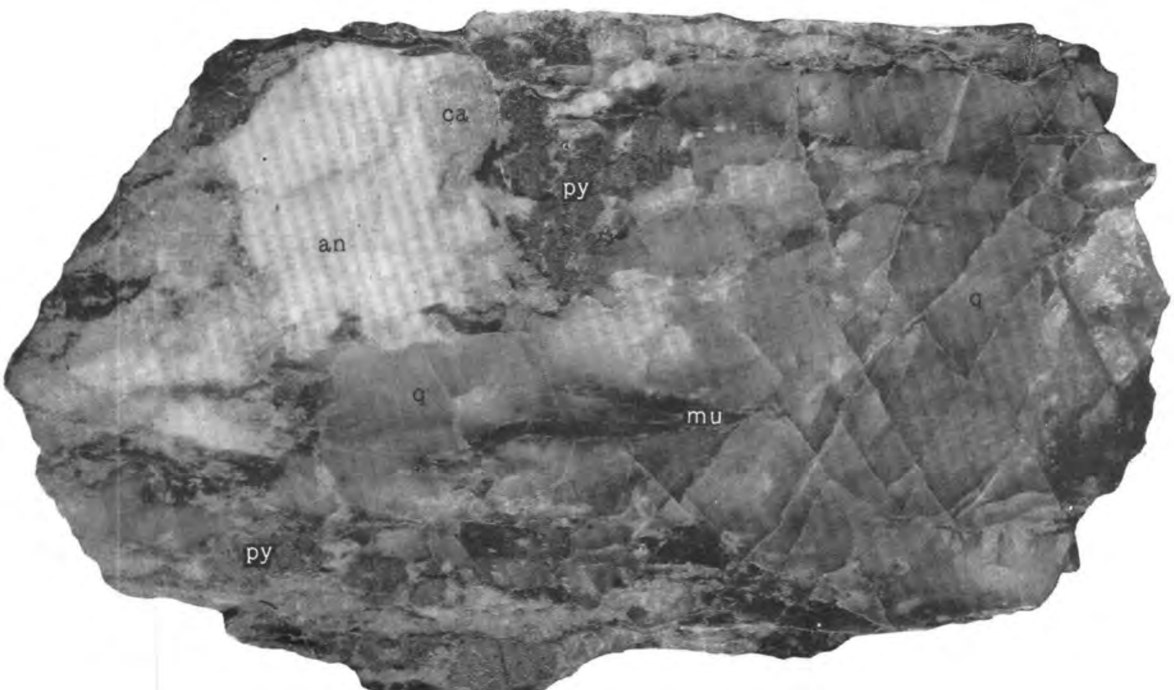
In the South Mountain region (pl. 14), nearly all the deposits that have been mined were alluvial placers, lying in the valleys of existing streams or in ancient channels higher than present drainage levels. At several places, such as Vein Mountain in McDowell County, N. C., some lode mining has been done on gold-bearing quartz veins and stringers exposed in the course of placer mining. Along Silver Creek, Muddy Creek, First Broad River, Second Broad River, and their tributaries the Recent alluvial deposits that have been mined are at least 60 miles in aggregate length. They range from 10 to 600 feet in width and, in the few places where their depth could be measured, from 3 to 15 feet in depth. The ancient channel deposits and the bodies of gold-bearing saprolite are much less extensive, and occur chiefly in areas about the headwaters of the streams. The reported yield of gold from deposits of these various kinds runs as high in some places as an ounce to the cubic yard, but the average yield for single deposits commonly ranges from 0.002 to 0.25 ounce. At a rough estimate, based on the assumption that the material worked averaged 25 cents (0.0175 ounce) a cubic yard, the total value of the gold produced was at least $2,500,000.

The remaining unworked deposits in this region include as yet unprospected stretches of alluvium along several streams—particularly along the lower courses of Silver Creek and Muddy Creek, in North Carolina—that may contain enough gold to be workable, and remnants of ancient elevated channels that are reported to be rich enough to mine provided an adequate water supply could be obtained. In a part of McDowell County, placer mining faces a handicap in an act of the State legislature, passed many years ago, prohibiting discharge of trailings from mills or placers into Muddy Creek or its tributaries.

In 1935, there were comparatively extensive alluvial placers along the Chestatee and Etowah Rivers and their tributaries, in White and Lumpkin Counties, Ga. The most extensive placer workings were in White County, and small operations were being conducted in many places throughout the gold-bearing part of the State. Most of the placer operations that were of economic importance utilized either a hydraulic giant or a steam shovel and dragline; the coarse gravel was screened off and the gold recovered in sluice boxes. A few of the smaller operators, working or reworking the richer gravels, managed to make a living by hand labor or with the help of water wheels and hydraulic elevators.



A. BEGINNING OF A HYDRAULIC CUT IN SAPROLITE, TOPABRI MINE, LUMPKIN COUNTY, GA.
Photograph by W. D. Johnston, Jr.



B. ORE FROM 290-FOOT LEVEL, FRANKLIN MINE, FAUQUIER COUNTY, VA.
py, Pyrite; *mu*, sericite; *an*, ankerite; and *ca*, calcite in quartz, *q*. Polished slab.

In South Carolina comparatively small alluvial placers were being mined in 1935 near the Haile, Brewer, and other gold-bearing lodes. Within a few years prior to 1935 a little placer gold had been recovered in Chesterfield, Union, and Abbeville Counties.[26]

RESIDUAL PLACERS

Except in the South Mountain region and possibly a few other places, most of the placer gold produced in the Southern Piedmont has come from material that has not been transported or rearranged by streams but remains at or near its place of origin. Such material includes soil as well as saprolite (see pl. 15, *A*). The depth to which residual material has been mined by placer methods is generally 50 feet or less, although at Dahlonega, Ga., huge open-cuts have been washed to depths of as much as 150 feet.

The gold, the other heavy minerals, and the undecomposed rock fragments in the residual placer deposits are largely concentrated below the surface in a layer that rests on saprolite or on firm rock. Whether this concentration is due to mechanical settling in the mass or to some other process is not known.

Hydraulic mining as perfected in California was introduced in 1857 by Dr. Marinus Van Dyck at the Janestown mine, in McDowell County, N. C., and its use was soon extended to other parts of the South Mountain region and from there to Georgia. Serious difficulties confronted miners of gold in the saprolite of the Southern Piedmont from the beginning because of two facts: much of the gold is in small particles, and its matrix, particularly in the residual placers, is a stiff and sticky clay. Early in the mining history the operators developed two crude implements, the barrel rocker[27] and the log washer,[28] which have proved more effective in saving gold than many of the more complex machines and methods tried in later years.

Residual placers commonly contain gold-bearing quartz fragments, and a method of milling these fragments after they had been freed from the clay by washing was developed at Dahlonega, Ga.; but this so-called Dahlonega method has not proved generally applicable elsewhere, mainly because of the difficulty of obtaining water under sufficient pressure. Dredging is rarely practicable, because most of the deposits are too shallow or otherwise unsuited to that method. Tram cars and dragline scrapers have been successfully used at some of the mines to move the dirt to a place where it could be washed.

Although the cream of the residual deposits was skimmed long ago, considerable deposits of medium to low tenor remain. Gold is scattered in small quantities over many areas, and the aggregate amount of material that contains a few cents to the cubic yard is probably enormous. Most of it is in situations unsuitable for hydraulic mining, but some of it may prove workable with the aid of dragline scrapers or similar apparatus. In estimating the value of the deposits, however, account should constantly be taken of the fact that the gold is mostly in fine particles and removable only with difficulty from its sticky clay matrix.

MINE DESCRIPTIONS

About 1,500 mines and prospects in the five Southeastern States—Virginia, North Carolina, South Carolina, Georgia, and Alabama—are known or reported to have produced gold. The names and locations of these properties are tabulated below, a table being included in the account of the mines of each of the states. Some gold-bearing deposits outside the Piedmont, mostly in western North Carolina, are listed in the tables for sake of completeness. Descriptions in the text are limited to the properties within the Piedmont for which at least a little pertinent information was obtained either from trustworthy records or direct observation or both.

VIRGINIA MINES

The distribution of the gold deposits in Virginia, all of which are within the Piedmont, is shown on plate 16, and the localities from which gold has been reported are given in the following table. The order is alphabetic, by counties. Most of the localities are described in fairly recent and still available (1935) reports by Laney[29] (1917) and Taber[30] (1913).

FAUQUIER COUNTY

FRANKLIN

The Franklin property, 594 acres in area, is in Fauquier County, north of the Rappahannock River, about 3 miles from Morrisville and about 26 miles from Fredericksburg. When visited during this survey the property was controlled by the P. G. Benedum interests, of Pittsburg, and J. L. Darnell, Jr., was in charge of operations.

The surface workings are shown in part on plate 17. The accessible underground workings consist of a shaft about 300 feet deep, a 50-foot level about 240 feet long, the western part of which is caved, a pumping station 81 feet below the collar of the shaft, a 150-foot level with 1,300 feet of workings, and a 290-foot level with 920 feet of drifting. These workings, together with a section through the shaft showing the general attitude and thickness of the lode, are shown on plate 18.

[26] Reports to U. S. Bureau of Mines.

[27] Nitze, H. B. C., and Wilkens, H. A. J., Gold mining in North Carolina and adjacent south Appalachian regions: North Carolina Geol. Survey Bull. No. 10, p. 30, 1897.

[28] Pratt, J. H., The mining industry in North Carolina during 1906: North Carolina Geol. and Econ. Survey, Econ. Paper 14, pp. 19–22, 1907.

[29] Laney, F. B., The geology and ore deposits of the Virgilina district of Virginia and North Carolina: North Carolina Geol. Survey Bull. 26; Virginia Geol. Bull. 14, 1917.

[30] Taber, Stephen, Geology of the gold belt in the James River basin, Va.: Virginia Geol. Survey Bull. 7, 1913.

Virginia gold localities

[Asterisks indicate properties visited]

County	Name	Location
Buckingham	Anaconda prospect	Near Eldridge Mill 3 miles northwest of Alpha.
	Anderson prospect	¼ mile south of Andersonville.
	Bondurant prospect	1 mile southwest of Andersonville.
	Buckingham prospect	¾ mile northwest of Dillwyn.
	Burnett prospect	1¼ miles north of Dillwyn.
	Duncan tract	1½ miles west of Alpha.
	Flood property	Southwest of Bondurant prospect, across Willis River.
	Gilliam property	Adjoins Flood property on the southwest.
	Greeley (Ayers) prospect	1½ miles southeast of Alpha.
	Hudgins prospect	1½ miles southwest of New Canton.
	Johnson (Staples) prospect	¾ mile south of New Canton.
	Lightfoot	Southeast side of Slate River, 2 miles north of Arvonia.
	London and Virginia (Eldridge) mine.	1 mile north of Dillwyn.
	Margaret (Terrell prospect)	West side of Phelps Creek, ½ mile south of New Canton.
	McKenna prospect	½ mile south of New Canton.
	Morrow (Bookers) mine	3½ miles southwest of Dillwyn.
	Morton (Hobson) mine	7 miles northeast of London and Virginia.
	Rough and Ready prospect	Southwest of Morton mine.
	Seay prospect	West of Morrow mine.
	Williams prospect	1 mile northwest of Dillwyn, at Shepherds Crossroads.
Culpeper	Culpeper property*	2 miles southeast of Richardsville.
	Dry Bottom prospect	2 miles south of east of Richardsville.
	Ellis prospect	2 miles north of east of Richardsville.
	Embrey prospect	½ mile southeast of Culpeper property.
	Love prospect	½ mile north of Culpeper property.
	Morgana prospect	On west side of Rappahannock River, 3 miles northeast of Richardsville.
Fauquier	Bancroft prospect	On Summerduck Run, 2 miles southwest of Morrisville.
	Franklin mine*	3 miles east of Morrisville.
	Kelly prospect	2 miles southwest of Summerduck.
	Liberty prospect*	3½ miles south of Morrisville.
	Little Elliot and Randolph	3 miles southeast of Morrisville.
	Kidwell, Waterman, Wykoff, Kirk, and Leopold prospects.	Locations not known.
Fluvanna	Bowles (Back Field) prospect.	1½ miles west of Tabscott.
	Bowles (Tellurium) prospect.	1 mile southwest of Tabscott.
	Hughes prospect	2 miles northwest of Fort Union Station.
	McGloam prospect	2 miles west of Tabscott.
	Page property	1 mile west of Wilmington on Long Island Creek.
	Scotia (Hodges)	½ mile north of Caledonia.
	Scotia (Tellurium)	1¼ miles north of Caledonia.
	Shaw property	2 miles west of Tabscott prospect.
	Snead prospect	1 mile north of Fort Union.
	Stockton tunnel	1½ miles northwest of Wilmington.
	Tellurium prospect*	Goochland-Fluvanna Counties, 2½ miles southwest of Tabscott.
Goochland	Atmore and Kent properties	Southwest of Grannison prospect.
	Belzow prospect	6 miles northeast of Columbia; ¾ mile north of Lantana.
	Benton prospect	¾ mile northeast of Tabscott.
	Bertha and Edith	East side of Big Bend Creek, 3 miles northeast of Columbia.
	Busbee prospect	1 mile southwest of Tabscott.
	Collins placer*	1 mile northeast of Lantana.
	Fleming prospect	1 mile northeast of Tabscott.
	Grannison prospect	West side of Camp Branch, 1 mile northwest of Lantana.
	Morgan prospect	Adjoins Young American mine on the west.
	Moss mine*	1½ miles southwest of Tabscott.
	Payne tract	½ mile southeast of Tabscott.
	Pryor tract	1½ miles southeast of Tabscott.
Goochland	Shannon Hill property	Shannon Hill, northeast of Tabscott.
	Tellurium prospect*	Goochland-Fluvanna County line, 2½ miles southwest of Tabscott.
	Waller prospect*	½ mile southeast of Tabscott.
	Young American mine*	1½ miles north of Lantana.
Halifax	Lucy and Howard prospect	¼ mile northeast of Red Bank mine.
	Pool and Harris prospect	1½ miles south of Red Bank mine.
	Red Bank mine	4½ miles northeast of Virgilina.
	Virgilina district (all Virgilina copper ores are reported to carry some gold).	
Louisa	Belden property	2¼ miles northeast of Mineral.
	Bibb property	1¼ miles southeast of Mineral.
	Chick property	1¾ miles east of Mineral.
	Cooper property	1¾ miles north of Mineral.
	Harris property	1¼ miles south of east of Mineral, north of Bibb property.
	Lett property	1 mile north of Mineral.
	Louisa property	2 miles west of south of Mineral.
	Luce	1½ miles south of Mineral.
	MacDonald	2 miles southwest of Mineral.
	New Luce	1 mile southeast of Mineral.
	Proffit	2¾ miles west of south of Mineral.
	Ricswan	1¾ miles south of Mineral.
	Slate Hill	1½ miles south of Mineral.
	Stockton	1½ miles east of Mineral.
	Tinder Flats	4¼ miles northeast of Mineral.
	Walnut Grove	3½ miles southwest of Mineral.
	Walton	1½ miles north of Mineral.
Orange	Grasty tract and Dickey prospect.	1¾ miles north from St. Just Post Office, 3¼ miles southwest of Locust Grove.
	Jones prospect	2 miles southeast of Indiantown, on Russell Run, 3 miles north of Locust Grove.
	Laird (Greenwood) prospect.*	½ miles northwest of Wilderness Store.
	Melville mine (Rapidan)*	½ mile northeast of Vaucluss mine.
	Partridge, Orange Grove, and Randolph.	Locations vague.
	Saunders prospect	3 miles southwest of St. Just Post Office.
	Seldon prospect	1¼ miles south of St. Just Post Office.
	Vaucluse mine*	2 miles north of Wilderness Store.
	Wilderness prospect*	½ mile north of Wilderness Store.
	Young prospect	3¼ miles southwest of St. Just Post Office.
Prince William	Crawford placer*	Neabsco Creek 4 miles north of Dumfries.
	Greenwood prospect	½ mile southeast of Independent Hill.
Spottsylvania	Beazley prospect	1¾ miles south of Parker.
	Bell prospect*	3½ miles northeast of Chancellorsville.
	Brinton prospect*	1 mile west of United States mine.
	Gardiner and Marshall properties.	Locations unknown.
	Goodwyn prospect*	1½ miles southeast of Stubbs.
	Grindstone prospect	2 miles southwest of Logan.
	Marsden prospect	2¼ miles east of Parker.
	Mitchell prospect	3 miles south of Logan.
	New Grindstone prospect	2 miles southwest of Logan.
	Quaker prospect	4 miles east of Parker.
	Ramsey prospect	3¾ miles northeast of Chancellorsville.
	Randolph prospect	2 miles south of Parker.
	Rawlings*	1 mile southwest of Logan.
	Smith prospect	3 miles northeast of Chancellorsville.
	United States property*	3¼ miles north of Chancellorsville.
	Whitehall mine*	1½ miles northeast of Logan.
Stafford	Eagle (Smith, Rappahannock) prospect.	14 miles northwest of Fredericksburg, near junction of Rapidan and Rappahannock Rivers.
	Horse Pin (Rattlesnake) prospect.	1½ miles southeast of Eagle prospect.
	Monroe and Lee properties	Locations unknown.

Considerable development work was done during 1934 and 1935, to determine whether or not sufficient ore was available to warrant construction of a mill. Seven diamond-drill holes were bored, 3,513 feet in aggregate length; three of them extended from the drift on the 150-foot level along the House vein, and four from the 290-foot level. Although some bodies of mineralized quartz comparable to those already explored were found, the results did not appear to justify large-scale operations, and the mine was abandoned in October 1935.

The country rock at the Franklin mine is an altered and sheared intrusive diorite or quartz diorite. Near the lodes the diorite is more schistose than elsewhere, showing that movement has taken place along the lodes. The rock immediately alongside the lodes is thoroughly sericitized and silicified and contains local concentrations of pyrite and carbonates. South of the House vein there are many rounded boulders of a diabasic rock, such as is typical of the Triassic dikes that occur throughout the region.

There are two strong veins on the property—the House vein and the Franklin vein. (See pl. 17.) Both of them are exceptionally well defined at the surface as compared with most of the veins in the Piedmont of Virginia, although they pinch and swell and in places grade into typical silicified replacement bodies. Several other veins (which have not been explored) lie north and east of the workings and are exposed in a few shallow pits.

The upper parts of the House and Franklin veins have mostly been mined out. The House vein, however, provides one of the few natural vein outcrops in the region, being exposed on the north wall of the pits as a ledge about 6 to 8 feet high. The quartz in this vein is light gray or white; it is mostly vitreous and massive, but is sugary in places. Layers of sericite schist and a little chlorite are common in the quartz, which also encloses a few cavities filled with hydrous iron-oxide. Fractures in the vein are stained with hydrous iron oxide and manganese oxide. The wall rocks are much altered, but in many places they show granitoid texture.

The Franklin vein, on which most of the underground work was done, is 16 feet thick on the 50-foot level near the main shaft, but only 7 to 4.5 feet thick on the 150-foot level; a little higher, where it is intersected by the shaft, it is represented only by a zone of sericitic schist. On the 290-foot level the vein seems to be breaking up into lenses.

The most abundant constituent of the vein is massive white quartz, with clear evidence of banding or comb structure. No vugs were seen except on the upper level, where they probably were formed by leaching of the carbonate and pyrite. Sericite is second to quartz in abundance, and streaks of sericite schist interfinger with and grade into the quartz, showing that the quartz has replaced the schist. Planes of schistosity locally bend around nodules and lenses of quartz, suggesting that such processes as solution pressure also were active. Carbonates—ankerite and a little pink calcite—occur in the vein. Here as in the Melville vein, the ankerite commonly lies between the quartz and the sericitic wall-rock. Pyrite occurs in large crystals and kidneys, which form layers, lenses, and nodules in both sericite and quartz, but it is most abundant in the sericitized walls of the quartz bodies (pl. 15, *B*). The gold is said to be almost entirely in the pyrite. A little chalcopyrite and chalcocite and a few green copper stains have been seen, and one specimen showed free gold.

Movement along the vein fissures is indicated by the sheared and schistose nature of the intrusive rock near the veins. In places the quartz of the veins is broken and partly recrystallized; small kidneys of quartz have apparently been rolled and recrystallized; and in many specimens the pyrite crystals are smeared on the enclosing rock and are highly polished.

The water level is said to have been about 8 feet below the collar of the shaft before the property was reopened. Oxidation is shallower in the intrusive material than in other rocks of the region. The 50-foot level shows considerable rock alteration; the walls are soft, and iron oxide is abundant; some pyrite, however, is found on this level. In the pumping station, at a depth of 81 feet, there is a little iron oxide. On the 150-foot level the only evidence of supergene activity is afforded by seams of marcasite and by iron oxides deposited along watercourses in the Franklin lode.

Samples taken by the company are reported to show a small body of mineralized quartz containing about 0.15 to 0.2 ounce of gold to the ton. A channel sample of 7 feet, taken across the Franklin vein in the west drift of the 150-foot level, where the vein was first cut, was assayed by E. T. Erickson in the United States Geological Survey laboratory and gave 0.17 ounce of gold and 0.06 ounce of silver to the ton.

A few notes on observations made at successive levels in the underground workings are as follows:

The pumping station, at a depth of 81 feet, extends 36 feet from the shaft. The vein is well exposed at the far end of the station, but has narrowed to a width of about 8 feet. The exposure there is similar to those shown on the 150-foot level.

Just above the 150-foot level the Franklin vein is intersected by the shaft. At this point the quartz is said to pinch out entirely, but the sericite schist zone continues, and on the 150-foot level as much as 7 feet of quartz is found. Here the lode is fairly persistent, and a considerable body of quartz, reported to contain about 0.15 to 0.2 ounce of gold to the ton, was found. A crosscut on the 150-foot level has been driven about 160 feet S. 35° E. from the shaft to intersect the House vein, and drifts have been driven along the vein from the intersection. The House vein here contains almost no quartz but is represented by a weakly mineralized sericitic zone.

Work on the 290-foot level has been confined to drifting on the Franklin vein, which is exposed for about 920 feet. On this level the quartz is not as persistent as on the 150-foot level, being in more lenslike and discontinuous bodies, whose thickness may diminish from about 5 feet to a few inches within a few feet. The quartz is milky white and is less mineralized than on higher levels.

LIBERTY

The old Liberty mine, about 3½ miles southwest of Morrisville, was reopened in June 1935. An old shaft, timbered solidly to a depth of 35 feet, was cleaned out, but nothing of value was found. Nothing was seen on the surface except old caved pits.

GOOCHLAND, FLUVANNA, AND BUCKINGHAM COUNTIES

MOSS

The Moss property, on a lode deposit, is about 1½ miles southwest of Tabscott, in Goochland County. A good description of it is given by Taber.[31] About 1835, shortly after the discovery of the lode, Benjamin Silliman visited the property, and took three samples that yielded $7.39 to 100 pounds of ore.[32] Since that time repeated attempts have been made to work the property. Figure 8 shows the extent of the surface and underground workings in 1935. Old reports say that two veins traverse the property and extend from 1,500 to 2,500 feet along the strike.[33] Only one vein was seen in 1935, and it could not be traced beyond the limits of the surface workings, although the mineralized zone may continue farther.

The Moss workings were partly cleaned out in December 1931 by J. C. Williams. A new inclined shaft was sunk on the vein to a depth of 106 feet, where the work was discontinued because of lack of capital. This new shaft and the old Manning shaft to the east, which had been unwatered, were accessible when the property was visited. The Manning shaft is sunk about 150 feet on the vein, and at the bottom a drift has been driven along the vein (fig. 8), which is exposed continuously throughout the length of the drift. The vein is from 8 to 24 inches wide, strikes about N. 60° E., and dips about 45° SE. It is well defined in the western heading, but in the eastern face it apparently has broken up into a stringer lead, though the wall rock is all silicified.

The country rock at the Moss mine is thoroughly decomposed wherever it was seen except in a few places on the 150-foot level. The decomposed material consists of a clay, containing much brown-stained mica, that is heavy when wet and requires timbering underground. The original rock is chiefly sericite-quartz schist containing considerable dark-red garnet. In some places a streak of amphibole schist less than 1 foot wide is present near the footwall of the vein.

[31] Taber, Stephen, op. cit., pp. 144–146.

[32] Silliman, Benjamin, On the gold region of Virginia: Am. Jour. Sci., vol. 32, pp. 99–130, 1837.

[33] Froehling and Robertson, A handbook of the minerals and mineral resources of Virginia, p. 51, Salem, Va., Salem Printing & Publishing Co., 1904. Watson, T. L., Mineral resources of Virginia, p. 560, Lynchburg, Va., Jamestown Exposition Commission, 1907.

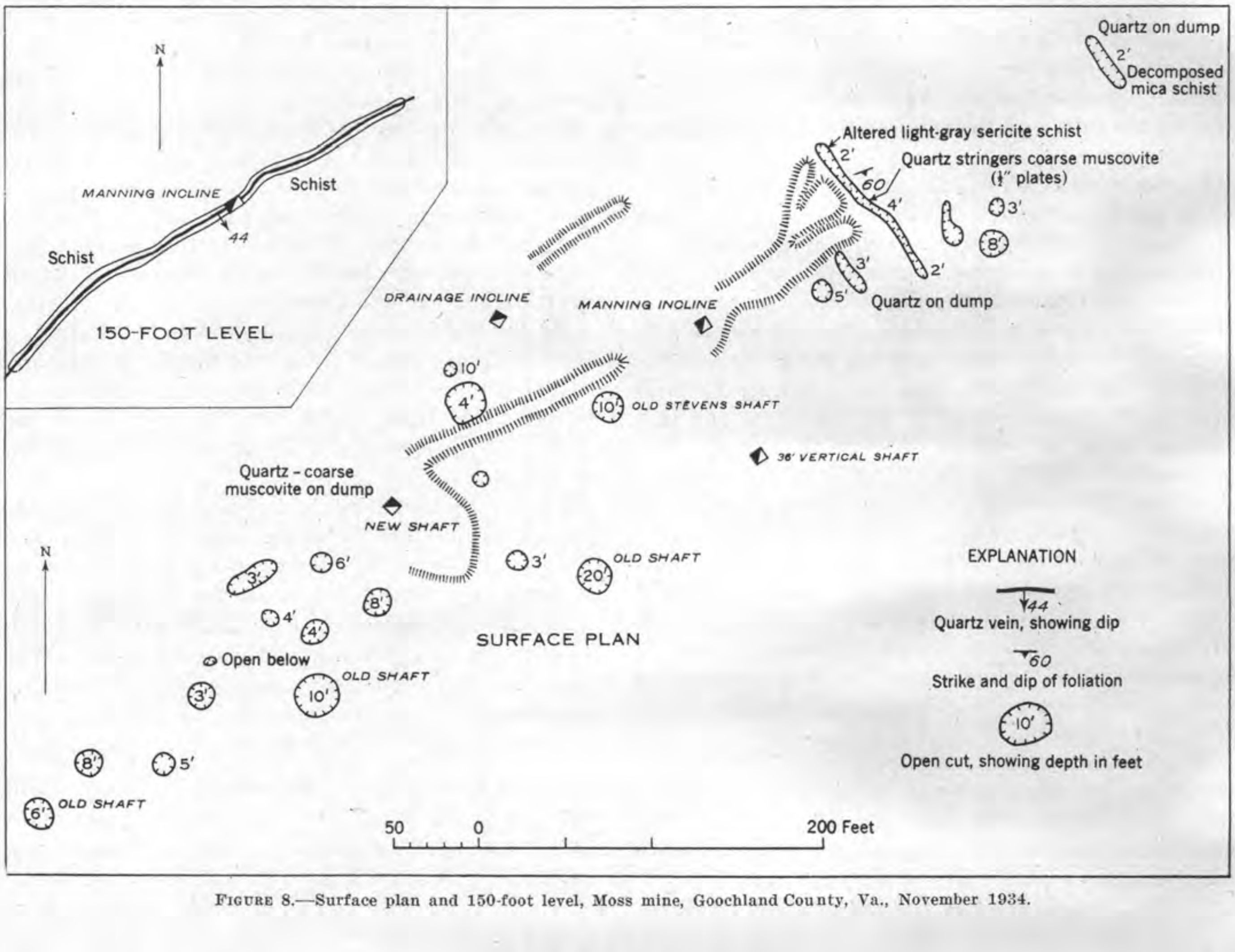
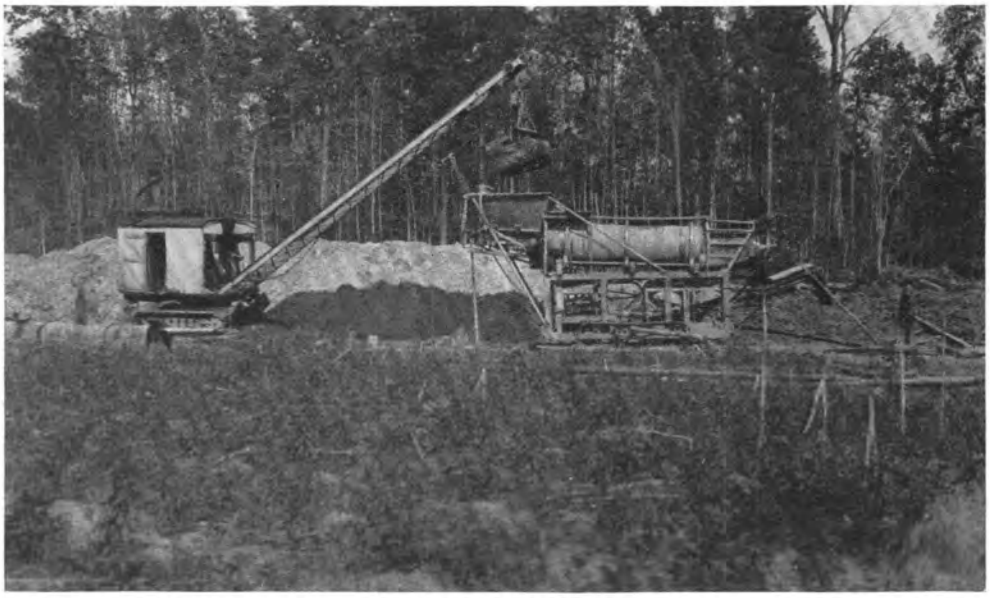


FIGURE 8.—Surface plan and 150-foot level, Moss mine, Goochland County, Va., November 1934.



A. DRAGLINE AND GOLD-SAVING MACHINE, COLLINS PLACER, GOOCHLAND COUNTY, VA.

B. VAUCLUSE MINE, ORANGE COUNTY, VA.

Open cut near south end of area shown on plate 20. Looking southwest. Note prominent fluting in walls.

The quartz in the Moss vein is platy, vitreous, and iron-stained. It contains abundant sericite, some pyrite, marcasite, galena, and sphalerite, and a little free gold. Pyromorphite and vanadinite were found in quartz from the near-surface workings, and tetradymite has been reported.

This property is said by the operators and by previous observers to have yielded some exceptionally high assay values, but no sampling was done during the 1935 survey. Late in 1935, after the writers' visit, additional capital was obtained and exploration work was resumed under the supervision of W. T. Millar. As the property has not been revisited since, the results of this work are not fully known, but according to Mr. Millar a small mill was constructed and some ore mined. The mine was shut down in 1936.

OTHER PROPERTIES

The old Collins placer is in the valley of Collins Branch, about 4 miles south of Tabscott, Goochland County. The property is controlled by the Powhatan Mining Co. and is in charge of Lewis L. Stow. It was visited in October 1934, and again in June 1935. A considerable area of bottomland along the branch had been cleared of timber and brush. A portable machine for recovering placer gold and a steam dragline were operating. The gravels are said to carry about 0.011 ounce of gold to the cubic yard. Plate 19, *A*, is a view of the dragline and gold-saving machine, which is designed to use a minimum of water. Judging from the results of several pannings of the heads and tails, the machine was making a clean separation.

The Tellurium mine, 2½ miles southwest of Tabscott, on the county line between Goochland and Fluvanna counties, was reopened late in 1935 by W. S. MacDonald. At the time the property was visited the work had just been started and nothing could be seen except the old mine dumps and a few caved pits and shafts. Taber visited the property in 1910, and at that time some of the workings were accessible.[34] The property is said to have been worked almost continuously, and profitably, from its discovery in 1832 until 1857, when the mill was burned. Since the War between the States, many attempts have been made to reopen the mine, but none has been successful. Three veins have been worked—the "Little," the "Middle," and the "Big Sandstone." The "Big Sandstone" vein is described by Taber as a ledge of quartzite about 3 feet in average width, cut by small gold-bearing stringers.

The Waller workings, near Tabscott, had recently been cleaned out in 1935, and a new shaft had been sunk to a depth of about 300 feet. A crosscut was driven from the bottom of the shaft to intersect the vein, and a total of about 300 feet of work was done on this level. When visited the workings were flooded, but the vein is said to have been thin and barren where it was cut. Work was discontinued because of lack of capital to pursue the development. The Waller property has been described by Taber.[35]

The gold deposits of the James River Basin have been described in detail by Taber.[36] The district was idle when visited, and no information to supplement Taber's individual mine descriptions was obtained.

HALIFAX COUNTY

VIRGILINA

The Virgilina district[37] has been almost inactive since 1918. It was primarily a copper district, but all the ores contained more or less gold, and a few prospects were explored mainly for gold. All the larger mines and prospects in the district and most of the smaller ones are described in Laney's report. No additional information was obtained during a brief visit to the district in 1934.

ORANGE COUNTY

MELVILLE

The Melville mine is about 18 miles west of Fredericksburg and about 3 miles northwest of the Wilderness Store, on the Fredericksburg-Culpeper highway. The Melville tract of 844 acres is leased by the V–M Corporation. C. E. Bass was in charge of the property at the time of visit. Underground work was discontinued in November 1935, but the mine was kept unwatered for some time thereafter.

The Melville workings are on a well-defined shear zone, which has been prospected from the Rapidan River on the north to a point more than 1,000 feet south of the area shown on plate 20. The Culpeper property, north of the Rapidan River, may be on the northern continuation of this zone.

The property is developed by two shafts 125 and 240 feet deep. A level at a depth of 110 feet connects the two shafts, and a 200-foot level has been driven from the deeper shaft. The total length of the drifts accessible in 1935 was about 1,800 feet. Old workings on and above the 110-foot level had been driven from the 125-foot shaft, but they were mostly caved and inaccessible.

A small modern flotation mill, equipped to handle a maximum of about 75 tons of ore a day, is reported to have recovered slightly more than 90 percent of the gold. The mill and the rest of the surface plant have

[34] Taber, Stephen, op. cit., pp. 18–19, 152–172.

[35] Taber, Stephen, idem, pp. 148–151.

[36] Taber, Stephen, Geology of the gold belt in the James River Basin, Va.: Virginia Geol. Survey Bull. 7, 1913.

[37] Laney, F. B., The geology and ore deposits of the Virgilina district of Virginia and North Carolina: North Carolina Geol. Survey Bull. 26, 1917; Virginia Geol. Survey Bull. 14, 1917.

been described by Anderson [38] and McGill.[39] McGill gives a partial analysis of the concentrates, which is reproduced below:

Silica	percent	28.70
Alumina	do	7.57
Iron	do	25.65
Calcium oxide	do	.21
Sulphur	do	25.59
Arsenic	do	.07
Antimony		Trace
Zinc	percent	.37
Copper	do	.32
Lead		Trace
Silver	ounces per ton	.07
Gold	do	3 to 5

Concentrates were shipped to the American Metal Co.'s smelter at Carteret, N. J., from June 7 to December 31, 1934. These shipments contained a total of about 529 ounces of gold, valued at $18,489.

The water level before the mine was reopened is said to have been about 30 feet below the collar of the 125-foot shaft. In 1935 the mine made about 90 gallons of water a minute, which was utilized in the mill and in drilling. According to the mill operator,[40] the mine water was consistently alkaline.

Very little information was gathered by mapping the numerous old shafts and pits on the surface. The distribution of the old workings shows the location of the main shear zone, and a very general idea of the extent of the underground developments may be obtained from the size of the dumps. As the early miners in the region located and worked all the known ore shoots that cropped out, the size and extent of the old surface workings may be considered fair indicators of what is to be expected in the sulfide zone. The few exposures of saprolitic schist in the pits and the character of the fragments of quartz and country rock on some of the dumps suggest that the nature of the shear zone and mineralization is in general the same throughout the property.

The rocks above the 110-foot level are almost completely decomposed, although it is generally possible to distinguish between the sericitized schist in the shear zone and the chloritized schist of the country rock. Downward from the 110-foot level the degree of decomposition of the rock in the shear zone gradually decreases. On the 220-foot level, except along fractures, the country rock is hard and appears fresh. In the stopes and raises about 50 feet above the 220-foot level, the rocks are slightly softer than below and show iron-oxide stains and solution cavities, but they are much fresher there than on the 110-foot level.

The mineralized zone is about 60 feet wide in the mine. It strikes about N. 30° E. and is nearly vertical. As the shear zone is approached sericite becomes increasingly abundant; it generally occurs in layers that fade laterally into the chloritized schist. Thin silicified streaks are usually present in the sericitic layers, and the positions of the hanging wall and footwall in a given place must often be decided somewhat arbitrarily. Grooving that strikes within 5° of the strike of the schistosity, usually diverging from it northwestward, and that pitches 25° to 35° NE. is conspicuous at many places in the mineralized zone. Much well-crystallized pyrite, which is not gold-bearing, is disseminated through the chlorite schist.

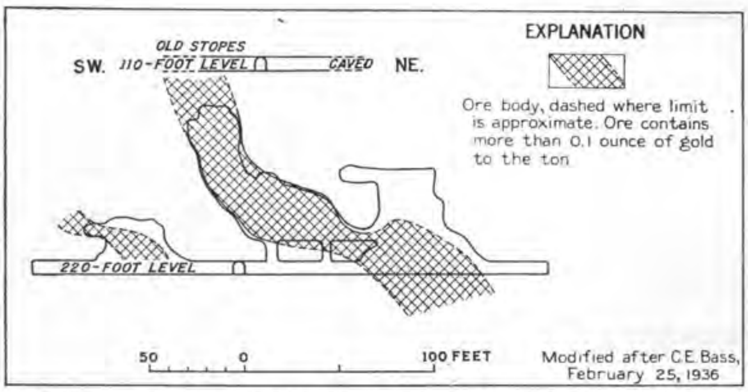


FIGURE 9.—Longitudinal section of part of the lode, Melville mine, Orange County, Va.

Most of the ore is confined to two streaks, both of which have been explored underground (see pl. 20), one near the footwall and one near the hanging wall of the shear zone. Between the two streaks is partly silicified and sericitized chloritic schist.

The best ore developed is in the eastern, or hanging-wall streak. Two shoots, each about 10 to 15 feet thick and 25 to 40 feet in strike length, were mined on the 220-foot level where the ore streak widened. They were formed where the lode was crossed by zones of northwestward striking faults. The shoots are nearly vertical, strike in general parallel to the schistosity of the country rock, and pitch about 35° NE., parallel to the grooving (see fig. 9). Ore of as high grade as that in

[38] Anderson, C. S., Mining lode gold in Piedmont Virginia: Eng. and Min. Jour., vol. 135, p. 404, Sept. 1934.

[39] McGill, W. M., Gold-mining operations in northern Virginia: Min. Cong. Jour., pp. 15–16, October 1934.

[40] Anderson, C. S., Personal communication, November 1934.

the shoots is said to occur in many other parts of the lode, but such ore cannot be mined profitably where it is narrow; but the enlargement at the intersection of the two fracture systems gives the lode sufficient width to make it minable. Figure 62 is a longitudinal section through part of the lode, showing the ore bodies.

In each of the stopes there are small faults of less than 6 feet displacement (fig. 7). They appear to be arranged in steplike groups that pitch about 35° NE., parallel to grooving in the shear zone. Individual faults die out within short distances and cannot be projected from level to level. They strike about N. 60° to 90° W. and are nearly vertical. Many fractures are sealed with quartz and ore, others brecciate the ore, and still others are entirely postore and cut across the mineralized zone with no widening of the ore streak. In the fractures seen the north wall has moved to the east relative to the south wall. Very little postmineral movement has taken place along the mineralized shear zone striking N. 30° E., although a few grains of grooved and polished pyrite were seen.

The gangue of the ore consists mainly of quartz and sericite but includes some ankerite. Coarse-grained pyrite is common and contains nearly all the gold. Small spots of chalcopyrite are present, and sphalerite is reported by the operators. A little pyrrhotite was seen in a polished section. Thin sections of the quartz from the northeast stope on the 220-foot level show a typical mortar texture, broken fragments of quartz lying in a fine-grained recrystallized aggregate. An 8-foot channel sample taken on the 220-foot level across the south face of the southwest stope was assayed in the Geological Survey laboratory by E. T. Erickson; the assay gave 0.16 ounce of gold to the ton and no silver. Most of the ore was probably formed by replacement of the schist, although some of the quartz lenses and veinlets may not be of replacement origin.

As the faults and fractures afford ready access for downward-moving solutions, they would seem favorable for supergene enrichment of gold. The assays that were given under the heading "Oxidation and enrichment" (p. 47), however, indicate that little such enrichment has taken place in the deeper ores.

The Melville mine was worked in 1934 and 1935 in conjunction with the nearby Vaucluse. The property was abandoned in 1938.

VAUCLUSE

The Vaucluse tract of 200 acres is owned by the V–M Corporation of Fredericksburg, Va. In 1935 the property was developed in conjunction with the work at the Melville mine, under the direction of Charles E. Bass, but it was closed and sold at auction in December 1938. Mr. Bass has described the later work.[41] The workings are on the southern continuation of the Melville shear zone (see pl. 20).

The Vaucluse tract was first worked in 1832, and decomposed surface material was mined for several years before the lode was discovered. In 1844 the property was acquired by an English company, which worked the lodes through two open-cuts, each about 60 feet deep, 75 feet wide, and 120 feet long.[42] By 1854 this company had sunk half a dozen shafts and had carried out extensive underground development. It also installed one of the most complete surface plants then existing in America, and is said to have extracted 556.3 ounces of gold, having a fineness of 0.943½, during 80 days of running in 1853. In December 1853 the mill was crushing 50 tons a day, and the average tenor of the ore was estimated to be 0.4 ounce a ton. The mine discontinued operations during the War between the States, and little has been done there since. In 1933–34 the old machinery was moved by Henry Ford to his museum at Dearborn, Mich.

The surface workings at the Vaucluse mine are the most extensive that were seen at any gold mine in Piedmont Virginia. The large pits shown on the map (pl. 20) continue about 1,000 feet southwest from the edge of the mapped area. There is a shaft with the shaft house still standing in 1935, near the south end of the workings. Most of the cuts were then full of water, and those that had been pumped dry were so full of silt and debris that little information was obtained from them. Plate 19, *B*, is a photograph of one of the Vaucluse cuts near the south end of the area shown on plate 20. The fluting on the walls is especially noticeable, and the ore shoots pitch parallel to this fluting.

The main working shaft, called the Vaucluse shaft, is nearly 100 feet west of the mineralized zone. In 1935 the shaft was cleaned out and deepened to about 220 feet and two new levels were driven, one at a depth of 110 feet and the other at 201 feet. There is also an old level at a depth of 50 feet.

The 110-foot level (pl. 20) contains about 275 feet of workings. The country rock is similar to that in the Melville mine but is somewhat more massive. Quartz, biotite, and chlorite are the most common constituents. A little sericite is usually present, and at some places in the mineralized zone it is the most abundant mineral. Layers of schistose quartzite alternate with layers of rock rich in chlorite and sericite. These layers strike N. 25° to 40° E.; near the shaft they seem to dip steeply eastward, but about 25 feet to the east they dip westward, and throughout the remainder of the level their dip is about 80° to 85° W.

[41] Bass, C. E., The Vaucluse gold mine, Orange County, Va.: Econ. Geology, vol. 35, pp. 79–91, 1940.

[42] Private report of O. Matthews and a committee to the Board of Directors of the Vaucluse mine, 1847, on file in the U. S. Geological Survey library. Gold mining in Virginia: Am. Jour. Sci., 2d ser., vol. 7, pp. 295–299, 1849. Whitney, J. D., Metallic wealth of the United States described and compared with other countries, p. 126, London, Lippincott Grambo & Co., 1854.

The rocks in the Vaucluse mine, possibly because of their more massive character, appear fresher than those at a similar depth in the Melville mine. Thin seams of marcasite are common, and cavities and iron-oxide stains occur along solution channels.

The mineralized zone is not tight as at the Melville mine, but consists of numerous small composite lenses of quartz, carbonate, and pyrite, separated by thin curving sheets of sericite. The management reported that where the 110-foot level cuts the west border of the main shear zone a width of 22 feet averaged 0.16 ounce of gold to the ton. The ore zone exposed is comparatively open, and descending waters circulate freely. Some of the pyrite is smoothed and polished, indicating that appreciable postore movement has occurred along the lode.

The old working level, which is intersected at a depth of 50 feet by the Vaucluse shaft, was visited the day after it was pumped out. The rock was thoroughly decomposed, and little could be observed in the mud-stained walls other than the dip and strike of the schistosity and the location of ore-bearing bands as indicated by the old timbered and caved drifts (pl. 20).

Exploration on and above the 110-foot level was abandoned in 1935, because of the difficulty of penetrating the loosened ground adjacent to old workings.

The lower level (pl. 20), driven at a depth of 201 feet, is about 90 feet below any of the known old workings. On January 1, 1936, it was being actively developed and about 780 feet of drifting had been done.

As on the upper level, the country rock is chlorite and biotite schist containing layers of schistose quartzite. Sericite is generally present in small quantity, and in the mineralized zone the rock has been changed almost completely to sericite schist. At this depth the country rock is hard and apparently unaffected by weathering. Small pyrite crystals are widely distributed but contain little or no gold. Marcasite is common along seams and planes of schistosity.

Where the mineralized zone is cut by the crosscut from the shaft, most of the quartz is concentrated in two streaks separated by 15 to 20 feet of sericite schist. Both streaks persist to the northeast as far as they have been followed, but to the southwest the western streak dies out and another quartz layer comes in east of it. The mineralized zone may thus include a series of irregularly distributed lenticular quartz masses, but sufficient work has not yet been done to prove that such is the case. The quartz is white and somewhat milky; it is liberally speckled with pyrite, both as irregular masses and as crystals, which are usually larger than the crystals in the wall rock. Here, as at the Melville mine, white ankerite is abundant, especially between the quartz bodies and the sericite schist.

Throughout this level, as in the upper workings, the quartz and pyrite are shattered and rolled. Some of the quartz is in smooth round nodules, and some of the pyrite grains are smoothed and polished. Mr. Bass reports having found a little very fine grained blackish pyrite, similar to some obtained along fractures at the Melville mine. The pyrite usually contains considerable gold and here, as at the Melville, it appears to be supergene. Grooving is well developed and pitches about 30° NE. The long axes of the ore shoots appear to be parallel to the direction of the grooving, but more information is needed before this can be determined with certainty.

LAIRD

The Laird property, southeast of the Vaucluse mine and about half a mile north of the Wilderness Store, was developed during 1934 and 1935 by the Melba Mining Co. A shaft was sunk in the country rock to a depth of 317 feet. Two crosscuts, driven at a depth of 300 feet across the schistosity for about 200 feet eastward and westward from the shaft, exposed a few small mineralized veinlets and lenses of quartz. Fig. 4, shows the typical character of the quartz bodies. The shaft entered hard rock at a depth of about 110 feet; above this level the shaft was lined with concrete. The country rock is a quartz-biotite schist similar to that at the Vaucluse mine. The results of the development work were discouraging; several small quartz lenses containing specks of galena and chalcopyrite with a little gold were found, but no well-defined mineralized zone. The property was abandoned early in September 1935.

PRINCE WILLIAM COUNTY

CRAWFORD

Shortly before 1935, Mr. William P. Crawford had found gold on Neabsco Creek and on a tributary known as Jack Patterson's Run, about 4 miles north of Dumfries and about 1¼ miles west of the main Richmond-Washington highway. So far as known, gold had not previously been reported from this locality.

The material being worked in June 1935 was stream gravel, containing gold in slightly rounded to angular particles that probably had not been transported far. Quartz stringers and lenses could be seen along the banks of the stream above the workings. The quartz is reported to contain some gold in places, and is probably the source of the gold in the gravel. A rock that appeared to be diorite formed the bed of the stream where the gravels were being washed, but the country rock that contains the quartz stringers is a series of schists and slates. The stream bed was covered with a layer of soil and gravel 3 to 4 feet thick. The average value of the gravel was not known, but such work as had been done was reported to indicate about 75 cents (0.021 ounce) a cubic yard for part of the material. The gravel is loose and clean and is so easily handled that a washer is not necessary. A small amalgam plate, mechanical pans, and sluice boxes were used to recover the gold.

SPOTTSYLVANIA COUNTY

UNITED STATES

The United States mine is in Spottsylvania County, on the south side of the Rappahannock River, near the old United States ford, about 12 miles from Fredericksburg. The property was prospected during 1934 by the North American Mining Co., Inc., under the direction of W. S. Hutchinson, Jr., but this work was discontinued early in 1935.

Plate 21 is a plane-table sketch map of the workings on this property. The operators cleaned out an old shaft in the northeastern part of the property and extended a crosscut eastward from it for about 75 feet. The shaft was flooded at the time of the writers' visit. It is reported to be 120 feet deep and to be connected with a short drift on a vein about 8 inches wide that strikes N. 30° E. and dips about 45° NW. The recent work consisted of sinking prospect pits and shafts in order to sample the veins. An effort was made to explore the property thoroughly and to determine, if possible, whether it was worthy of more extensive development.

Part of the country rock on the dump of the 120-foot shaft is a schist consisting of chloritic and amphibolitic layers commonly less than 1 centimeter thick, and part of it is dark-gray sheared quartzite. Some of the chlorite-amphibole schist is almost completely silicified, showing only remnants of amphibole and a little sericite in a dense, fine-grained aggregate of quartz. Dark-red garnet and pyrite are common in this rock, which, in a much-weathered condition, is recognized in most of the workings near the shaft. In one pit north of the shaft a streak of granitic pegmatite about 6 inches wide was seen.

In the northern group of workings, west of those near the shaft, the country rock is much decomposed but is probably diorite. This rock is almost entirely altered to saprolite, and although its texture is preserved its mineral composition has been completely changed. The pits in the southwestern part of the area mapped expose a somewhat fresher fine-grained bluish-gray rock, which contains small phenocrysts of quartz in a clayey matrix and resembles a rhyolite or a dacite. The easternmost pits in the southern part of the property are in the typical quartz-chlorite schist common in the region. This schist is fresher than the igneous rocks, and in places it requires blasting to sink below 10 or 15 feet. The strike of the schistosity is N. 25° to 45° E., and its dip about 75° NW. One of the pits in the schist was sunk about 10 feet through clay, near the base of which was a layer of water-worn cobbles 1 to 2 feet thick. This material is thought to be a remnant of the Coastal Plain deposits, which form a continuous mantle in the country to the east.

The gold is found mainly in quartz veins and stringers, which have a pronounced tendency to form lenses. Many of these lenses, as shown by the numerous shallow workings uncovered during the recent prospecting, have been mined near the surface. Those parts of the veins that could be seen were generally less than 2 feet thick and were, with few exceptions, the narrow pinches between the mined-out thicker parts. The veins strike N. 30° to 40° E. and, except for the westward-dipping vein said to be exposed in the shaft, dip about 75° E.

Two types of quartz are recognized. One type is clear and glassy and appears homogeneous in most hand specimens, though in a few specimens a well-defined banding is visible. The other type has a pronounced sugary texture and ranges in color from milky white through pink to deep reddish brown. The quartz on the dump of the shaft is gray to bluish gray and has a vitreous luster. It commonly shows discontinuous partings consisting largely of sulfides and chlorite, and a few specimens contain sericite. Ankerite is common on the dump; it is white on fresh surfaces but becomes brown on weathering. Sulfides recognized on the dump are pyrite, marcasite, chalcopyrite, and sphalerite. Maury [43] mentions, in addition to these, galena, wulfenite, and vanadinite.

The gold has a tendency to be coarse, and many specimens containing visible specks of free gold were picked up on the dumps and in the pits. Most of the gold is in small fractures and around grains in the sugary quartz; a minor part, however, is enclosed in quartz grains and has no obvious relation to visible fractures. Ordinarily the gold is in sugary quartz, and pink and reddish quartz are considered by the miners to be more favorable than white. A little gold was seen by the writers in one specimen of the glassy quartz.

No definite information was obtained as to the amount of supergene enrichment. It seems probable, however, that at the shallow depths where prospecting was being done in 1934 considerable mechanical enrichment, and possibly some chemical enrichment, has taken place.

NORTH CAROLINA MINES

TABULAR SUMMARY

In the table below is given a list, by counties, of the mines in North Carolina that are known or reported to have produced gold. An index map of part of the central Piedmont gold belt in North Carolina and South Carolina is shown on plate 22. In order to make the list as complete as possible the known gold deposits and mines in the counties west of the Blue Ridge outside of the Piedmont area, are included.

[43] Maury, M. F., Notice of the gold mines of the United States mine near Fredericksburg, Va.: Am. Jour. Sci., vol. 32, pp. 325–330, 1837.

North Carolina gold localities

County	Name	Location
Alamance	Gold reported	Not located.
Alexander	do	Do.
Anson	Hamilton (Bailey)	2 miles southeast of Wadesboro.
	Jessie Cox	
Ashe	Copper Knob (Gap Creek)	Southern part of county, on New River.
	Elk Knob	Not located.
Buncombe	Cane Creek	
Burke	Brown Mountain	13 miles north of Morganton, on Caney Branch.
	Carolina Queen	Northeast slope of White's Knob, Hall Creek.
	Hancock, placer	Foot of northeast slope of Hall's Knob.
	Hedge (Hodge)	3½ miles north of Pilot Mount, on Silver Creek.
	Hunts Mountain	Not located.
	Glen Alpine placer	Do.
	J. C. Mills	13 miles southwest of Morganton, at Brindletown.
	White Bank and Magazine	Lower slope of Pilot Mount.
Cabarrus	Allen Boger	4 miles southwest of Georgeville.
	Allen Furr (Eva Furr, Silver Valley).	½ mile south of Georgeville.
	Allison	Concord city limits.
	Arey	6 miles southeast of Concord.
	Barnhardt	Do.
	Barber	1¾ miles south of Georgeville.
	Barrier	3 miles northwest of Georgeville.
	Black	Near Pioneer Mills.
	Buffalo	½ mile west of Georgeville.
	Charlie Bost	6 miles southeast of Concord.
	Cline (Cruse)	3½ miles north of Mount Pleasant.
	Coates	4 miles northeast of Mt. Pleasant.
	Crayton	2½ miles north of Georgeville.
	Crosby (Poplan)	1 mile east of Allen, near Mecklenburg County line.
	Crosby No. 2	1½ miles north of Georgeville.
	Dan Boger	4 miles west of Georgeville.
	Dixie Queen (Newell)	2 miles northeast of Pioneer Mills.
	Ellsworth	1½ miles north of Georgeville.
	Faggart	5 miles southeast of Concord.
	Furniss	3¾ miles northwest of Georgeville.
	Furniss Furr	3 miles northwest of Georgeville.
	Gannon	Not located.
	Garman (Gorman)	1¾ miles south of Georgeville.
	Gibb	4 miles northwest of Georgeville.
	Harris	2 miles east of Harrisburg.
	Heilig	4½ miles east of Concord.
	Hopkins No. 1	3 miles north of Mount Pleasant.
	Hopkins No. 2	5 miles north of Mount Pleasant.
	Hunnicutt	4 miles southwest of Gold Hill.
	Isenhour	3 miles southwest of Gold Hill.
	Joel Reed	¼ mile east of Concord.
	Johnson	Near Pioneer Mills.
	Klutz	Near Concord.
	Linker	Not located.
	Litaker	Near Concord.
	Mauney	1½ miles southwest of Gold Hill.
	Maxwell	Near Pioneer Mills.
	McMakin (Whitney)	2¾ miles southwest of Gold Hill.
	Meadow Creek	Not located.
	Montgomery	Concord city limits.
	Morrison	Not located.
	Narville	3¾ miles northwest of Georgeville.
	Nash and Plott	5½ miles southeast of Concord.
	Nugget (New Nugget)	1 mile northeast of Georgeville.
	Old Field	Not located.
	Open cut copper	Do.
	Phoenix (Miami)	3½ miles northwest of Georgeville.
	Pioneer mills	5¼ miles southeast of Harrisburg.
	Quaker City	6 miles southeast of Concord.
	Randolph	Continuation of Gold Hill district.
	Reed	2¼ miles south of Georgeville.
	Rogers	
	Rocky River	1 mile southwest of Georgeville.
	Sanders (Saunders)	4 miles northwest of Georgeville.
	Smith	2 miles northeast of Georgeville.
	Spears	1 mile northwest of Pioneer Mills.
	Standard	South of Gold Hill.
	Stinson	Near Pioneer Mills.
	Taggart	3½ miles North of Rocky River.
	Troutman	2 miles south of Gold Hill.
	Tucker	¾ mile northwest of Georgeville.
	Union Copper	1¾ miles south of Gold Hill.
	Whitney	2¾ miles southwest of Gold Hill.
	Widenhouse	3¾ miles northwest of Georgeville.
Caldwell	Baker	John's River, in southern part of county.
	Bald Knob	Do.
	Bee Mountain	4 miles N. 80° west from Lenoir.
	Corpening	Near Baker mine.
	Flemming	Near Lenoir.
	Francis	Johns River, in southern part of county.
	Michaux	Near Baker mine.
	Miller	Johns River, in southern part of county.
	Old Miller	Do.
	Pax Hill (Packs Hill)	Do.
	Scott Hill	Do.
Catawba	Abernathy	6 miles east of Maiden.
	A. D. Shuford placer	¾ mile southeast of Shuford mine.
	England	East of Newton.
	McCorkle	Do.
Catawba	McCubb	Not located.
	Peachtree	Do.
	Rufty	Catawba Station.
	Shuford	6¾ miles southeast of Catawba.
Chatham	Chatham	3 to 4 miles east of Oxford.
	Chick	Not located.
	Phillips	Do.
Cherokee	Marble Creek	Do.
	Shuford (Catawba)	Do.
	Tathour Creek	Near Andrews.
	Valley river placers	
Clay	Warne mine	Southern part of Clay County.
Cleveland	Durham	5 miles south of Kings Mountain.
	Kings Mountain	1 mile south of Kings Mountain.
Davidson	Baltimore	2½ miles north of Silver Hill.
	Billy Allred	¾ mile northeast of Silver Hill.
	Black	1¾ miles south of Thomasville.
	Briggs	2½ miles north of Silver Hill.
	Brown	1 mile north of Cid.
	Cid	6 miles east of Silver Hill.
	Claude Hepler	2 miles northwest of Cid.
	Conrad Hill	6 miles northeast of Silver Hill.
	Cross	3 miles southwest of Silver Hill.
	Dodge Hill	6 miles northeast of Silver Hill.
	Emmons (Hercules)	1 mile south of Cid.
	Eureka	1¾ miles south of Thomasville.
	Hepler	2 miles northwest of Cid.
	Hunt	2½ miles southwest of Silver Hill.
	Ida	1 mile north of Silver Hill.
	Lalor (Allen)	1¾ miles southeast of Thomasville.
	Laffing (Laftin)	1½ miles southeast of Thomasville.
	Liberty Mining Co.	2½ miles north of Silver Hill.
	Morgan	2½ miles north of Silver Hill.
	Nooe	1¾ miles north of Silver Hill.
	Ore Knob	Not located.
	Peters	2 miles southwest of Silver Hill.
	Plyler	2½ miles north of Silver Hill.
	Secrest	1½ miles northeast of Silver Hill.
	Silver Hill	7½ miles southeast of Lexington.
	Silver Valley	1¾ miles northwest of Cid.
	Ward	2 miles east of Cid.
	Welborn	2 miles northwest of Silver Hill.
Davie	Butler (County Line)	8 miles southeast of Mocksville.
	Callahan Mountain	Not located.
	Gray	Near Statesville.
	Isaac Allen	1 mile northwest of Mocksville.
Franklin	Kearney	Near the Portis mine.
	Mann	Do.
	Nick Arrington	12 miles east of Portis.
	Portis	Northeast corner of Franklin County.
	Taylor	Near the Portis Mine.
	Thomas	Do.
Gaston	Asbury	8 miles northwest of Gastonia.
	Burrell Wells (V. W. Smith)	2 miles west of south of Mount Holly.
	Caledonia (Crowders Mountain).	8 miles southwest of Gastonia.
	Catawba (Kings Mountain)	1½ miles south of Kings Mountain.
	Clemmer	2 miles south of Stanley.
	Dameron	7 miles southeast of Gastonia.
	Derr	17 miles west of Charlotte.
	Dixon	7½ miles north of Gastonia.
	Duffie	6 miles northeast of Gastonia.
	Eddleman (Berry, Holland)	4½ miles southeast of Gastonia.
	Farrar	¼ mile east of Mountain Island.
	Gap	3 miles east of north of Stanley.
	Hayes	Northeast corner Gaston County.
	Lineberger	4 miles south of east of Gastonia.
	Long Creek	8 miles northwest of Gastonia.
	McCarter Hill	7½ miles northwest of Gastonia.
	McClurd	3 miles southeast of Stanley.
	McLean (Rumfeldt)	Southeast corner Gaston County.
	Oliver	1 mile east of Mountain Island.
	Oliver No. 2	1½ miles west of Mount Holly.
	Ormond	5½ miles west of Gastonia.
	Patterson	1¼ miles northeast of the Caledonia mine.
	Puett	2 miles southeast of Belmont.
	Reese	1¾ miles southwest of Stanley.
	Rhodes	2 miles southeast of Belmont.
	Rhyne	2 miles east of Stanley.
	Robinson	5½ miles northeast of Gastonia.
	Rumfeldt	Southeast corner of Gaston County
	Sam Beattie	3 miles south of Mount Holly.
	Smith	13 miles west of Charlotte.
	Smith, W. V. (Burrell Wells).	2 miles west of south of Mount Holly.
	Wright	4 miles south of Belmont.
Granville	Gold reported	Near Adoniram and Venable.
	Holloway	Northwest border of the county.
Guilford	Aberdeen (Horney)	Jamestown.
	Ball	Near Jamestown.
	Beard	1 mile south of Jamestown.
	Beason	Near Jamestown.
	Bolton	2 miles east of High Point.
	Deep River	Do.
	Eudy	Near Jamestown.
	Fentress (North Carolina)	10 miles south of Greensboro.
	Fisher Hill	5 miles south-southwest of Greensboro.
	Gardner Hill	8 miles southwest of Greensboro.
	Harland	2 miles south of east of High Point.
	Heath	6 miles southeast of Greensboro.
	Hodges Hill (Hodgins Hill)	6 miles south of Greensboro.

North Carolina gold localities—Continued

County	Name	Location
Guilford	Hoover	Not located.
	Horney (Aberdeen)	Jamestown.
	Horwitz	5 miles southeast of Greensboro.
	Hudson	Not located.
	Jacks Hill	2 miles south of Jamestown.
	Lauder	Near Jamestown.
	Lindsay	2¼ miles south of Jamestown.
	McCullough (North State)	Do.
	Millis Hill (Willis Hill?)	5 miles south-southwest of Greensboro.
	North Carolina (Fentress)	10 miles south of Greensboro.
	North State (McCullough)	2¼ miles south of Jamestown.
	Oak Hill	Not located.
	Palachian	Do.
	Pine Hill	8 miles southeast of Greensboro.
	Pucket	5 miles south-southwest of Greensboro.
	Twin	6 miles southwest of Greensboro.
	Vickory	Near Jamestown.
Halifax	Davis	Southwest corner of Halifax County.
Henderson	Boylston (Baylston Creek)	12 miles west of Hendersonville.
Iredell	Gold reported	Near Moorseville.
Jackson	Georgetown Valley placers	
Lincoln	Burton	Not located.
	Cherry	4 miles south of Denver.
	Graham	4 miles south of west of Denver.
	do	4 miles northeast of Iron.
	Hoke	4 miles southeast of Denver.
	Hauss (House)	4 miles west of Lincolnton.
	Muller	5 miles north of east of Lincolnton.
	Tucker, H. C.	2 miles southwest of Denver.
Macon	Ammons Branch (Horse cove).	Ammons Branch.
	Sugartown River placer	
	Whiteners Valley	Southeast corner Macon County.
McDowell	Brackettown	Brackettown headwaters of South Muddy Creek.
	Cane Creek	Cane Creek.
	Granville (Marion Bullion)	2 miles southwest from Huntsville Mountain.
	Huntsville	
	South Muddy Creek placer	
	Sprouse	Near Deming.
	Vein Mountain	4 miles southwest from Huntsville Mountain.
Mecklenburg	Abernathy, Clem	8 miles northwest of Charlotte.
	Alexander (Chapman)	6 miles northeast of Charlotte.
	Alexander, Amos	6 miles north of Charlotte.
	Alexander, Martin	6 miles northeast of Charlotte.
	Alexander, Morehead	9 miles northeast of Charlotte.
	Arlington	6 miles west of Charlotte.
	Baltimore and North Carolina (Ray).	2 miles northwest of Matthews.
	Barringer	3 miles south of west of Charlotte.
	Beaver	11 miles south of east of Charlotte.
	Bennett	West-northwest of Charlotte.
	Black (Z. V. Teeter)	8 miles eastrf of Charlotte.
	Black Cat	12 miles east of Charlotte.
	Blair	11 miles south of east of Charlotte.
	Blake	Near Charlotte.
	Brafford	11 miles south of east of Charlotte.
	Brawley	5 to 10 miles northwest of Charlotte.
	Caldwell (Craig-Davidson)	3 miles northeast of Charlotte.
	Campbell	5 to 10 miles northwest of Charlotte.
	Capps Hill	5 miles west of north of Charlotte.
	Carson (Clark)	1½ miles southwest of Charlotte.
	Cathey	7 miles north of west of Charlotte.
	Cathey, G. C.	8 miles northwest of Charlotte.
	Champion (Zeb Teeter)	6½ miles east of Charlotte.
	Chinquepin	¼ mile northwest of Charlotte.
	Clark (Carson)	1½ miles southwest of Charlotte.
	Craig-Davidson (Caldwell)	3 miles northeast of Charlotte.
	Davidson Hill	2 miles west of Charlotte.
	Dudley	7½ miles west of Charlotte.
	Dunlop (Mole Hill)	8 miles northwest of Charlotte.
	Dunn	9 miles northwest of Charlotte.
	Dunn, W. L.	7 miles west of north of Charlotte.
	Ellington	11 miles south of east of Charlotte.
	Elwood (Hunter)	4 miles east of north of Charlotte.
	Empire	6 miles east of Charlotte.
	Ferguson Hill	11 miles south of east of Charlotte.
	Ferris (Faires)	6 miles norrth of Charlotte.
	Ferris, Tom	1 mile west of Shopton.
	Frazer	5 to 10 miles northwest of Charlotte.
	Frederick	Not located.
	Gibson	9 miles west of Charlotte.
	Gold Hill	6 miles north of Charlotte.
	Grier	Not located.
	Hagler (Maxwell)	11 miles east of Charlotte.
	Harris	6½ miles east of Charlotte.
	Hayes	5 to 10 miles northwest of Charlotte.
	Helms, Mrs. John	2 miles southwest of Griffith.
	Henderson	5 miles east of north of Charlotte.
	Henson, Pat	9 miles east of Charlotte.
	Hipp	7 miles west of north of Charlotte.
	Hood	2 miles southwest of Mint Hill.
	Hoover, Bob	2 miles northwest of Pineville.
	Hoover, Jas. (McCall?)	8½ miles northwest of Charlotte.
	Hoover	Paw Creek.
	Hopewell (Kearns)	10 miles west of north of Charlotte.
	Hovey	½ mile south of Capps Hill mine.
	Howell	Southern extension of the Rudisil.
Mecklenburg	Hunter (Elwood)	4 miles east of north of Charlotte.
	Hunter, Dr.	5½ miles southeast of Charlotte.
	Hunter, J. P.	6 miles west of north of Charlotte.
	Hunter, S. H.	Not located.
	Isenhour (Yellow Dog, Taylor).	½ mile south of Charlotte.
	Johnson	Cabarrus County line near Pioneer Mills.
	Jordan	Not located.
	Juggernaut	7¾ miles west of Charlotte.
	Kearns (Hopewell)	10 miles west of north of Charlotte
	King Solomon	2½ miles northeast of Charlotte.
	Maxwell (Hagler)	11 miles east of Charlotte.
	Mayberry	1½ miles south of Huntersville.
	McCleary (McLeary?) (Williams).	1½ miles southeast of Paw Creek.
	McCombs	5 miles northeast of Charlotte.
	McCord	6 miles northwest of Charlotte.
	McCorkle	8 miles southwest of Charlotte.
	McDonald (Wilson)	1 mile southeast of Paw Creek.
	McGee	5–10 miles northwest of Charlotte.
	McGinn	5 miles northwest of Charlotte.
	McGinn, copper	Do.
	Mears (Means)	Do.
	Mole Hill (Dunlop)	8 miles northwest of Charlotte.
	Moore	Not located.
	Neal, F. S.	6 miles northeast of Charlotte.
	Neal, T. G.	8 miles northeast of Charlotte.
	Newell	Not located.
	Nolan	5 miles north of Charlotte.
	Orr, R. B.	5 miles north of east of Charlotte.
	Parks	1 mile northeast of Charlotte.
	Pharr	Not located.
	Plummer	7 miles west of north of Charlotte.
	Point	1 mile west of Charlotte.
	Poplin	11 miles south of east of Charlotte.
	Prim	5 to 10 miles northwest of Charlotte.
	Pruit, S. I.	2 miles southeast of Huntersville.
	Queen of Sheba	2¼ miles northeast of Charlotte.
	Ray (Rhea, Rea, Baltimore-North Carolina).	2 miles northwest of Matthews.
	Rudisil	Charlotte city limits.
	Shaffer	11 miles south of east of Charlotte.
	Simpson	10 miles east of Charlotte.
	Sloan	8 miles northwest of Charlotte.
	Smith (Palmer) (Wilmore)	1½ miles southwest of Charlotte.
	Smith and Palmer	1 mile south of Charlotte.
	St. Catherine	Charlotte city limits.
	Stewart (Stuart)	4½ miles northwest of Charlotte.
	Summerville (Wilhelmina)	6 miles northwest of Charlotte.
	Surface Hill	11 miles south of east of Charlotte.
	Taylor (Isenhour)	½ mile south of Charlotte.
	Teeter, Zeb (Champion)	6½ miles east of Charlotte.
	Todd	5 miles northwest of Charlotte.
	Tredenick	7 miles southeast of Charlotte.
	Trotter	2 miles southwest of Charlotte.
	Troutman	5 to 10 miles northwest of Charlotte.
	Walker	8 miles west of Charlotte.
	Wilhelmina (Summerville)	6 miles northwest of Charlotte.
	Wilmore (Wilson-Woods, Smith, Palmer).	1½ miles southwest of Charlotte.
	Wilson (McDonald)	1 mile southeast of Paw Creek.
	Wilson, F.	Near Charlotte.
	Wilson, Stephen	4 miles west of Capps mine.
	Wilson-Woods (Wilmore)	1½ miles southwest of Charlotte.
	Woodruff (Woolworth)	3 miles south of west of Charlotte.
	Yellow Dog (Isenhour)	½ mile south of Charlotte.
Montgomery	Appalachian (Coggins)	2 miles northwest of Ophir.
	Beaver dam placer	Flagtown post office, northeast corner of Montgomery County.
	Black Ankle	4 miles north of Ether.
	Bright	West flank of Uharie Mountains.
	Buck Mountain	7 miles north of west of Troy.
	Bunnell Mountain placer	West flank of Uharie Mountains.
	Carter	3 miles east of Troy.
	Christian, Sam, placer	4½ miles west of Wadeville.
	Coggins (Appalachian, Rich Cog).	2 miles northwest of Ophir.
	Coggins, Sallie	3½ miles southwest of Ophir.
	Crump	4 miles south of west of Ophir.
	Curry (Iola)	2 miles west of Candor.
	Davis (Ophir)	West flank of Uharie Mountains.
	Deep Flat placer	Do.
	Dry Hollow placer	Do.
	Dutchman's Creek placer	Do.
	Grandman	4 miles southwest of Ophir.
	Griffin	1½ miles northeast of Russell.
	Harbin	2 miles southeast of Moratock.
	Henderson	
	Iola (Uwarra, Martha Washington).	2 miles northwest of Candor.
	Island Creek placer	West flank of Uharie Mountains.
	Martha Washington	2 miles northwest of Candor.
	Montgomery	2½ miles northwest of Candor.
	Moore	Northeast part of Montgomery County.
	Moratock (Worth)	1 mile southeast of Moratock.
	Morris Mountain	2½ miles west of Ophir.
	Nall	Near Stokes' Ferry.
	Ophir (Davis)	West flank of Uharie Mountains.
	Palmer (Russell)	3 miles north of Ophir.
	Pear Tree Hill	West flank of Uharie Mountains.
	Peebles (Russell)	3 miles north of Ophir.
	Reynolds	4 miles northeast of Troy.
	Richcog (Coggins)	2 miles northwest of Ophir.
	Riggan Hill	1 mile northeast of Ophir.

North Carolina gold localities—Continued

County	Name	Location
Montgomery	Russell (Palmer, Peebles)	3 miles north of Ophir.
	Saunders, Tebe	2 miles east of Moratock.
	Sedberry	1 mile south of Onvil.
	Spanish Oak Gap placer	West flank of Uharie Mountains.
	Sted	Not located.
	Steel	1 mile west of Ophir.
	Swift Creek	Southwest part of Montgomery County.
	Tone's Creek placer (Toms Creek).	West flank of Uharie Mountains.
	Troy	6 miles north of Troy.
	Uwarra (Iola)	2 miles northwest of Candor.
	Worth (Moratock)	1 mile southeast of Moratock.
Moore	Bat Roost	½ mile to 3 miles west and north of the Brown mine.
	Bell	7 miles east of Carter.
	Brown (Burnes, Alred)	2 miles southwest of Hemp.
	Cagle (Laurel Hill, Hancock, Talc).	1½ miles southwest of Hemp.
	Cameron placer	5 miles northwest of Carter.
	Clegg (Wright)	1½ miles west of Hemp.
	Cotton	4 miles northeast of Carter.
	Dry Hollow (Jenkins)	2 miles south of Hemp.
	Elise	Near Hemp.
	Grampusville (Grampus)	4½ miles southeast of Carter, south of Sewell property.
	Hancock (Cagle)	1½ miles southwest of Hemp.
	Jackson	7 miles northeast of Carter.
	Jenkins	2 miles south of Hemp.
	Laufman	Not located.
	Laurel Hill (Cagle)	1½ miles southwest of Hemp.
	Monroe	2 miles southwest of Spies.
	Moody	2 miles southwest of Carter.
	Red Hill	1 mile southwest of Hemp.
	Richandson	2½ miles south of Hemp.
	Ritter	4 miles northeast of Carter.
	Sewell	4½ miles southeast of Carter.
	Shields	½ mile to 3 miles north and west of Brown mine.
	Talc (Cagle)	1½ miles southwest of Hemp.
	Wright (Clegg)	1½ miles west of Hemp.
Nash	Argo	Not located.
	Arrington	1 mile southeast of Portis mine, Franklin County.
	Conyers	7 miles from Whitakers, on Fishing Creek.
	Kearney	Near Portis mine.
	Mann	Do.
	Mann-Arrington	Argo Post Office, in northwest corner Nash County.
	Taylor	Near Portis mine.
	Thomas	Do.
Orange	Robeson	12 miles northwest of Chapel Hill.
Person	Durgy	3½ miles south of Virginia line and 1 mile west of Granville County.
	Yancey	North-central Person County, southern part of Virgilina copper belt.
Polk	Adams	Not located.
	Carpenter Double Branch Hamilton MacIntire L. A. Mills Neal Patty Abrams Ponder Prince (Price) Red Springs Riding Smith Splawn Tom Arms Wetherbee	Continuation of the South Mountain area, southern part of Polk County.
Randolph	Allred (Burns, Overton, Randolph)	10 miles northeast of Asheboro.
	Asheboro (Jones)	2½ miles south of Asheboro.
	Boson	Not located.
	Branson	6 miles south of Asheboro.
	Brown Hill (Delph)	2½ miles northwest of Jackson Creek.
	Burns (Allred)	10 miles northeast of Asheboro.
	Cameron Mountain (Southern Homestake)	3½ miles northwest of Jackson Creek.
	Coburn	7 miles southwest of Asheboro.
	Conroy (Dorr's Hill)	3½ miles west of Asheboro.
	Copple (Spencer, Ruth)	6 miles north of Jackson Creek.
	Davis Mountain (Dorr's Hill)	3½ miles west of Asheboro.
	Delph (Delft, Lytton, Hermonring, Empire, Miller, Brown Hill, Loflin Big A cut, Laughlin, Lofflin).	2½ miles northwest of Jackson Creek.
	Dorr's Hill (McAllister, Davis Mountain, Conroy).	3½ miles west of Asheboro.
	Dowd (Rush)	
	Empire (Delph)	2½ miles northwest of Jackson Creek.
	Gluyas	
	Goliham (Smith)	7 miles east of south of Asheboro.
	Gold Bowl (Pugh)	6½ miles north of east of Asheboro.
	Gray	2 miles west of Asheboro.
	Griffin	Southwest corner Randolph County.
Randolph	Harney	7 miles southeast of Asheboro.
	Herring (Delph)	2½ miles northwest of Jackson Creek.
	Hill (Talbert)	Southwest corner Randolph County.
	Hoover Hill	5 miles northeast of Jackson Cree
	House (McGrew)	1¾ miles south of Asheboro.
	Johnson (Porter)	8 miles southeast of Asheboro.
	Jones (Keystone)	3½ miles north of Jackson Creek.
	Jones (Asheboro)	2½ miles south of Asheboro.
	Keystone (Jones)	3½ miles north of Jackson Creek.
	Kindley (Parish)	2 miles north of Jackson Creek.
	Kindley (Wilson)	4 miles northeast of Jackson Creek.
	Kismet (Parish)	2 miles north of Jackson Creek.
	Laughlin, John	9 miles northeast of Asheboro.
	Laughlin Loflin Lofflin (Delph)	2½ miles northwest of Jackson Creek.
	Lowdermilk (McAdoo)	7 miles south of Asheboro.
	Lytton (Delph)	2½ miles northwest of Jackson Creek.
	McAdoo (Lowdermilk)	7 miles south of Asheboro.
	McAllister (Dorr's Hill)	3½ miles west of Asheboro.
	McGrew (House)	1¾ miles south of Asheboro.
	Merrill	3 miles southwest of Worthville.
	Miller (Delph)	2½ miles northwest of Jackson Creek.
	Newby (Newberry)	4 miles south of west of Asheboro.
	New Sawyer (Ross, Powell)	3½ miles southwest of Randleman.
	Overton (Allred)	10 miles northeast of Asheboro.
	Parish (Kindley, Kismet)	2 miles north of Jackson Creek.
	Pee Dee (Spoon)	6 miles south of east of Asheboro.
	Pierce Mountain	8 miles northeast of Asheboro.
	Pilot Mountain (Porter)	8 miles southeast of Asheboro.
	Pine Hill	Do.
	Porter (Johnson, Pilot Mountain).	Do.
	Powell (New Sawyer)	3½ miles southwest of Randleman.
	Prichett	1 mile northeast of Asheboro.
	Pugh (Gold Bowl)	6½ miles north of east of Asheboro.
	Randolph (Allred)	10 miles northeast of Asheboro.
	Redding	4½ miles northeast of Asheboro.
	Ross (New Sawyer)	3½ miles southwest of Randleman.
	Rush (Dowd)	8 miles southwest of Asheboro.
	Ruth (Copple)	6 miles north of Jackson Creek.
	Sawyer	8 miles northwest of Asheboro.
	Scarlett	2 miles north of Asheboro.
	Slack	2½ miles south of Asheboro.
	Sloan	5 to 10 miles west-northwest of Charlotte.
	Smith (Goliham)	7 miles east of south of Asheboro.
	Southern Homestake (Cameron Mountain).	3½ miles northwest of Jackson Creek.
	Spencer (Copple)	6 miles north of Jackson Creek.
	Spoon (Pee Dee)	6 miles south of east of Asheboro.
	Stafford	Southwestern corner Randolph County.
	Talbert (Hill)	Do.
	Uwharrie (Uharie)	12 miles southwest of Asheboro.
	Wilson (Kindley)	4 miles northeast of Jackson Creek.
	Winslow	5 miles southwest of Asheboro.
	Winningham	2½ miles northeast of Asheboro.
Rowan	Atlas	4 miles east of Rockwell.
	Bame (Jacob Holtshauser)	Do.
	Bame	2 miles west of Granite Quarry.
	Barnhardt (Miller)	1 mile south of Gold Hill.
	Bullion	2¼ miles southeast of Granite Quarry.
	Camp Ridge	4 miles east of Rockwell.
	Dunn's Mountain	1½ miles north of Granite Quarry.
	Dutch Creek	4½ miles north of Gold Hill.
	Gold Coin	Near Gold Hill.
	Gold Hill (Randolph)	Gold Hill.
	Gold Knob	4 miles northeast of Rockwell.
	Goodman	2 to 9 miles southwest of Salisbury.
	Graf (Jacob Holtshauser)	4 miles east of Rockwell.
	Holtshauser, Jacob (Graf, Bame).	Do.
	Harrison	4 miles southwest of Granite Quarry.
	Hartman	2 miles southwest of Salisbury
	Hill	2 to 9 miles southwest of Salisbury.
	Honeycutt (Union Copper)	1 mile southwest of Gold Hill.
	Miller (Barnhardt)	1 mile south of Gold Hill.
	Negus	2 to 9 miles southwest of Salisbury.
	New Discovery	2 miles north of Granite Quarry.
	Parks	2 miles north of east of Granite Quarry.
	Randleman	2 to 9 miles southwest of Salisbury.
	Randlph (Gold Hill)	Gold Hill.
	Reimer	1 mile east-southeast of Granite Quarry.
	Roseman	2 to 9 miles southwest of Salisbury.
	Rumple (Rumpler)	1 mile north of Gold Hill.
	Southern Belle	4½ miles southwest of Granite Quarry.
	Standard (Gold Hill)	Gold Hill.
	Steele	Not located.
	Tuxler (Drexler)	6 miles east of Salisbury.
	Union Copper (Honeycutt)	1 mile southwest of Gold Hill.
	Varnadore	2 miles northeast of Rockwell.
	Yadkin	Not located.
Rutherford	Biggerstaff	Near Golden.
	Carson	Not located.
	Double Branch	Do.

North Carolina gold localities—Continued

County	Name	Location
Rutherford	Elwood	3 miles N. 20 E. from Rutherfordton.
	Glendale	Not located.
	Golden Valley	4½ miles from Brindletown.
	Idler (Alta, Monarch)	5 miles north of Rutherfordton.
	Jones	Not located.
	Leeds	100 feet north of Elwood mine.
	Melton	Near Golden.
Stanly	Barringer	Northwest corner of Stanly County.
	Crawford (Ingram) placer	4 miles south of east of Albermarle.
	Crowell	1½ miles northeast of New London.
	Eudy	8 miles west of Albemarle.
	Fesperman placer	4 miles east of Albemarle.
	Flint Springs placer	1 mile east of New London.
	Haithcock	2½ miles west of Albermarle.
	Hearne	Do.
	Henderson	Near New London.
	Ingram (Crawford) placer	4 miles southeast of Albermarle.
	Kimball Hill	2 miles northeast of New London.
	Lowder	2½ miles west of Albermarle.
	Mumford placer	1 mile west of New London.
	Parker	New London.
	Thompson	5 miles east of Albermarle.
Swain	Everett	
	Fontana	
Transylvania	French Broad placers	
Union	Black	½ mile east of Indian Trail.
	Bonnie Bell (Washington)	1½ miles northwest of Mineral Springs.
	Bonnie Doon (Smart)	1 mile northeast of Indian Trail.
	Brewer	Not located.
	Bright Light (Crowell)	Northwest corner of Union County.
	Brown Hill	3½ miles south of Indian Trail.
	Butterfield	4¼ miles east of Indian Trail.
	Crowell (Brightlight)	Northwest corner of Union County.
	Crump	4 miles east of Indian Trail.
	Davis	10 miles northwest of Monroe.
	Dulin	3½ miles northeast of Indian Trail.
	East Hill	4½ miles southwest of Indian Trail.
	Fag Hill (Fox Hill)	3½ miles northeast of Indian Trial.
	Fogler Hill	10 miles northwest of Monroe.
	Ford	5 miles northeast of Indian Trail.
	Fox Hill (Fag Hill)	3½ miles northeast of Indian Trail.
	Grand Union (Includes Howie, Wyatt, Washington, and Penman).	Indian Trail.
Union	Harkness	3½ miles south of Indian Trail.
	Hemby	4 miles southwest of Indian Trail.
	Howie (Colossus)	3 miles east of north of Waxhaw.
	Long	2 miles southwest of Midland Brief.
	Lemmonds	4¼ miles northeast of Indian Trail.
	Lewis	4½ miles southwest of Indian Trail.
	McClarty	2 miles east of north of Waxhaw.
	McNeely	4 miles south of Mineral Springs.
	Mint Hill	10 miles northwest of Monroe.
	Moore (Blue Shaft)	4 miles southwest of Midland Brief.
	Moore Hill	10 miles northwest of Monroe.
	Moore (Wentz)	4½ miles southwest of Midland Brief.
	Nesbit	2½ miles southwest of Waterloo.
	New South	4½ miles southwest of Midland Brief.
	Ore Hill	5 miles southwest of Indian Trail.
	Penman	1½ miles northwest of Mineral Springs.
	Phifer (Phiffer) (Price)	5 miles southwest of Indian Trail.
	Phifer, Henry	1 mile northwest of Indian Trail.
	Phifer, Sam	4 miles northwest of Indian Trail.
	Price (Phifer)	5 miles southwest of Indian Trail.
	Rogers, Grady	2½ miles northwest of Waxhaw.
	Rogers, Wiley	3 miles northwest of Waxhaw.
	Secrest	2 miles northeast of Indian Trail.
	Smart (Bonnie Doon)	1 mile northeast of Indian Trail.
	Stewart	5½ miles northeast of Indian Trail.
	Strothers	2 miles northeast of Weddington.
	Union	
	Vinsons Half Acre	2½ miles northeast of Waxhaw.
	Washington (Bonnie Bell)	1½ miles northwest of Mineral Springs.
	Wenona	
	Wyatt	2½ miles northeast of Waxhaw.
Watauga	Hardin's	1 mile north of Boone.
	Howard's Creek	
Wilkes	Bryan's Gap (Trap Hill)	Bryan's Gap.
	Flint Knob	6 miles east of Deer Gap, southwest Wilkes County.
	Roaring River placer	Northern Wilkes County.
	Trap Hill	Bryan's gap.
Yadkin	Dixon	8 miles southeast of Yadkinville.
	Gross	7 miles southeast of Yadkinville.

BURKE COUNTY

MILLS

The Mills property, 13 miles southwest of Morganton, in the South Mountain region, is a large tract that includes the site formerly occupied by the mining camp of Brindletown. Many placer deposits have been mined on it. In a report made in 1916, William E. Hidden estimated the production of the tract at more than $1,000,000. The gold was 0.825 to 0.827 fine and occurred mostly in small grains, though a few nuggets were found, the largest weighing 1½ ounces. Considerable monazite sand was recovered with the gold. On the basis of the recovery from test holes, Hidden estimated the average gold content in remaining parts of the deposit at 50 cents to the cubic yard.

As described by Hidden, the mining history of this region began in 1828, with the discovery of gold at the ford of Brindle Creek, named from the Brindle family, the first settlers. The tract that includes this locality came into the possession of Captain Mills, grandfather of the present owner, Miss May Mills, about 1835 and, except for the operations of a few leasers, it has been mined by the Mills family ever since. In the course of the mining several small veins and stringers of gold-bearing quartz were uncovered, and for a time considerable gold was recovered with a 5-stamp mill operated on ore mined from the upper parts of these veins and on loose fragments or float from the veins. In addition to monazite, the placer concentrate contained more or less zircon, fergusonite (an unusual mineral, essentially an oxide of niobium and tantalum with varying amounts of such rare metals as erbium, cerium, and uranium), xenotime (yttrium phosphate), rutile, garnet, and corundum. A large crystal of clear beryl was found in 1874.

CABARRUS COUNTY

ALLEN FURR

In 1934 and 1935 development work was done and ore produced at the Allen Furr mine (known also as the Eva Furr mine and the Silver Valley mine), in Cabarrus County half a mile south of Georgeville. This mine is on a vein that strikes a little west of north and cuts across moderately schistose beds of tuff representing the volcanic series. Near the surface the rock is altered to saprolite, in which a foliation or cleavage is the most noticeable structure. At a depth of about 40 feet the alteration is less conspicuous and the rock is seen to be a fine-grained thin-bedded water-laid tuff in which a distinct slaty cleavage has developed. The workings include shallow pits and trenches and a shaft 70 feet deep, from which, prior to May 1935, drifts had been driven about 75 feet northward and southward on the 45-foot level. The vein is a well-defined tabular body that pinches and swells, ranges from 6 inches to 5 feet or more in width but is mostly from 1 to 3 feet wide.

It extends along a fault fracture that shows evidences of both premineral and postmineral movement, and in the north drift it is slightly displaced by several cross faults. The vein filling consists of quartz and sulfides, chiefly pyrite, galena, and sphalerite. Samples from a stock pile of 150 tons representing "run of mine" ore in 1934 assayed 0.17 to 0.27 ounce of gold, 2 to 3 percent of lead, 3 to 5 percent of zinc, and about 2 ounces of silver to the ton. A selected sample, consisting chiefly of the sulfides mentioned above, assayed 11 percent of zinc, 18 percent of lead, and 10 ounces of silver to the ton. It contained no more gold than the samples that were relatively low in sulfides. All the samples contained a little copper. Considerable ore was shipped from the Allen Furr property in 1935, but its value was not learned.

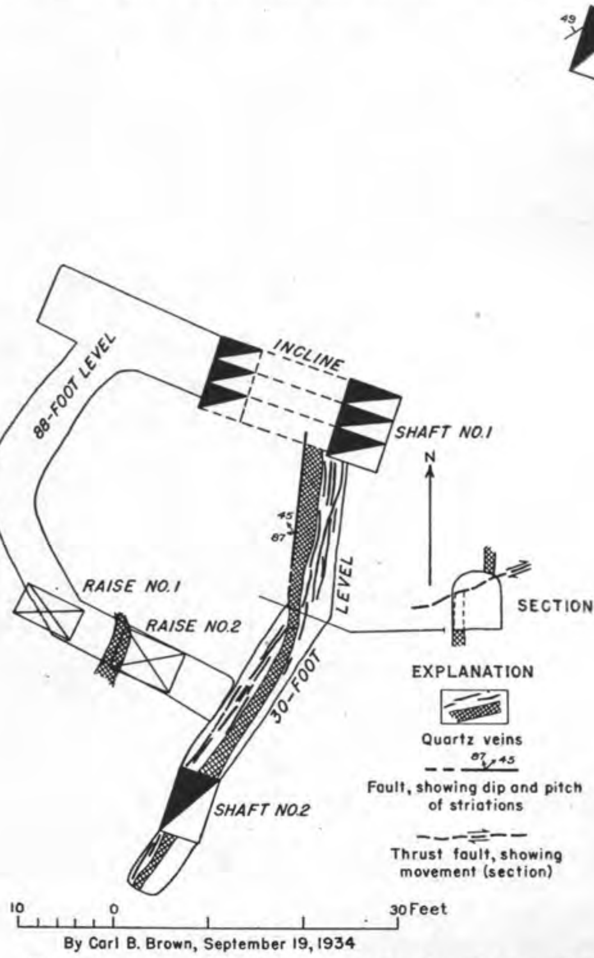


FIGURE 10.—Plan and section, Crayton mine, Cabarrus County, N. C.

CRAYTON

The Crayton mine, 2½ miles north of Georgeville, is on a lode 2 to 6 feet wide, composed of several veins and stringers of quartz and calcite in slaty rocks of the volcanic series.

The lode was discovered about 1923 and has been explored by three shafts, the deepest of which in September 1934 was 88 feet deep. Short levels had been driven from this shaft at 30 feet and at the bottom (fig. 10). The equipment includes a steam hoist and a 10-stamp mill. A mill run on 30 tons of ore is reported to have recovered $6.47 (0.32 ounce) to the ton by amalgamation. In addition, one part of concentrate was produced from 50 parts of crude ore.

The lode ranges in strike from N. 10° to 35° E. and dips about 50° NW. It follows a fracture zone and consists largely of quartz that has replaced parts of the country rock, leaving other parts as dark bands parallel to the walls and as detached fragments. A little pyrite is present in scattered grains and cubes, and there are films of pyrite in both the vein and the wall rock. Gold occurs as minute grains in the quartz.

The lode is cut by three or more undulating low-angle faults of westward dip, on which reverse or overthrust movements have occurred, causing at one place a displacement of 14 feet. At another place, northeast of shaft No. 2 (fig. 10), the lode is cut off by a nearly vertical fault that strikes N. 8° E.

FURNISS FURR

The newer workings at the Furniss Furr mine, half a mile southwest of the Barrier mine and near the northeast bank of Rocky River, include shafts and pits on two veins that strike about N. 33° E. and cut greenstone schist. One of the veins, as exposed in a cut made in 1934, dips steeply northwest and is made up of two sheets of quartz separated by a horse of schist. The hanging-wall quartz, which is a foot or more thick, is flinty in character and includes abundant pyrite. On the footwall there is about a foot of quartz, part of it cellular and iron-stained, and part of it enclosing bunches of pyrite. Associated with this footwall quartz is a streak of barite.

Older workings extending 1,500 feet to the north include two or three shafts, the dumps of which contain more or less iron-stained quartz. A fairly good showing of fine gold was panned from the dump of a shaft on the west vein. A shipment of ore from this mine containing a little more than 15 tons, was treated by flotation in August 1934 at the plant of the White Star Mining Co., at Smyrna, S. C. The mill heads assayed $15.37 (about 0.44 ounce) gold per ton, the ratio of concentration was 11.1 to 1, and the tailings assayed $2.10 (0.06 ounce). The net return to the shipper after deducting mill and smelter charges was $8.90 per ton.

NUGGET (BIGGERS) PLACER

The Nugget or Biggers placer, a mile northeast of Georgeville on land belonging to M. E. Herrin of Charlotte, N. C., gained attention in 1932 as the source of a nugget that weighed 12½ pounds and sold for $3,400. A 10-pound nugget is said to have been found some years ago. According to local reports, the mine had been worked now and then during the period 1885–1935, and the total production of the mine is estimated at $80,000 (4,000 ounces) or more.

In the summer of 1933 gravel ("grit") from this deposit was transported a short distance in wheelbarrows to a plant consisting of two concrete mixers arranged in tandem, which disintegrated the clayey material by washing and then delivered it to sluice boxes, in which the gold was recovered from the sludge with the aid of quicksilver.

Most of the workings are scattered along a dry ravine that heads near the crest of a low ridge. The lower slope of the ridge is underlain by schist derived from a siliceous tuff of the volcanic series, and the summit consists of greenstone representing a basic member of the same series. Small veins of cellular rusty quartz cut the greenstone, and some of them contain a little pyrite and, rarely, galena. The veins are explored by a number of shallow pits.

PHOENIX

The Phoenix mine, 6 miles southeast of Concord, was discovered before 1856, at which time it had been developed to a depth of 140 feet. During the 1880's it was operated by Adolph Thies, who extracted the free gold by amalgamation and recovered the remainder with a modification of the Mears chlorination process, which he perfected and later used successfully at the Haile mine in South Carolina. During the last period of operation, extending from 1900 to 1906, the mine was worked by the Miami Mining Co., which is said to have sustained a considerable loss. In the summer of 1934 the surface equipment was gone, the buildings were down, and the shafts were caved. The total production is estimated at $400,000 in gold.

The country rock is a fine-grained, dark greenish-gray variety of diorite, partly altered to an epidote-chlorite schist.

According to published and unpublished reports,[44] the main vein, called the Phoenix, was explored for a distance of 700 feet from two shafts, each 600 feet deep, from which several levels were driven. A winze was sunk 40 feet below the 600-foot level, and from the bottom of this winze a drift was turned. An ore body 300 feet long has been largely stoped out above the 425-foot level. There is also a large stope above the 200-foot level, and several small ore shoots have been mined in other parts of the lode down to the 520-foot level (see fig. 11).

The Phoenix vein strikes N. 57° W., dips 80° NW., and extends along a shear zone. On the lower levels the vein is a mere stringer in some places and as much as 4 feet wide in other places; its width averages about 15 inches for distances of 300 to 500 feet (see fig. 12). The vein is narrower in the drift from the winze at 640 feet depth. In places the vein splits into two parts, and stringers branch from it to follow nearby parting planes in the schist, or fractures that cross them. Some post-mineral movement is indicated by slickensides on the walls and on parting planes within the vein.

The ore minerals are pyrite, chalcopyrite, free gold, and very subordinate galena. The gangue consists of quartz, barite, and members of the carbonate series, calcite-ankerite-siderite. Emmons[45] states (1856) that at a depth of 140 feet the oxidized ore that had yielded from 1 to 3 dollars per bushel, was succeeded by ore consisting mainly of white quartz and barite, which yielded only 25 cents a bushel (about ¼ ounce per ton).

Below the oxidized zone the sulfides, localized for the most part in bands near the walls, constituted from 3 to

[44] Balch, D. M., Mines, miners, and mining interests in the United States in 1882, pp. 1101–1105, Philadelphia, Baird, 1883. Emmons, Ebenezer, Geological Report on the Midland Counties of North Carolina, pp. 177–178, Raleigh, H. D. Turner, and New York, G. R. Putnam Co., 1856. Genth, F. A., Mineralogical notes in American Journal Science, 2d ser., vol. 19, pp. 16, 18, 1855; vol. 28, p. 248, 1859; vol. 45, p. 316, 1868. Lake, M. C., unpublished report, May 15, 1928, and supplement, Feb. 24, 1934. Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina; North Carolina Geol. Survey Bull. 3, pp. 121–122, 1896. Pratt, J. H., The mining industry in North Carolina during 1906; North Carolina Geol. and Econ. Survey, Economic Paper 14, 1907. Notes in Eng. and Min. Jour., vol. 30, September 18, 1880; vol. 42, September 11, 1886; vol. 43, April 30, 1887; vol. 70, November 24, 1900; vol. 74, November 1, 1902; vol. 75, January 24, 1903; vol. 76, July 25, 1903; vol. 78, December 8, 1904. Precious metals reports of the U. S. Bureau of the Mint for 1882 and 1890.

[45] Emmons, Ebenezer, op. cit., p. 177.

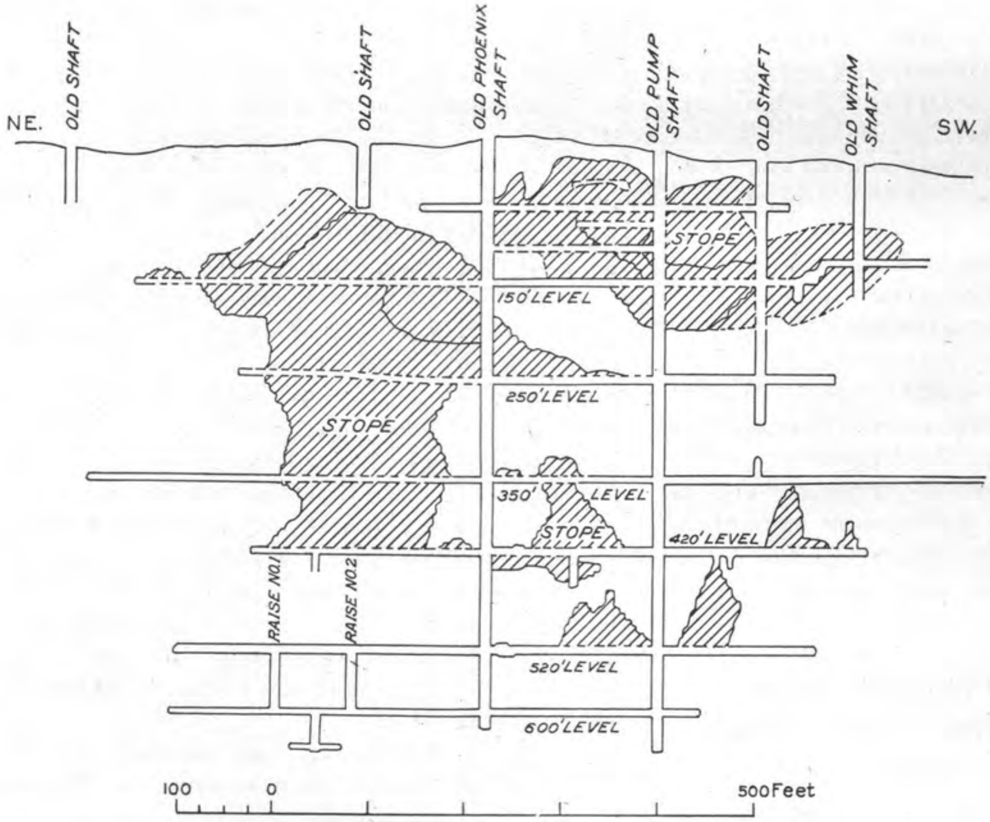


FIGURE 11.—Longitudinal section through Phoenix workings, Cabarrus County, N. C.

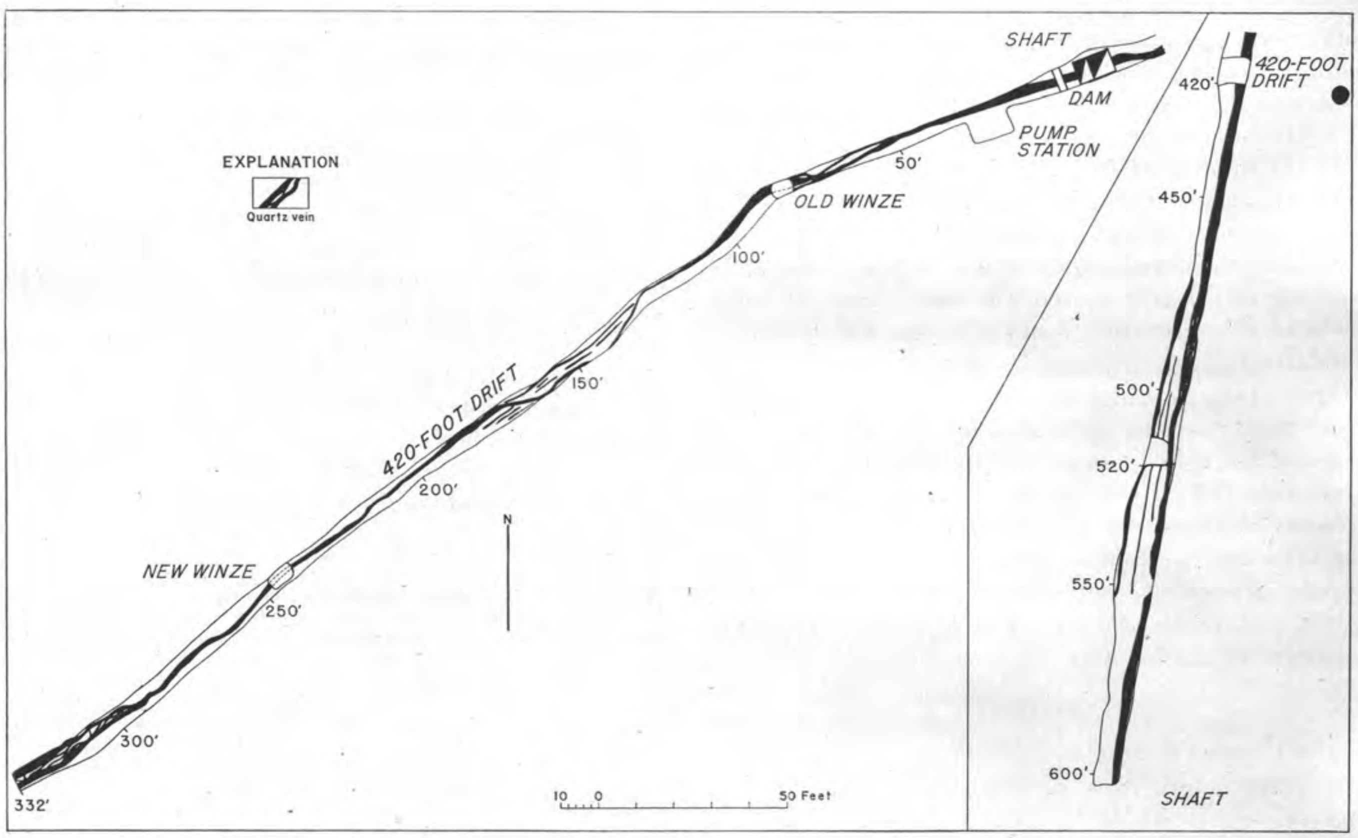


FIGURE 12.—Plan of part of 420-foot level and section of shaft below 420 feet, Phoenix mine, Carbarrus County, N. C. From surveys by Miami Mining Co.

60 percent of the vein. The shoot worked by Thies above the 425-foot level yielded \$10.00 per ton by amalgamation, \$7.50 per ton remaining in the sulfides, of which 90 to 95 percent was recovered by chlorination. The ore contained from 1 to 3 percent of copper. On the 600-foot level, northeast of the shaft, the vein was 15 to 24 inches wide for a distance of 200 feet and averaged nearly 1 ounce in gold per ton. Southwest of the shaft, on the same level, the vein contained about a quarter of an ounce per ton. On the 520-foot level. the average gold content was 0.47 ounce per ton for 300 feet northeast of the shaft and 0.83 ounce per ton for 290 feet southwest of it. On the 420-foot level, an ore shoot 75 feet long southwest of the shaft assayed about 1 ounce of gold per ton, and from 130 feet to 320 feet southwest of the shaft the average gold content was about 0.9 ounce per ton. Sampling in the shaft from 520 feet to 570 feet depth gave an average of 2¼ ounces per ton for a streak that averaged 1 foot in width. From 570 feet to the bottom (604 feet) the gold content was only 0.7 ounce per ton.

There are known to be several other veins in the Phoenix property. One, called the "copper vein" lies about 1,000 feet southeast of the Phoenix vein. Old workings indicate that it strikes N. 60° E. Another lies a little farther southeast and two that are not developed meet the Phoenix vein at very small angles near the main shafts.

PIONEER MILLS

The Pioneer Mills mine, 5 miles southeast of Harrisburg, is said to have been opened as early as 1844. Emmons[46] mentions the recovery of \$5,674 (about 283 ounces) of gold from different lots of ore that add up to 1,677 bushels (probably about 100 tons). Except for brief periods the mine appears to have remained closed since the late 1850's.

In the spring of 1934 the workings were unwatered, surveyed, and sampled under the direction of H. A. Herzog. According to a report made at that time to C. W. Abernethy, the owner of the mine, the workings include a shaft, sunk to a depth of 147½ feet, the first 50 feet being vertical and the remainder on an incline, from which drifts were turned at several levels. Those on the 100- and 130-foot levels extend southwest 44 feet and 222 feet respectively. One at 133 feet depth extends only 16 feet northeastward. Older workings at higher levels extend as much as 770 feet southwest from the shaft. Stopes raised from the 130-foot level are 180 feet long at the level, but lengthen to 700 feet near the surface. Their average width is estimated to be 3 feet or more. The workings were again under water when the area was visited by a Geological Survey party later in the season.

The country rock is a dark greenish-gray diorite or a related granitic rock. The vein is in a fracture or shear zone that strikes N. 80° E., and that dips 80° NW. at the surface but flattens to 50° at the 130-foot level. The vein is cut off just east of the shaft by a cross-fault dipping steeply west. On the 130-foot level the vein is about 4 feet wide and has slickensided walls coated with gouge. It contains about 2 feet of quartz, enclosing pyrite, chalcopyrite, and a little ankerite. Samples were cut at intervals of 5 feet along a stretch extending for 80 feet from the face of the drift. In a section near the face that is 20 feet long and averages 19 inches in width, the gold content was 0.32 ounce per ton. Disregarding a sample at 55 feet from the face that contained 0.86 ounce, the 80-foot length averaged only 0.09 ounce per ton.

REED

The Reed (Reid) mine, 2½ miles south of Georgeville, includes both placers and lodes. It is the site of the first authenticated discovery of gold in North Carolina, made in 1799 and apparently contained the richest placer deposit ever found in that State. It was especially noteworthy for the size and number of nuggets produced. Nuggets listed by Wheeler (History of North Carolina) as having been recovered between 1803 and 1835 had a total weight of 115 pounds, and individually they weighed from 1 to 24 pounds. Production for the same period is popularly estimated as more than \$1,000,000.

The early history of the mine is related in considerable detail by Partz,[47] and brief notes about its operations in the period 1894–99 are found in the Engineering and Mining Journal.[48]

The lodes were not mined until after 1831. During the next 4 years they were actively exploited by lessees ("tributers"). Ore found near the surface commonly yielded \$100 or more to the bushel (about 100 pounds). For a long time after 1835 the mine was idle as a result of litigation and the distribution of the Reed estate. In 1854 a company was organized to work the lodes but apparently did little. Spasmodic mining was carried on between 1881 and 1887 and again from 1894 to 1899. During the latter period a 10-stamp mill was built, and in the course of mining a nugget was found that weighed 25 pounds, of which 22 pounds was gold and the remainder quartz. The last run of the mill was on ore from a 20-foot zone that yielded 60 cents a ton. In 1934 a few miners were still washing parts of the residual placer deposit and were each recovering about 50 cents per day with barrel rockers of the type used at the same place more than 100 years before.

[46] Emmons, Ebenezer, Geologic report of the Midland Counties of North Carolina, pp. 178–180, Raleigh, H. D. Turner, and New York, G. R. Putnam Co., 1856.

[47] Partz, August, The Reed mines, North Carolina: Mining Mag., 1st ser., vol. 3, pp. 161–168, 1854.

[48] Eng. and Min. Jour., vols. 58, p. 374, 1894; 59, pp. 374, 590, 1895; 61, p. 190, 1896; 62, p. 614, 1896; 67, p. 302, 1899; 68, pp. 318, 498, 1899.

The Reed property includes a long ridge, trending slightly east of north, that rises 50 to 75 feet at the east of Little Meadow Creek. A saddle near the southern end of the ridge divides it into a southern part, known as the "lower hill," and a northern part, known as the "upper hill."

The country rocks are fine-grained tuffs of the volcanic series and a sill of greenstone intruded into the tuff. The greenstone forms the crest of the ridge and is about 150 feet wide.

The gold-bearing material that can be worked by placer methods is of three intergrading types: (1) decomposed rock remaining practically in place; (2) a modified form of the first, produced by the action of gravity and by variations of temperature, which together cause the loosened material to creep down the slopes; and (3) material that has reached the valleys and been reworked by the streams. All these materials are generally from 2 to 10 feet deep. The gold became more and more concentrated toward the bottom as the deposit passed from the residual to the alluvial type. The gold-bearing float leads directly uphill to the outcrops of quartz veins.

Early operations at the mine were confined to the alluvial material composing the floodplain of Little Meadow Creek. This deposit has an average width of about 250 feet, and practically all of it has been worked and reworked for a distance of more than a mile. The area is poorly drained and swampy, and the early work was carried on by sinking pits 15 or 20 feet square to bedrock and taking out the "grit" for washing. When one pit was exhausted the operator sank another, dumping the waste into the first one, and so on. Placer work that was being carried on in 1935 was confined for the most part to the residual material classified under numbers 1 and 2 above.

Quartz veins were discovered on the hill above the creek at an early date, and before 1855 a shaft had been sunk on one of them to a depth of 90 feet. Lode mining was carried on intermittently from 1881 to 1887. A 10-stamp mill was erected about 1895 and was operated for several years.

Several veins from 1 to 6 feet in width and a large number of branching veinlets and stringers of quartz together form a broad stringer lode or mineralized zone, said to have a width of 200 feet, that trends northeast and dips 45° to 70° SE. Surface workings indicate that the lode persists for 2,000 feet or more along the strike. Apparently it has been explored little if at all below a depth of 120 feet.

A tunnel driven eastward into the zone along the ridge was accessible in 1934. It cuts dozens of small quartz stringers and several veins, the largest of which is 6½ feet wide (fig. 13). The greenstone, moreover, has been partly replaced by quartz for a considerable distance along the tunnel. The general strike of the veins is N. 25° to 30° E. and their dip southeastward.

The country rock is cut by a number of reverse faults that strike northeast and dip 45° to 60° NW.

OTHER MINES AND PROSPECTS

At the Allen Boger mine, 4 miles north of Cabarrus station and 2 miles south of Rocky River, pits and trenches partly filled with debris and overgrown with vegetation, are distributed for a distance of 375 feet along a course of about N. 25° E. In addition to a little quartz, the dumps contain fragments of a coarse-grained diorite or related rock in which there are dark-green hornblende needles up to half an inch in length, more or less epidote, and scattered grains of chalcopyrite.

The Arey prospect, 3¼ miles southwest of Mount Pleasant, was being opened in May 1934 by W. M. Arey. A vein from 1 to 6 inches thick, explored by a shaft 36 feet deep, consists of quartz containing considerable limonite and, at the bottom of the shaft, pyrite and a little bornite. This prospect is probably near the Vanderburgh mine, said by Emmons [49] to be on a vein composed of barite and quartz with chalcopyrite.

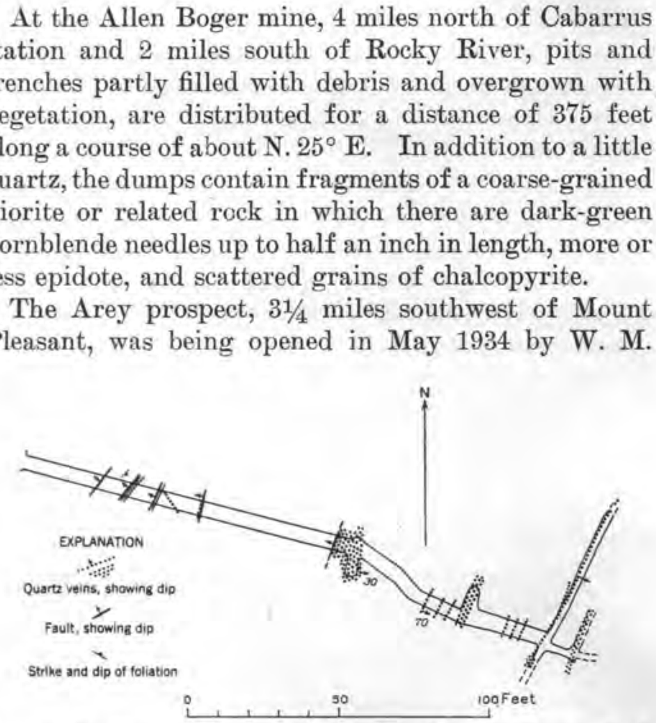


FIGURE 13.—Plan of adit level, Reed mine, Cabarrus County, N. C.

The Barnhardt mine 2½ miles southwest of Mount Pleasant (not the Barnhardt of the Gold Hill district), was mentioned by Emmons in 1856.[50] Nitze and Hanna [51] in 1896 describe it as on a quartz vein 5 feet wide containing galena and chalcopyrite. Coarse gold had been washed from the alluvium of a small stream on the property. Two old partly filled shafts could be seen in 1934; in one there was a 4-foot quartz vein containing much limonite. The country rock is diorite.

The Barrier mine, near Bost's mill and three-quarters of a mile north of Rocky River, is said by Nitze and Hanna [52] to have been active before 1860. According to a note in the Engineering and Mining Journal of September 30, 1893, the mine was reopened and a 5-stamp mill built. The ore was produced from two veins, 14

[49] Emmons, Ebenezer, op. cit., p. 178.

[50] Emmons, Ebenezer, op. cit., p. 178.

[51] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina; North Carolina Geol. Survey Bull. 3, p. 123, 1896.

[52] Nitze, H. B. C., and Hanna, G. B., op. cit., p. 122.

inches and 16 inches thick respectively, and is said to have contained gold to the value of $60 a ton. Later (1935) prospecting has uncovered a vein of iron-stained quartz a foot or less in width. Dumps at the old workings consist mainly of greenstone schist but contain a small amount of vein quartz.

The Buffalo mine, half a mile west of Georgeville, according to Nitze and Hanna,[53] is on a mineralized zone 25 feet wide that contains pyrite and assays 0.17 ounce of gold to the ton, of which 0.05 ounce is free milling. The country rock is schist of the volcanic series.

The Cline (Cruse) mine, 3½ miles north of Mount Pleasant, was last operated in 1902. According to Howard Beaver, who was employed at the mine in 1901 and 1902, two carloads of high-grade gold-copper ore were produced and shipped to a smelter at that time. According to Pratt [54] the ore forms lenses from 1 to 3 feet thick in a vein that strikes N. 35° W. and dips 55° NE. It consists chiefly of chalcopyrite and pyrite in a quartz-siderite gangue; it also contains some specularite. The workings include shafts 35, 40, and 140 feet deep. The country rock is a greenstone schist. In 1934 a dilapidated boiler, hoist, and steam pump remained at the main shaft.

The Dixie Queen mine, 3 miles south of Rocky River, is said to have been opened about 1895 or 1900; it was chiefly a copper mine but produced a little gold. In 1923 it was operated by a Mr. Chappell, who is reported to have taken out two carloads of high-grade ore. The workings include two shafts, which are said to explore a 2-foot quartz vein containing chalcocite, chalcopyrite, and pyrite. The dumps in 1934 contained perhaps 10 percent of quartz, some of it enclosing these sulfides. Both the vein and the country rock showed green stains of copper carbonate. In some specimens chalcocite forms a crust on chalcopyrite.

The Furniss mine, about a quarter of a mile northeast of the Phoenix mine and formerly under the same ownership, was reopened by the Miami Mining Co. within the period 1900–1906. A vertical section from an unpublished report by M. C. Lake, dated November 1, 1903, shows a shaft 176 feet deep with drifts turned at 90, 100, and 170 feet. Stopes are shown above the 90- and 100-foot levels.

A short distance to the southwest a new shaft was sunk in 1931 by Mr. P. L. Fink to a depth of 60 feet. This shaft is said to have opened, at the bottom, a 3-foot quartz vein which contains about 5 percent sulfides. Some specimens from the dump show pyrite, chalcopyrite, specular hematite, and specks of free gold.

At the Heilig prospect, 4½ miles east of Concord and half a mile west of Adams Creek, a number of large specimens of quartz showing coarse gold were found in a trench. No definite vein was discovered. The country rock is biotite granite.

In the Quaker City mine, a quarter of a mile south of the Barnhardt, much pyrite and a little copper ore were found, according to Nitze and Hanna,[55] in a vein 2 to 5 feet wide that was explored by shafts 40, 60, and 80 feet deep. Only waste rock was observed on the dumps in 1934.

The Rocky River mine, a mile southwest of Georgeville, is said to have been worked shortly after the War of 1861–65, again in the eighties by W. A. Smith of Concord, and finally by Wayne Darlington, who supplied much of the information recorded by Nitze and Hanna.[56] As shown on a plat prepared by Darlington, the workings include six shafts, five of them along the crest of a northerly trending ridge and one on the slope below to the east. At each shaft a vein is indicated on the plat that trends a little east of north. The five veins on the ridge are not continuous but form a disconnected group within a narrow belt 700 to 800 feet long. The country rock is a sericitic schist of the volcanic series, in which the foliation strikes northeastward and dips steeply to the northwest. The workings are described as reaching a depth of 130 feet, and as exposing rather indefinitely bounded quartz veins and lenses, ranging in width from a few inches to 3 feet, within a belt of pyritized and silicified schist. In addition to pyrite the ore contains more or less galena, sphalerite, and chalcopyrite, and the gangue includes an iron-bearing carbonate. Samples of the ore are reported to assay from a quarter of an ounce to 3 ounces in gold per ton, and from a trace to $7 in silver. In 1934 nothing was seen but dumps and partly filled pits and trenches, all thickly overgrown.

The Smith placer, 2 miles northeast of Georgeville, is said to have been worked intermittently from 1905 to 1935. The deposit lies in the bed of a dry run. It has been mined out for a distance of 200 yards and is 3 to 4 feet deep. It is 8 feet wide at the lower end; upstream it widens to 50 feet, but there the ground worked included parts of the adjacent slopes. The bedrock is "slate" of the volcanic series, cut by several quartz veins, one of them 18 inches wide. The gold recovered is said to have been exclusively in coarse grains and nuggets, the two largest of which weighed 20 pennyweights and 1½ pounds respectively.

At the Taggart mine, 3½ miles north of Rocky River, little was seen in 1934 except dumps overgrown with vegetation. The workings at the surface are alined on a course of about N. 55° W.

[53] Nitze, H. B. C., and Hanna, G. B., op. cit., pp. 45, 91, 93.

[54] Pratt, J. H., Mining Industry in North Carolina: North Carolina Geol. Survey Econ. Paper No. 6, p. 24, 1902.

[55] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, p. 123, 1896.

[56] Nitze, H. B. C., and Hanna, G. B., op. cit., pp. 91–93.

According to Nitze and Hanna,[57] the Tucker property, a mile north of Rocky River and three-quarters of a mile southeast of the Phoenix, was worked before 1884. A shaft 175 feet deep, from which some lateral work was done, explored a vein 8 inches wide that strikes N. 52° E. The ore consisted chiefly of pyrite with a little chalcopyrite, and was said to have been worth $15 per ton; this would be equivalent to 0.75 ounce of gold, which was presumably the only metal recovered. It was treated in a Plattner chlorination plant, with unsatisfactory results.

A line of old pits and shafts 500 feet long marks the course of another vein that strikes about N. 80° E. Vein material on the dumps consists of quartz with much barite and partly oxidized pyrite.

CATAWBA COUNTY

SHUFORD

The Shuford mine, 6¾ miles southeast of Catawba Station on the Southern Railway, explored a stringer lode. As described by Pratt [58] in 1908, the deposit is a zone, about 300 feet wide and between 1,000 and 2,000 feet long, in which the country rock (schist and gneiss) is penetrated by variously oriented seams of gold-bearing quartz. After unsuccessful attempts to mine the deposit through a shaft and from an open-cut, a variety of drag-line scraper was installed in 1907 by which the material was more economically handled. The resulting pit reached a depth of 90 feet in saprolite, and all the excavated material was treated with an improved variety of log washer,[59] which recovered 85 percent of the gold. During the period 1902–11 the production [60] reported from this mine was 1,716 ounces of gold and 586 ounces of silver, most of which presumbaly was recovered after 1906.

DAVIDSON COUNTY

CONRAD HILL

The Conrad Hill mine, 6 miles northeast of Lexington, was worked as early as 1832. From an original record by Roswell King, later in the possession of J. P. McKee, it appears that between January 17, 1832, and May 30, 1835, a total of 48,390 bushels of ore—estimated as equivalent to 1,951 tons—was mined and treated in a Chilean mill, with a total recovery of 37,190 pennyweights of gold, worth at the time $31,611.50 or about 85 cents a pennyweight. The recovery per ton was thus about $16.15, or, at the 1935 valuation of gold, $28.26. The main workings were a pit and a shaft 60 feet deep. Part of the property west of the tract worked by King was mined extensively during an early period by Governor Morehead, who produced, according to various popular estimates, from $75,000 to $250,000 worth of gold.

The later history of the mine and descriptions of the veins and the enclosing rocks are given by Emmons,[61] Kerr and Hanna,[62] Nitze and Hanna,[63] and Pogue.[64] After 1853 the mine was probably closed most of the time until 1880, when rather extensive developments were begun under the direction of J. P. McKee. The workings were deepened, one shaft reaching a depth of 400 feet. Much ore was extracted and was treated in milling and smelting plants built on the property. Operations ceased in 1884 and since then the mine has remained idle except for very brief periods.

The country rock is chiefly a sericite schist derived from tuffs of the volcanic series. The authors cited describe as many as six veins, of which three strike northeast about parallel with the foliation and the others intersect the foliation at various angles. From the surface to a depth of 50 feet the ore consisted of quartz with brown iron-oxides and was valuable for gold only. At 50 feet chalcopyrite began to appear, and at 100 feet that mineral and ankerite had displaced the iron oxides entirely. In the deeper workings, shoots of the chalcopyrite-ankerite ore several feet thick were found that contained up to 33 percent of copper and half an ounce or more of gold. An unknown but apparently large amount of such ore was mined and treated. McKee reported (about 1832–35) the recovery of $49,000 in gold and $11,000 in copper (probably 50,000 pounds or more). Nitze and Hanna mention (1896) a stock pile of 3,000 tons at the mine that averaged $26.60 per ton in gold and copper.

Whether the ore pinched out or continued in depth is not made clear in the reports available. In 1934 all buildings connected with the mine were in ruins. The dumps contained several thousand tons of quartz-ankerite vein material, most of which encloses at least a little chalcopyrite.

SILVER HILL

The Silver Hill mine, 7½ miles southeast of Lexington, is variously described in published reports [65] as a stringer lode, as a disseminated deposit, and as a replacement deposit. These descriptions, together with the fact that the deposit is enclosed in rocks of the volcanic

[57] Nitze, H. B. C., and Hanna, G. B., op. cit., p. 123.

[58] Pratt, J. H., Mineral industry in North Carolina, North Carolina Geol. and Econ. Survey, Econ. Paper 15, pp. 16, 17, 1908.

[59] Pratt, J. H., The mining industry in North Carolina during 1906: North Carolina Econ. and Geol. Survey, Econ. Paper 14, pp. 19–22, 1907.

[60] Mineral Resources, U. S., 1902–1911, inclusive.

[61] Emmons, Ebenezer, op. cit., pp. 143–144.

[62] Kerr, W. C., and Hanna, G. B., in Geology of North Carolina, vol. 2, ch. 2, 2d ed., pp. 268–274, Raleigh, Edward and Broughton, 1893.

[63] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pp. 68–74, 1896.

[64] Pogue, J. E., Jr., Cid mining district of Davidson County, N. C.: North Carolina Geol. and Econ. Survey Bull. 22, pp. 108–112, 1910.

[65] Emmons, Ebenezer, op cit., pp. 183–193. Kerr, W. C., and Hanna, G. B., Ores of North Carolina; North Carolina Geol. Survey, Bull. 2, pp. 193–197, 1888. Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina; North Carolina Geol. Survey Bull. 3, pp. 61–66, 1896. Pogue, J. E., Jr., Cid mining district: North Carolina Geol. and Econ. Survey Bull. 22, pp. 98–103, 1910. Taylor, R. C., Reports on the Washington silver mine, in Davidson County, N. C., Philadelphia, 1869.

series and trends northeast parallel to the schistosity, suggest that it belongs in the category of mineralized zones.

This mine is one of the very few in the Southern Piedmont region that is valuable chiefly for its output of silver, lead, and zinc. It was operated from 1840 to 1855, and for a time during the War of 1861–65 for lead to make bullets. After the war it continued to be worked until 1882, and since then it has been operated intermittently for short periods. During the first 27 months of operation "2,661 pigs of lead" are said to have been produced, from which $13,289 in gold and silver was obtained. The remaining litharge was worth $5,499, making the total value $18,788. A run lasting from December 9, 1843, to December 20, 1844, produced 160,000 pounds of lead, containing $2,254 in gold and $24,009 in silver, from a carbonate-sulfide ore. The total production is popularly estimated at $1,000,000 or more, chiefly in silver, lead, and zinc. The mine was inaccessible in 1934 and 1935.

From published reports by Pogue [66] and others it appears that the ore zone, which is in a sericite schist, contains two main lodes, the "east" and "west" veins, which strike northeastward and dip 50° to 60° NW. At the surface these veins are as much as 30 feet apart. Below, they approach each other, join, separate, and join again. The intervening schist contains some smaller veins and lenses. The main shaft extends 725 feet down the east vein, or to a vertical depth of 570 feet. Drifts and other shafts explore the lode for a maximum horizontal distance of 700 feet. An ore shoot worked from the main shaft was 100 to 200 feet long and extended to the bottom. Another, worked from the north shaft, was at least 200 feet long at the surface but only 50 feet long at the 316-foot level. Information as to the width of the ore bodies is scanty. The west vein was said to be 10 to 16 feet wide and an ore shoot in the east vein 2 feet wide. The main shoot contained lead carbonate (cerussite) ore rich in silver from the surface to a depth of 60 feet. At that depth galena appeared, and lower down the carbonate gave place entirely to galena and sphalerite. At 200 feet sphalerite was more abundant than galena. As determined from 200 samples, the average composition of the sulfide ore free of gangue was: galena 21.9, pyrite 17.1, sphalerite 59.2, and chalcopyrite 1.8 percent.[67] Little quartz accompanied the ore, the gangue being chiefly unreplaced country rock. Assays showed from a trace to more than 25 ounces of gold and from 4 to 120 ounces of silver to the ton. Ore from the lower levels is described as a mixture of galena and sphalerite containing a few ounces of silver to the ton. The mine was celebrated for beautiful specimens of arborescent silver, which all occurred above the 200-foot level. Manganese oxide ore was found between depths of 60 and 100 feet.

[66] Pogue, J. E., Jr., Old mining district of Davidson County, N. C.: North Carolina Geol. and Econ. Survey Bull. 22, pp. 98–103, 1910.

[67] Pogue, J. E., Jr., op. cit., p. 103.

OTHER MINES

The Emmons mine, about 14 miles southeast of Lexington, is described in detail by Pogue.[68] It is on a stringer lode that trends northeast in rocks of the volcanic series, and was worked extensively for both gold and copper before and after the War of 1861–65. The last operations of record, in 1906 and 1907, produced about $8,500, chiefly in copper but partly in gold and silver. The earlier production is estimated at not less than $100,000. The workings are extensive horizontally and reach a depth of 600 feet. One of the ore bodies was 50 feet long, at least 400 feet deep (pitch length), and from 2 to 3 feet wide. The chief ore mineral is chalcopyrite, which is accompanied by a little pyrite, galena, and sphalerite; the gangue consists of quartz, ankerite, calcite, and chlorite. The smelter returns from a representative carload of concentrate were reported to be 7.7 percent of copper and 1.27 ounces of silver and 0.10 ounce of gold to the ton.

FRANKLIN COUNTY

PORTIS

The Portis mine is in the northeast corner of Franklin County, a short distance east of Wood Post Office. It has been the most productive and extensively exploited of several alluvial and saprolite placer deposits scattered over an area 5 or 6 miles wide and 15 miles long in adjoining parts of Franklin and Nash Counties; this area has been known as the eastern Carolina gold belt.

In this area mining has been done intermittently and at times rather extensively since about 1840. Gold is said to have been discovered by a traveler who, stopping overnight at the cabin of a man named Portis, observed particles of gold in the mud daubing between the logs—an interesting tale, but strangely similar to the account put forth at Brindletown, Burke County, of the discovery of gold in that neighborhood. Whatever the manner of discovery, there is evidence of long-continued and extensive surface mining at the Portis mine. According to P. G. Sturges, in whose family the ownership of the property rested for a long time, about 50 acres have been washed for gold, the excavations ranging from 5 to 20 feet in depth. No authentic records of production are available. Popular estimates of total gold recovered ranges from several hundred thousand to more than a million dollars.

In recent years attempts have been made to mine parts of the saprolite beneath the placer deposit as milling ore. The last of these attempts was made by the Norlina Mining Company, which in the fall of 1935 built a large mill, equipped with 40 stamps and with classifiers, plates, and other apparatus.

[68] Pogue, J. E., Jr., op. cit., pp. 115–117.

At and near the Portis mine the country rock is very deeply weathered to a saprolite that so far as exposed is mostly a deep-red sticky clay. The prevailing type appears to have been derived from a fine-grained, distinctly foliated sericite schist, associated with which is a less decomposed grayish rock resembling a gneissoid or schistose diorite. Intrusive into the schistose rocks are two sheets or sills that dip about 25° westward. Within the saprolite zone these and some dikelike offshoots are decomposed to a soft light-gray claylike mass of granular quartz and kaolin. Locally this material is known as the "white belt." Excavations in the "white belt" have uncovered a few residual boulderlike bodies or kernels that have resisted weathering and remain comparatively fresh. Under the microscope the rock from these kernels is seen to be a granite, mainly composed of finely granular quartz and feldspar (albite and orthoclase) and minute scales of muscovite and biotite. The rock contains more or less epidote, zoisite, and chlorite; pyrite has been introduced along cracks.

The "white belt," and locally the schistose saprolite adjoining it, are traversed by a network of rusty quartz veinlets, some of which contain gold. Weathering and erosion of the "white belt" over a large area have concentrated the gold in the superficial layer that is worked as placer. The veinlets are more numerous in the available exposures of the "white belt," than they are in the schist. They appear to have filled shrinkage cracks that presumably formed upon cooling of the intrusive body, although some of them cross the boundaries of the intrusive rock and extend into the schist (see fig. 6). The facts observed indicate that the mineralization is related to an intrusive mass, of which the sill may be an offshoot. The sill, having been fractured more extensively than the schist, offered an easier path to the mineralizing solutions emanating from below.

Drifts expose only 5 or 6 feet of the upper of the two sills, but the total thickness is reported to be 8 or 9 feet. The lower one is said to be somewhat thicker than the upper, and separated from it by only a few feet of schist. The workings show that the upper sill underlies an area of several acres. According to the company's technologist, J. C. Letellier, the gold content of samples representing a considerable part of the body ranges from about 0.03 ounce to about 0.6 ounce to the ton and averages about 0.15 ounce.

GASTON COUNTY

CALEDONIA (CROWDERS MOUNTAIN)

The Caledonia or Crowders Mountain mine, 8 miles southwest of Gastonia and on the east side of Kings Mountain, is on a northeastward-trending mineralized zone said to be 8 to 10 feet wide. The country rocks are quartzite and schist. Workings, said to have been started just after 1865, include two shafts about 500 feet apart, one of which was reopened by J. N. Smith in 1934. Shallow pits about 1,000 feet to the southwest are on a 2½-foot zone in quartzite, reported to contain gold.

KINGS MOUNTAIN

The Kings Mountain mine, 3 miles southeast of the village of Kings Mountain, is variously reported as having been discovered in 1820 and in 1834. It was worked at irregular intervals until about 1895, and is estimated to have produced from $750,000 to $1,000,000. The mine and the character of its enclosing rocks are described by Keith and Sterrett,[69] who provide a map showing the surface workings and plant as they were in 1913. In 1934 hardly any visible evidence of the former activity remained, as the workings were then entirely caved. However, they are said to have reached a depth of 320 feet, encountering a mineralized zone 10 to 40 feet wide in an impure limestone. The ore bodies mined ranged from 2 to 20 feet in width, and consisted of quartz, containing sparsely disseminated galena, sphalerite, pyrite, and chalcopyrite, together with enough gold to make it a low-grade ore. One engineer estimated an average recovery of 0.40 ounce of gold to the ton during his period of supervision.

LONG CREEK

The Long Creek mine, 8 miles northwest of Gastonia, includes lodes known as the Dixon, Asbury, and McCarter Hill veins.[70] A shaft that was 140 feet deep in 1852 was located on the McCarter Hill vein, and other workings were distributed along the lode for a distance of 250 feet. The lode was last worked in 1892. The assay value of the ore mined was reported as 0.40 ounce of gold to the ton, of which 0.15 ounce was recovered by amalgamation. The concentrate that was produced carried 1.2 ounces to the ton. Two shafts on the Asbury lode, one of them 110 feet deep, are said to have opened up a vein 6 to 8 feet wide, containing rich ore shoots composed of pyrite, chalcopyrite, galena, sphalerite, arsenopyrite, and a bismuth mineral. The Dixon lode, 3 feet or more in width, was reported to have been explored by two shafts, one of which was 140 feet deep, opening into drifts turned north and south. All three lodes trend northeast and are enclosed in schist. Some of the workings were unwatered and sampled in 1934.

PATTERSON

The Patterson mine 1¼ miles northeast of the Caledonia, is mentioned by Kerr and Hanna [71] as yielding low-grade ore. This mine was reopened in 1934 by Richard Vail, who found ore showing pyrite and free

[69] Keith, Arthur, and Sterrett, D. B., U. S. Geol. Survey Geol. Atlas, Gaffney-Kings Mountain folio (No. 222), p. 8, 1931.

[70] Kerr, W. C., and Hanna, G. B., in Geology of North Carolina, vol. 2, ch. 2, 2 ed., p. 304, Raleigh, Edwards & Broughton, 1893.

[71] Kerr, W. C., and Hanna, G. B., in Geology of North Carolina, vol. 2, ch. 2, 2 ed., p. 306, Raleigh, Edwards & Broughton, 1893.

gold at a depth of 70 feet. A sample across a width of 4 feet assayed 0.47 ounce to the ton.

GUILFORD COUNTY

FENTRESS (NORTH CAROLINA)

The Fentress or North Carolina mine, about 10 miles south of Greensboro, is a formerly productive mine on a northeast-striking vein in granite. It was opened before 1853 as a gold mine,[72] but at a depth of 50 feet iron and copper sulfides were found, and the deposit consequently achieved the distinction of being the first in North Carolina to be mined for copper. Except for intermittent operation from 1901–07 the mine has been idle most of the time since 1865. In 1856 Emmons [73] reported that the mine had produced $133,000 "up to the end of 1855." During the period 1901–07 it yielded nearly $26,000, and the total to 1935 is estimated at $175,000. Emmons described a sulfide ore body developed on the 310-foot level, 80 to 90 feet long and 34 inches in greatest thickness, that yielded ore containing 14 to 23 percent of copper. Other observers describe the vein as being 1 foot to 8 feet or more in width and composed of quartz and iron carbonate with pyrite and chalcopyrite. Emmons comments that "a discouraging feature is long intervals of barren vein between ore shoots." According to Pratt,[74] who examined the mine in 1906, the vein is a composite of stringers, containing a little copper on the lowest levels, and the gold is associated with pyrite. The man then operating the mine said that a 3-inch streak assayed 5 ounces to the ton.

In 1934 all workings were either choked or otherwise in bad condition. At the main shaft an old Cornish pump and boilers and engine remained partly in place. The mill site was flooded with backwater from the dam. The dumps consist mainly of granitic rocks, more or less sheared or schistose, and showing epidote, chlorite, sericite, and other evidences of hydrothermal alteration. Vein rock in the dumps consists chiefly of quartz and siderite. Some specimens enclose partly replaced fragments of granite. Chalcopyrite and pyrite are irregularly scattered through the gangue, and in some specimens they are arranged in bands. Crystals of quartz and carbonate occur in cavities.

FISHER HILL, MILLIS HILL, AND PUCKET

The Fisher Hill, Millis Hill, and Pucket mines, named in order from north to south, are about 5 miles south-southwest of Greensboro. The Fisher Hill is described by Emmons [75] as being on a rather flat-lying quartz vein that contained white pyrite. The ore mined in 1856 looked poor but proved to average $3 in gold to the bushel (about 100 pounds); the gold could be recovered in a drag mill after the ore had been roasted. Nitze and Hanna [76] described the property in 1896, when it embraced 900 acres, as containing one group of veins that runs north and south and another that runs nearly northeast and southwest. The vein most extensively worked (apparently the one striking north-south) contained ore bodies 4 inches to 10 feet in thickness. In 1886 and 1887 a 10-stamp mill was operated. A little copper ore was found in the Fisher Hill mine, more in the Millis Hill, and a considerable amount with much pyrite in the Pucket.

In 1934 a Chilean mill and other equipment used in former operations remained. The size of the dumps at the Fisher Hill mine indicated rather extensive underground workings. Vein rock in the waste piles consisted of quartz with a little ankerite and more or less pyrite, chalcopyrite, and specularite. The country rock is granite.

GARDNER HILL

The Gardner Hill mine, 8 miles southwest of Greensboro, was extensively developed long before 1861 but has probably been idle since about 1865 except that at times since 1880 parts of the dumps were milled. In 1854 Ebenezer Emmons, then State Geologist of North Carolina, estimated that the mine had produced $100,000 in gold from "lode and surface" (placer) workings.[77] The deposit was then being worked by leasers, who paid a toll of 25 percent but made a profit nevertheless. The ore in the upper part of the lode consisted of quartz and brown iron-oxides. At a depth of 110 feet the oxides had given place to chalcopyrite. The ore produced from that level yielded "under careful management" about $1 per bushel (equivalent to about 1 ounce per ton) and under "the poorest" management about half as much. The sulfide, separated by hand cobbing, yielded as much as 30 percent of copper.

About 40 years later Nitze and Hanna [78] described the vein as having been worked for a distance of 5,000 feet "from the Creek shaft on the northeast to the White Oak shaft on the southwest," but said that the work had mainly been confined to the southern part of the property. There were five shafts, ranging in depth from 110 feet on an incline (Creek shaft) to 258 feet vertical (New Engine shaft). Levels averaging 500 feet in length were opened at depths of 60, 100, 150, and 228 feet. The property included three veins—the Main vein, presumably the one most extensively developed, the Worth vein, which is said to have been rich from the surface down but for which no records are available,

[72] Jackson, C. T., Report on the copper mine of the North Carolina Copper Company: Mining Mag., ser. 1, vol. 1, pp. 44–47, 290–292, 1853.

[73] Emmons, Ebenezer, Geological report on the Midland Counties of North Carolina, pp. 196–202, Raleigh, H. D. Turner, and New York, G. R. Putnam Co., 1856.

[74] Pratt, J. H., The mining industry in North Carolina during 1906: North Carolina Geol. and Econ. Survey, Econ. Paper 14, p. 38, 1907.

[75] Emmons, Ebenezer, op. cit., pp. 172–173.

[76] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pp. 110–111, 1896.

[77] Emmons, Ebenezer, Geological report of the Midland Counties of North Carolina, Raleigh, H. D. Turner, and New York, G. R. Putnam Co., 1856.

[78] Nitze, H. B. C., and Hanna, G. B., op. cit., pp. 112–114.

and the Goshen vein, said to be small, but not otherwise described. Below water level (60 feet) chalcopyrite ore averaging 20 to 25 percent copper was mined, a production of 40 tons a week being maintained for "a long period." The width of the veins was in places 20 feet and the gangue minerals were quartz and iron carbonate (probably ankerite).

In the summer of 1934 the mine was unwatered under the direction of Haydn Gunter for the owner, J. E. Latham. In September a survey with Brunton compass was made of accessible parts of a level at 95 feet depth, connected with the Eudy and Gardner shafts, and of a level turned from the Stafford shaft at 200 feet (see pl. 23). These workings are on a vein in granite that strikes, on the average, about N. 20° E. and dips 20° to 25° NW. At a depth of 150 feet a branch having a steeper dip splits off and continues downward. The size and number of the stopes indicate that the ore

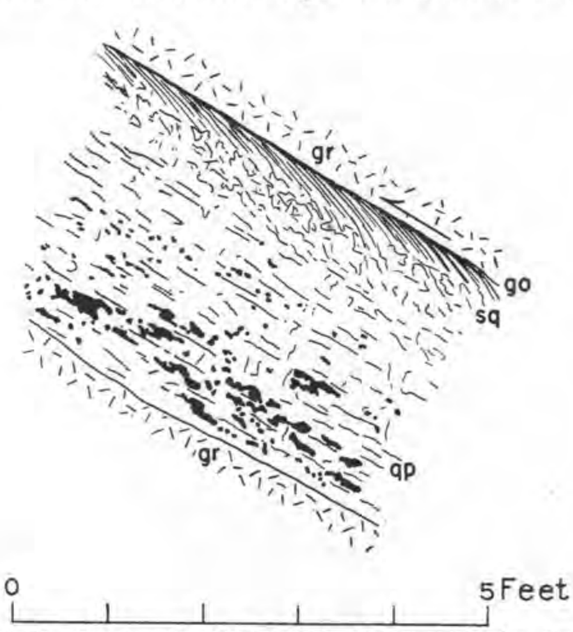


FIGURE 14.—Quartz vein, 200-foot level, Gardner Hill mine, Guilford County, N. C., *gr*, Granite; *go*, slickensided wall coated with gouge; *sq*, shattered vein quartz; *qp*, massive quartz and pyrite.

bodies mined out were 1 foot to 6 feet or more in thickness, and that one of them was from 60 to 120 feet long and 270 feet or more in depth (pitch length). Parts of the vein remaining in 1934 were from 1 to 7 feet in width and consisted chiefly of quartz, with pyrite and chalcopyrite irregularly and, as a rule, rather sparsely scattered through it. Next to the hanging wall the vein is brecciated, and the wall itself is slickensided and bordered with a selvage (fig. 14) of schistose material, the structure of which indicates that the wall has been thrust upward. A large amount of vein rock remains but its assay value was not learned.

LINDSAY, NORTH STATE (McCULLOCH), AND JACKS HILL

The Lindsay, North State (McCulloch), and Jacks Hill mines, about 2 miles southward of Jamestown, are on a vein or vein system that strikes northeast, in granite. The mines are named in order beginning at the southwest. According to Nitze and Hanna [79] the vein system continues northeastward into an unprospected tract (Whitehead property) and, by implication, into the Aberdeen mine still farther north, its total length is thus nearly 3 miles. These authors cited speak of the "immense accumulation" of vein rock on the dumps. These mines were active before the War between the States. The North State mine reported a yield of nearly $35,000 in gold and more than $10,500 worth of copper between March and November 1854, and the total production is estimated to be at least $125,000. Emmons described the veins as being 2 feet to 24½ feet wide, and as containing a streak of "brown ore" rich in gold 6 inches thick. Next to this streak was some "copper pyrites," then a belt of brown ore containing nodules of pyrite that was more or less oxidized, the middle of which was rich in gold. The principal mass of quartz was generally poor in gold value. The underground workings are said to have a total extent of several thousand feet, the deepest shaft being 350 feet deep. Except for intermittent operations, chiefly in the 1880's, the mines have been idle since about 1860. The workings were not accessible in 1934. The vein is described by J. A. Alred as dipping southeast at various angles. It was very productive in gold to a depth of 50 feet, and between 50 and 100 feet it yielded much copper. The ore occurs in shoots and pockets, and consists of pyrite and chalcopyrite in a gangue of quartz and siderite. Native gold occurs in both the oxide and the sulfide zones. A selvage of schistose material lies on the walls.

LINCOLN COUNTY

The Cherry mine, about 4 miles south of Denver, consists of several pits and a shaft. The shaft was said to be 100 feet deep, and it was open to a depth of 20 feet in 1935. The dump consists of granite gneiss and of white vein quartz enclosing a little sulfide. In 1935 an old mill still stood near a stream about a quarter of a mile to the southeast, on the property of Miss Lizzie Young, but it was said to have been idle for 40 years.

The Graham mine, 4 miles northeast of Iron Station, is described by Kerr and Hanna [80] as being on a vein 30 to 42 inches wide that contained gold and copper. The mine is said to have been active in 1896 and 1897. At the time the property was seen in 1935 a new shaft had been sunk to a depth of 32 feet, but the lode had not yet been exposed.

On the farm of C. M. Haefner, about 4 miles west of Lincolnton, there is a pit that was about 5 feet deep when visited. This pit marks the site of the old Hauss mine, which is said to have been worked with slave labor

[79] Nitze, H. B. C., and Hanna, G. B., op. cit., pp. 114–116, 1896.

[80] Kerr, W. C., and Hanna, G. B., in Geology of North Carolina, vol. 2, ch. 2, 2 ed., p. 221, Raleigh, Edwards and Broughton, 1893.

before the War of 1861–65. It exposes two veins of white quartz, which trend N. 20° to 80° W. and are separated by a few feet of granitic saprolite. Both are from 2 to 3 feet thick and contain a small amount of sulfides. The owner reported an assay showing 0.17 ounce of gold and a little silver per ton.

At the Mueller mine on the J. F. Mueller farm, about 5 miles east of Lincolnton, placer gold is said to have been panned along a small stream. The source may have been stringers of quartz, several of which are exposed in or near the mine. In the vicinity of the Keener line quarry nearby, a rich pocket of gold is said to have been mined out before the War of 1861–65.

The Tucker mine is on the H. C. Tucker property, near the old Kidsville Post Office and about 2 miles southwest of Denver. In 1935 a caved pit was the only indication of the workings from which gold is said to have been produced more than 50 years previously. Pieces of sugary vein quartz remained on the dump. Placer gold is said to have been found in nearby streams in the vicinity of Daly Mountain.

McDOWELL COUNTY

At the Sprouse mine, near Deming, placer and lode deposits were worked intermittently during the period 1885–1935 by Capt. J. J. Sprouse. Incomplete records indicate that at least 12,700 pennyweights of gold was recovered from stream gravels. Quartz veins 1 to 6 inches wide were exposed at several places, and for a time ore averaging 0.35 ounce of gold per ton was milled from one of them. Specimens from a small vein developed by a shaft said to be 125 feet deep contain galena and sphalerite in quartz.

At the Vein Mountain mine, saprolite has been extensively mined by hydraulic methods. According to Miles P. Flack, agent and caretaker for the property, the Vein Mountain Mining Co. operated profitably before 1908. In that year the deaths, in quick succession, of the mill foreman, his two assistants, the president, and other officers of the company, followed by prolonged litigation, caused the work to be indefinitely suspended. A mill on the property, said to have been closed since 1908, remained in fairly good repair in 1934. At that time the bin contained ore that was understood to have come from small veins in the schist or gneiss, uncovered in the course of placer mining. This ore consisted of vein quartz enclosing a little cerussite (lead carbonate), galena, and sphalerite. Some of the quartz showed a linear structure, which may be inherited from replaced schist.

MECKLENBURG COUNTY

CAPPS HILL, McGINN, AND McGINN COPPER

The Capps Hill and McGinn mines, about 5 miles northwest of Charlotte, are on a group of veins in the granite belt. According to old reports, the Capps Hill mine was operated as early as 1826 and continued in operation for several years thereafter, during which it "yielded nearly as much as Gold Hill from a smaller space and less depth." After 1840 the mine appears to have been idle until about 1882, when it was reopened and worked for some years by Capt. John Wilkes. Records of production for this period indicate that about 6,000 tons of ore, mined above the 145 (128)-foot level, yielded $60,000 in gold. In 1934, after another long period of idleness, one of the shafts was being reconditioned with a view to reopening the deposit. Little information concerning the McGinn mine has been found, but one vein is said to have been richly productive in gold and another in copper.

Numerous surface workings, distributed through a belt 1½ miles long, indicate a lode trending north to slightly northeast worked in the Hovey and McGinn mines, and two northwestward-trending veins worked in the Capps Hill and McGinn Copper mines. The southern of the two northwest veins, the Capps, is traced for a distance of more than 2,000 feet by a mass of closely spaced surface workings and several shafts (see pl. 24). Mine maps in the possession of J. Frank Wilkes show drifts and crosscuts, at levels 78 feet and between 120 and 128 feet below the surface, that aggregate about 3,000 feet in length and extend 1,000 feet or more along the strike of the vein (N. 30° to 40° W.). These workings explore a schistose body 35 feet wide, which dips 40° W. and is bordered on the upper and lower sides by veins 4 feet and 7 feet respectively in average width, with a smaller vein between. All veins consist of quartz and pyrite, and the production of $60,000 already mentioned is understood to have come from shoots that were mined above the 128-foot level. One of the shafts is shown on the mine maps as extending to a depth of 185 feet, but no drifts appear to have been turned from it. The surface workings on the McGinn copper vein extend for a length of about 1,000 feet, and those on the gold veins in the McGinn and other mines aggregate 3,000 feet or more.

RUDISIL

One of the larger mines of the Piedmont belt is the Rudisil, in Charlotte, N. C., about a mile southwest of the intersection of Trade and Tryon streets.

From various documents [31] it appears that gold was first discovered on the property in 1829. Next year the Mecklenburg Gold Mining Co. began operations under the direction of a superintendent known as the Chevalier de Rivafrinola (or Rivafinoli). Much of the

[31] Reports on the Rudesill gold and copper mine at Charlotte, Mecklenburg County, N. C., New York, 1854. Includes report by Stephen B. Leeds, Geologist and Chemist, Brooklyn, N. Y., August 5, 1853; "History" of the Rudesill mine by John E. Penman, Charlotte, N. C., April 29, 1854, "certified" by G. W. Caldwell, Supt. of the U. S. Mint at Charlotte, and W. W. Elms; and a supplementary extract from a report by Penman on production and copper ores.

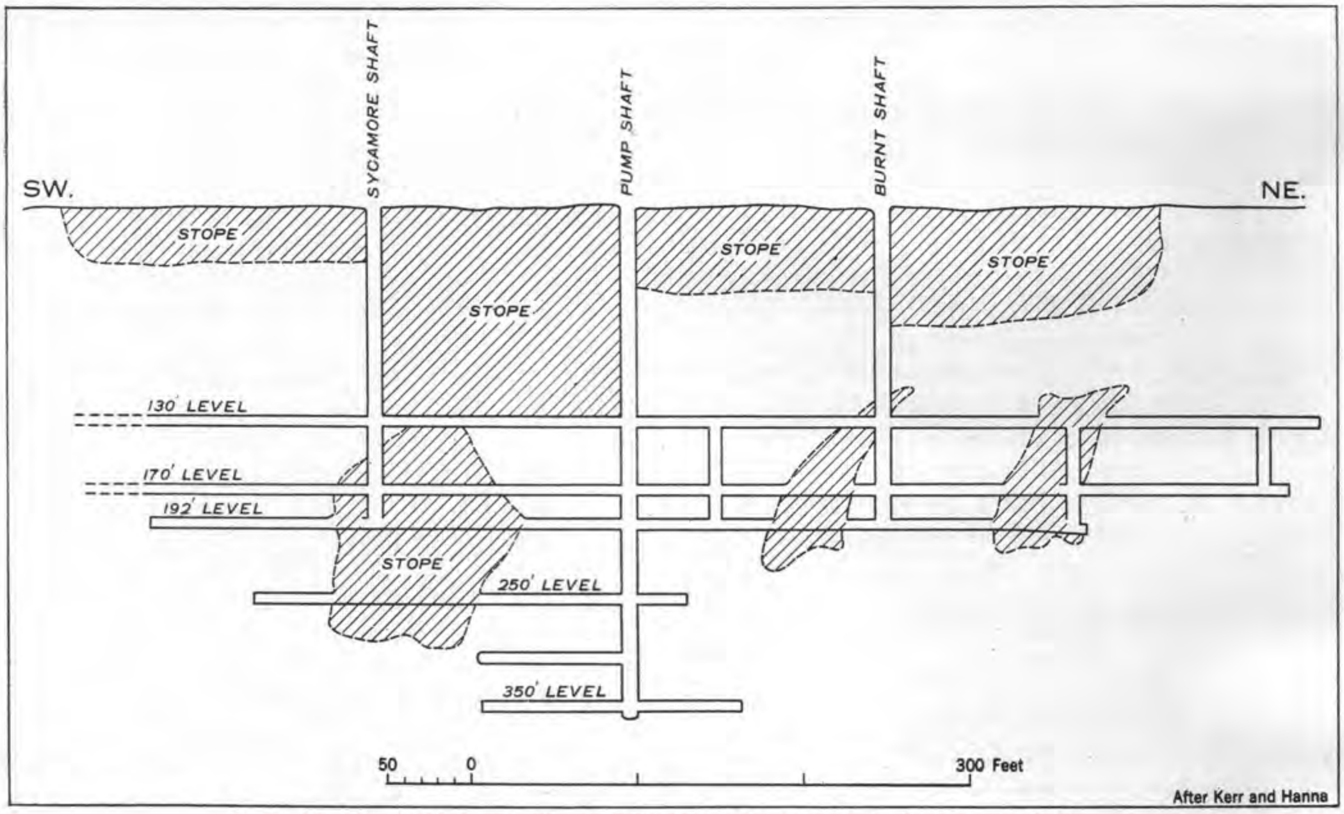


FIGURE 15.—Longitudinal projection on Rudisil lode, Charlotte, Meckenburg County, N. C.

ore above water level was mined, and in one month more than $30,000 in gold was recovered. After a few years this company suspended operations, and in 1837 the property was purchased by John E. Penman, who, in association with others, operated it successfully, "taking out in several instances from ten to twelve thousand dollars per month." A disagreement between Penman and his partners led to a sale of the property in 1840, but Penman soon obtained possession again and resumed work. He records that at this mine "thousands of dollars have been washed out" at the surface and that good ore was obtained from all of the "various shafts sunk in both branches" of the vein (the shafts were 15 to 35 feet deep). The gold was worth $0.96 to $1 a pennyweight; in other words it was almost pure. Apparently the deepest opening in 1840 was the "old engine shaft down 110 feet." The mine is said to have been operated from 1840 until the outbreak of the War Between the States, and again in the periods 1880–87 and 1905–1908.

The total production has been popularly estimated at $1,000,000 in gold (about 50,000 ounces). Hanna [82] said in 1903: "It is quite certain that the yield has not been less than half a million dollars."

During the later periods of activity the workings were much extended. The "pump shaft" was vertical for the first 192 feet, and then followed the vein, at an inclination of about 45° for 158 feet; the total vertical depth was 302 feet.[83] The total extent of shafts and winzes attained about 1,000 feet and that of the levels about 2,400 feet. Kerr and Hanna [84] give a vertical projection showing the extent to which the deposit had been mined up to 1883 (see fig. 15). From their description it appears that the zone below water level contained iron pyrite with a little chalcopyrite, and that the sulfides were in part scattered thinly through a quartzose and somewhat slaty gangue, and in part occurred in narrow seams or in large rich shoots.

The strike of the lode is given as about N. 30° E. and the dip as about 45° NW. The ore was found in a belt of "slate" (schist?), in places as much as 100 feet wide, between walls of massive granite, or between granite on one side and dark-colored diorite or diabase on the other. In depth the slate body narrows, and ore bodies along its margins, known as the "front" and "back" veins, approach each other, so that they begin to merge into one vein at 200 feet; at intervals, however, as shown by the published section, some slate is found between the veins as far down as the 300-foot level.

From a report by Pratt [85] it appears that in 1904–06 the mine was reopened under the direction of George E. Price, and the workings unwatered to within 50 feet

[82] Hanna, G. B., History of mining in Mecklenburg, in Tompkins, D. A., History of Mecklenburg County and the city of Charlotte, vol. 2, p. 119, 1903.

[83] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pls. 10, 24, 1896.

[84] Kerr, W. C., and Hanna, G. B., in Geology of North Carolina, vol. 2, ch. 2, 2 ed., Raleigh, Edwards and Broughton, 1893.

[85] Pratt, J. H., Mining industry in North Carolina during 1906: North Carolina Geol. and Econ. Survey, Econ. Paper 14, pp. 66–67, 1907.

of the bottom. Price estimated the ore remaining in the stopes at 10,000 tons containing \$6 to \$9.50 and averaging \$8 per ton, and 10,000 tons containing \$5 to \$6 per ton. Seams and bunches of higher-grade ore were found, from which "hand-picked ore" averaging about \$125 per ton was produced.

Late in 1934 the Rudisil mine was reopened by the Carolina Engineering Co., with W. A. White in charge. Water was pumped out to a point somewhat below the 250-foot level. In 1935 a concentrating mill was built nearby and a considerable amount of ore extracted and treated, the concentrate being shipped to smelters. In August of that year, parts of the 250-foot level and connected workings were examined by C. F. Park, Jr.

In 1935 new underground work had opened up several ore lenses. They are on the average about 5 feet thick, 10 to 20 feet long (stope length) and 10 feet deep (pitch length). They consist chiefly of pyrite and quartz and appear to have formed where the lode flattens, owing either to a roll or to a split in the lode. The ore bodies that were seen are badly shattered by longitudinal postmineral fractures, which are particularly numerous in the hanging wall. Nearly vertical seams, also, cross the lode at right angles, both in the new ore bodies and in the old stopes, but they appear to be rare or absent from intervening, probably barren, stretches of the lode.

The wall rocks in the Rudisil mine are chiefly granite and schist. The relation between the lode and the contact between the granite and schist is nowhere clearly visible but the lode apparently tends, at least above the 250-foot level, to remain near the contact. In some places the hanging wall is granite and the footwall schist; in other places the reverse is true; and in still other places a part of the lode is entirely in schist and the remainder entirely in granite. According to the operator, no granite was found in the lower levels along the ore shoots that have been mined. In the upper levels, parts of the lode that are in the sericite schist and not near the granite are composed of many stringers; lenses of quartz and ankerite are scattered in places through a width of 4 or 5 feet.

Some difficulty is added to the problem of determining the ore distribution in this mine by the presence of several diabase dikes. One of them was observed to cut sharply across the lode; another turns into the lode for a distance. Although the dikes are postmineral, several good ore shoots have been found next to them in the upper levels; elsewhere, however, the lode is generally poor near the dikes. Whether the occurrence of rich ore near the dikes is accidental, or whether it is the result of enrichment by supergene solutions or by hydrothermal solutions associated with the dikes, is not apparent. Figure 16 is a notebook sketch of an unusual shoot. It shows two dikes; one extends along the schist-granite contact and stops at the lode; the other swings into the lode and may cross the lode farther down the dip, although the relationship is obscure at this point. Between the two dikes a shoot of good ore was found.

Information afforded by the recent operations at the Rudisil mine indicated that the material classified as marginal during earlier operations may prove workable with the advantages afforded by modern methods and the enhanced value of gold.

A specimen from the Philip Argall collection, now in the U. S. Geological Survey, presumably from an upper level of the Rudisil, shows native gold enclosed in a limonite pseudomorph after pyrite.

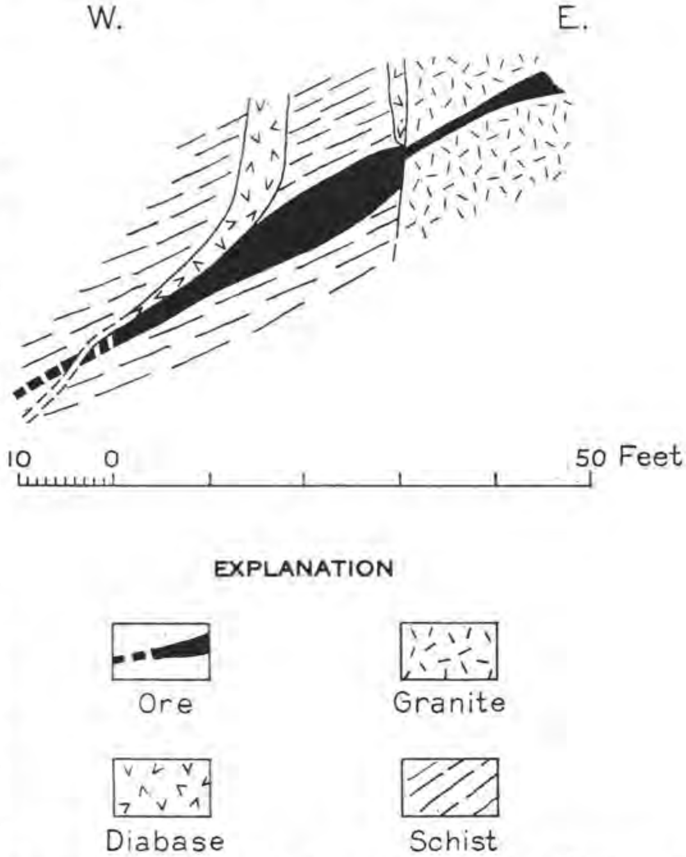


FIGURE 16.—Sketch of ore lens, Rudisil mine, Charlotte, Mecklenburg County, N. C.

ST. CATHERINE

The St. Catherine mine (first called the McCombs and later the Charlotte) is in the city of Charlotte, 2,500 feet N. 25° E. from the Rudisil. These two mines are supposed to be near opposite ends of the same vein, but shallow prospecting between them has disclosed nothing of promise. The main shaft of the St. Catherine is in an undeveloped portion of Post Street, 125 feet northwest of the main line of the Southern Railway. For the first 155 feet the shaft is vertical; for the remaining 305 feet it follows the vein, which dips about 45°. Its total vertical depth is 370 feet.

In 1906 the development work that had been done under the direction of George E. Price [86] included the extending of a drift on the 200-foot level toward the Rudisil mine, the length of the drift being increased from 95 to 462 feet. This work resulted in the finding of two small bodies of shipping ore, and also, apparently, of a lens of $10.00 ore, 75 to 80 feet long and 6 feet thick in the middle.

The St. Catherine is generally supposed to have been the first mine opened in Mecklenburg County. Mitchell's map, made in 1826, showed it and the Capps Hill as operating mines. Little is known of its history in the period before the War of 1861–65, but undoubtedly it had many years of activity. In a report dated 1853 [87] Professor Renwick, of Columbia College, relates that he visited Charlotte, N. C., in the summer of 1832, for the purpose of examining and reporting upon the mining operations of the Chevalier de Rivafinoli. He found the St. Catherine mill, on Sugar Creek, treating ore "by the Mexican method from small veins at no great depth." The ore was a cellular quartz with oxides of iron, and only about half of the gold was being saved. The operation was unprofitable, chiefly for the reason, Renwick concluded, that Rivafinoli had an unnecessarily large "staff of mining officers." From the same report it is learned that the mine was idle after the "depression of 1836–37," and that in 1848 Capt. Charles Wilkes, of the U. S. Navy, got possession, through foreclosure, not only of the St. Catherine but also of the Means and Capps Hill mines. Wilkes is quoted as saying that poachers had gouged over the surface for gold-bearing material, which they carried to neighboring streams and washed, until the property resembled a "Rabbit warren." Power for the St. Catherine mill, later called the Bissells mill, was obtained from a 12-foot dam on Sugar Creek that made a lake 130 acres in area, just outside the southwestern limits of the present city of Charlotte. The later history of the St. Catherine mine is similar in many respects to that of the Rudisil; the mine was active through most of the decade of the 1880's, and in the four years 1905–08 it was operated jointly with the Rudisil.

The surficial ores are described by Penman [88] as resembling those of the Rudisil mine. Two parallel veins lie next to the granite walls of a belt of slate which at the surface is many feet thick. At a depth of 165 feet these two veins unite to form a single vein. The schist or slate body or bodies of the Rudisil and St. Catherine mines may be interpreted as roof pendants in the intrusive granite. Such bodies are commonly repositories of metalliferous ores. Above the water level, to a depth of 40 to 50 feet, the ore bodies were oxidized to a rich free-milling ore. Beneath these bodies were found several shoots of solid sulfide ore, some of them extending down to the 155-foot level.

Below 200 feet large bodies of low-grade concentrating ore were found. One of them according to Kerr and Hanna,[89] from 4 feet to more than 60 feet in width, was worked from the pump shaft between the depths of 200 and 370 feet, and it continued to a still greater depth. It is described as "a series of obscurely parallel seams of slate, between which are bodies of ore 2 to 6 feet in thickness, more or less mixed with quartz." Below 275 feet irregularities were found in the footwall and in the dip of the vein, but the conditions were not clearly worked out. A cross vein, trending northwestward, was examined for 100 feet along its course, but only low-grade ores were found. Assays show that concentrates from the low-grade ores generally contained less gold than hand-picked or cobbed ore.

By 1935 most of the material in the dumps had been removed for use in surfacing streets and roads. Remnants that were seen by the writers contained the same rocks and minerals that occur at the Rudisil mine.

WILSON

Surface workings of the Wilson (Stephen Wilson) mine, about 4 miles west of the Capps Hill, indicate a quartz vein that extends for at least 800 feet in a northeasterly direction in granite. A report published in 1878 [90] refers to the Wilson mine as on an east-west vein that had been worked the "most extensively of any in this section." It was developed by an inclined shaft 400 feet deep, from which drifts extended for a maximum distance of 1,500 feet.

MONTGOMERY COUNTY

BLACK ANKLE

The Black Ankle mine, 11 miles northeast of Troy, is in a mineralized zone in schistose rocks of the volcanic series. The deposit was not discovered until 1928. The mine has been operated intermittently since then, and the present owner, Edward Hedrick, reported in 1935 a total production of $15,000 (about 750 ounces) in gold.

The workings comprise a pit 225 feet long, 120 feet wide, and 50 feet deep (fig. 17), a shaft 112 feet deep in the west bank of the pit, and a shallow shaft sunk in the bottom of the pit. The 112-foot shaft follows a rich gold-quartz stringer. Specimens from this stringer taken below the oxidized zone consist of a dense light bluish-gray quartz that has partly replaced sericite schist, retaining the foliated structure and fine-grained texture of that rock. Minute cubes of pyrite are rather uniformly distributed through the quartz

[86] Pratt, J. H., op. cit., pp. 66–69.

[87] Renwick, James, Report of the North Carolina Gold Mining Co. (prospectus), Kneeland, printer, 57 Ann St., N. Y., 1853.

[88] Penman, J. E., Report on the Rudisil gold and copper mine (historical sketch), Charlotte, N. C., 1854.

[89] Kerr, W. C., and Hanna, G. B., in Geology of North Carolina, vol. 2, ch. 2, 2 ed., p. 290, Raleigh, Edwards and Broughton, 1893.

[90] Mining Board of Charlotte, N. C., Statistics of mines and minerals in North Carolina, 1878.

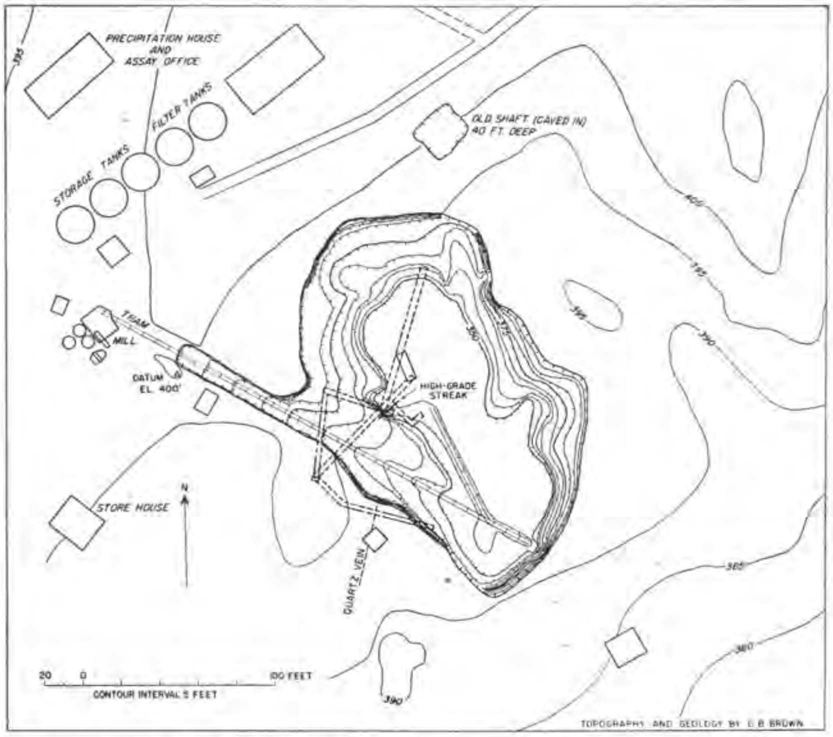


FIGURE 17.—Plan of Black Ankle mine, Montgomery County, N. C.

and locally are aggregated in bands. Exposed in one corner of the shaft in the bottom of the pit is a seam showing iron oxides and spangled with fine particles of native gold. The pit is excavated in highly weathered saprolite, derived from tuff that had been largely altered to sericite schist. The rich stringer and seam lie in a fracture zone that trends irregularly northeast. Outside this zone a small amount of gold is found along seams that extend into the adjoining rock (saprolite). The ore body as a whole is evidently of low grade, though its gold content is not accurately known. Treatment of the material by washing, amalgamation, cyanidation, and other methods has recovered, on the average, only a few cents to the ton, but considerable gold is said to have been lost owing to its extremely fine subdivision and the superabundance of slime produced by the enclosing claylike saprolite.

COGGINS (RICH COG)

The Coggins (Rich Cog), together with the Russell, Sallie Coggins, and Steel (Steele) mines, all near the village of El Dorado, in northwestern Montgomery County, are in a group of closely spaced deposits that trend northeast and are to be classified as indefinitely bounded mineralized zones.

The Coggins mine, 1½ miles north of El Dorado, has been operated intermittently since its discovery in 1882. From unpublished manuscripts and published reports [91] it appears that the workings were 50 feet deep in 1886, and that a 40-stamp mill was built in 1887. In 1890 the mine was 200 feet deep. In 1911 the Whitney Company obtained a lease and bond on the property, began development work, and installed a 40-ton Lane mill. At that time the shaft was 226 feet deep and the drifts were 660 feet in length. A report dated September 26, 1911, by Bela Low, an engineer, states that $4,820 in gold was recovered by amalgamation from 1,698 tons of ore—an average of $2.84 (0.14 ounce) per ton. In addition, 35 tons of concentrate was produced, which assayed $49 per ton, its total value being $1,715. Systematic sampling by Low of the ore remaining showed, on the 100-foot level, assay values ranging from $5 to $9.50 (0.25 to 0.475 ounce) per ton for a width that ranged from 10 to 40 feet. On the 200-foot level, Low obtained values of $18 to $25 (0.9 to 1.25 ounce) per ton for a width of 16 to 20 feet.

Between 1913 and 1916 the mine was actively developed and the ore was treated in a 10-stamp mill. A sampling record made after the main workings had reached a depth of 350 feet shows an assay value of $8.20 (0.41 ounce) per ton for an average width of 7 feet on the 250-foot level, and an assay value of $3.65 (0.182 ounce) per ton for a body of similar width on the 350-foot level. Samples from a winze sunk 47 feet deeper on a body 7 feet wide averaged about $12 (0.6 ounce) per ton.

Development work was continued, and in 1919, when the mine had reached a depth of 550 feet (the same that it had in 1935), it was examined by Joseph Hyde Pratt. He estimated that about 65,000 tons of ore, worth $5 to $7 or more a ton, then remained above the 350-foot

[91] Mineral Resources U. S., 1910 to 1928, inclusive.

level, and that 3,000 tons of $9 (0.45 ounce) ore was developed below that level. Presumably part if not all of this ore was extracted during a period of activity lasting from 1922 to 1925, in which a 50-stamp mill was operated. Samples taken by Pratt along a drift on the 550-foot level showed an average assay value of 80 cents (0.04 ounce) per ton for a distance of 160 feet. Samples from a crosscut at right angles to the drift showed an average assay value of $1.58 (0.079 ounce) per ton for a distance of 60 feet. Pratt expressed the opinion that the shoot of relatively good ore in the winze below the 350-foot level probably continued downward on a slope that carries it farther northwest than the end of this crosscut. The mine was shut down in 1926, but early in the summer of 1934 it was temporarily unwatered by John M. Rogers for the purpose of sampling.

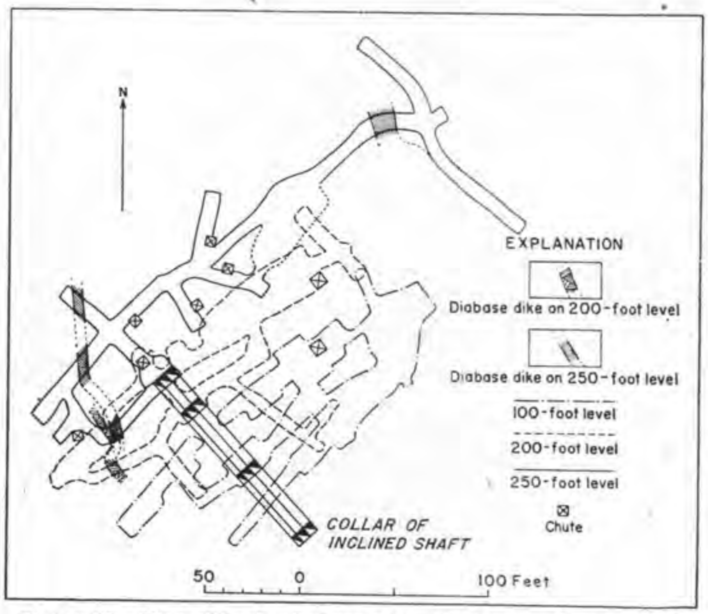


FIGURE 18.—Plan of levels, Coggins mine, Montgomery County, N. C. From Brunton compass traverse by J. M. Rogers, May 1934.

The results of Rogers' sampling are not available, but from a Brunton survey that he made (fig. 18) it appears that an ore body stoped out between 100-foot and 250-foot levels is from 60 to 70 feet long (stope length) and about 20 feet in average width. If a substantial part of the assay value as indicated by the samples of Pratt and Low was recovered, the total yield of this body, including the part that extended to the surface, must have been at least $100,000 (5,000 ounces).

As seen during an incomplete examination of the workings unwatered in May 1934, the deposit is composed chiefly of fine-grained quartz that has replaced the foliated country rock to a greater or less degree. It contains a small amount of pyrite, or its oxidation products, irregularly disseminated in grains or streaks. No gold was visible, and any that is present presumably occurs in minute free grains. The lode zone is crossed, but not faulted, by northwest-trending diabase dikes.

SALLIE COGGINS

The main opening at the Sallie Coggins mine, which is a short distance west of the Coggins, is an open-cut in a hillside. It is about 75 feet long and 30 feet wide, and the back of it rises 35 feet from the surface of standing water. The submerged part is said to be 35 feet deep, and below it is a 60-foot shaft. The visible excavation is in a schistose zone about 30 feet wide, which trends N. 45° E. and dips about 65° NW. Some 250 feet northeast of this cut are old hydraulic pits and other open workings, in which stringers and lenses or rusty quartz parallel to the schistosity may be seen. About 150 feet northwest of the cut a ledge known as the "West Lead" crops out. It strikes N. 40° W., is about 15 feet wide, and is composed largely of quartz stringers.

From notes in the Engineering and Mining Journal issues of April, May, June, and December 1896, and April and June 1897, it appears that both a hydraulic plant and a 10-stamp mill were operated in that period, and that a belt 50 feet wide was washed, yielding 30 cents per cubic yard. This work uncovered ore stringers containing sphalerite, galena, and pyrite. Milling done at various times between 1906 and 1916 produced a total of $2,477 (about 123.5 ounces) of gold.[92]

IOLA AND UWARRA

The Iola and Uwarra mines, 2 miles west of Candor, are both on a lode that has been very productive. It was not discovered until 1901. During the 15 years thereafter, it is estimated that these mines produced $1,000,000 in gold, of which $900,000 came from the Iola mine. There is a recorded production of $732,500 [93] from the Iola for the years 1902 and 1905–15 inclusive, and of $93,904 from the Uwarra during its last period of operation, in 1914–16. To these amounts should be added an unknown but presumably large amount produced at the Iola in the years 1901, 1903, and 1904 and recovered from mine dumps and mill tailings since 1915. The Uwarra is also understood to have produced substantially before 1914. The figures given above are therefore probably not far from the totals. Little or no work has been done since about 1916, and in 1934 none of the workings were accessible.

The lode is at the eastern margin of the volcanic series, which there passes under a cover of later sediments (see pl. 25). The outcrop is concealed by these sediments—a fact that probably accounts for the lateness of the discovery. Descriptions by Hafer [94] and Lyon [95] indicate

[92] Mineral Resources, U. S., 1906 to 1916, inclusive.

[93] Mineral Resources, U. S., 1902, 1905–15, inclusive.

[94] Hafer, Claude, The Iola mine: North Carolina Geol. and Econ. Survey, Econ. Paper 34, pp. 26–29, 1914.

[95] Lyon, E. W., The progress of gold mining in North Carolina: Eng. and Min. Jour., vol. 87, p. 295, 1909.

that the lode strikes northeast and dips 45° to 50° NW. Unlike most other lodes of northeasterly trend in the volcanic series, this is a fairly definite vein. It averages about 3 feet in width for a distance of 2,000 feet in the Iola ground. It consists chiefly of quartz, which contains free gold, mostly in extremely fine particles. Several ore shoots were mined, one of them 100 to 150 feet long and 350 feet deep (pitch length). Mill recoveries by amalgamation and cyanidation ranged from 0.43 to 2.50 ounces of gold to the ton and averaged about 0.50 ounce for the life of the mine.

Specimens of the vein rock from the dump are all very fine-grained. Some are banded quartz containing shreds of chlorite that represent unreplaced parts of the country rock, some are pearly-gray flinty-appearing quartz containing chalcedony that has filled cavities, and some are banded pink to red rock made up of sugary quartz and later calcite.

The workings as they existed in 1909 are described by Lyon.[96] There appears to be no authentic record of later developments as the mine survey plats and records are said to have been destroyed by fire. The vein is supposed to have been mined out within the limits of the Iola ground, and to have passed down the dip, into the ground of the Martha Washington mine at a depth of 600 feet. In the Uwarra property, described by Barbour,[97] the vein has been explored to a depth of 400 feet, and it has been drifted on for a considerable distance. At the 225-foot level a "blind" vein known as the Montgomery vein was found. The veins in the Uwarra ground range from 5 to 9 inches in width and—as is somewhat unusual in this region—some are displaced as much as 35 feet by faults. During the last period of operation the yearly average recovery from ore milled ranged from 0.165 to 0.215 ounce of gold to the ton. As the ore was almost free from sulfides and was entirely free-milling, it was very successfully treated by the cyanide process. A description of the plant is given by Barbour.[98]

RUSSELL

The Russell mine, 2 miles north of El Dorado, includes several open pits and underground workings that attain a depth of 200 feet or more. The largest pit, known as the Big Cut, is about 300 feet long, 150 feet wide, and 60 feet deep. As a whole, the material excavated from this pit is said to have averaged $2 (0.10 ounce) to the ton in gold. According to published reports[99] the deposit is a good example of the indefinitely bounded lodes herein called mineralized zones. It consists of hard silicified schist. The entire mass is gold-bearing, but only certain parts of it are rich enough to work, and even these parts are of low grade except for rich seams, which appear and disappear abruptly. Ore is difficult to distinguish visually from waste. A plan of the workings shows six parallel ore zones, called leads, which are 10 to 70 feet wide and strike northeastward parallel to the schistosity. A number of assays are cited in the reports that show values of at least 0.10 ounce of gold and 0.05 ounce of silver to the ton, but the size of the bodies that they represent is not stated.

The longitudinal and vertical extents of the Big Cut and of the workings on the neighboring zones are indicated by sections drawn to illustrate an unpublished report made by Leo von Rosenberg about 1896. (See fig. 19.)

The total production of the mine is said to have exceeded $300,000.

STEEL

Gold is said to have been discovered at the Steel mine, a mile and a half east of El Dorado, about 1832, and the mine appears to have been worked extensively before 1853, but its history during the intervening period is not known. In 1876 the property was purchased by an English company, and from then until 1884 the ore was treated in Chilean mills. Notes in the Precious Metals report of the U. S. Mint for 1886, and in issues of the Engineering and Mining Journal for February 20, May 22, and September 11 and 25, 1886, and October 6, 1887, tell of the repairing of old shafts and the building of a new mill containing at first 20 stamps and later 40 stamps. One shaft was 135 feet deep. Ore containing galena and "rich in free gold" was found in narrow seams that had an aggregate width of 6 to 12 inches. Material outside the seams contained 1 to 3 percent of sulfides, and by milling it a concentrate was produced that commonly averaged $50 per ton. The reported production during 1887 was $150,000.[1] Kerr and Hanna[2] and Nitze and Hanna[3] describe the lode as being in most places 9 to 12 feet wide, but in some places as much as 20 feet wide. It is conformable with the schistosity, its strike being N. 25° E. and dip 70° NW. The rich seams contained galena, sphalerite, chalcopyrite, and pyrite. Assays of ore from them, reported by Prof. F. A. Genth, ranged from 20 to several hundred ounces of gold to the ton, and the ore from a few assayed more than 100 ounces of silver per ton. A sample reported to represent the entire width of the vein at a depth of 65 feet assayed nearly 8 ounces in gold and 3½ ounces in silver per ton. Presumably these rich ores were largely confined to the upper work-

[96] Lyon, E. W., op. cit., p. 295.

[97] Barbour, P. E., Mining industry in North Carolina: North Carolina Geol. and Econ. Survey, Econ. Paper 34, pp. 39, 44, 1914.

[98] Barbour, P. E., Eng. and Min. Jour., vol. 94, pp. 505–509, 1912.

[99] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pp. 74–76, 1896. Kerr, W. C., and Hanna, G. B., Ores of North Carolina: North Carolina Geol. Survey Bull. 2, p. 248, 1893.

[1] Mineral resources, U. S., 1887, p. 246, footnote.

[2] Kerr, W. C., and Hanna, G. B., op. cit., pp. 188–201.

[3] Nitze, H. B. C. and Hanna, G. B., op. cit., pp. 77–78.

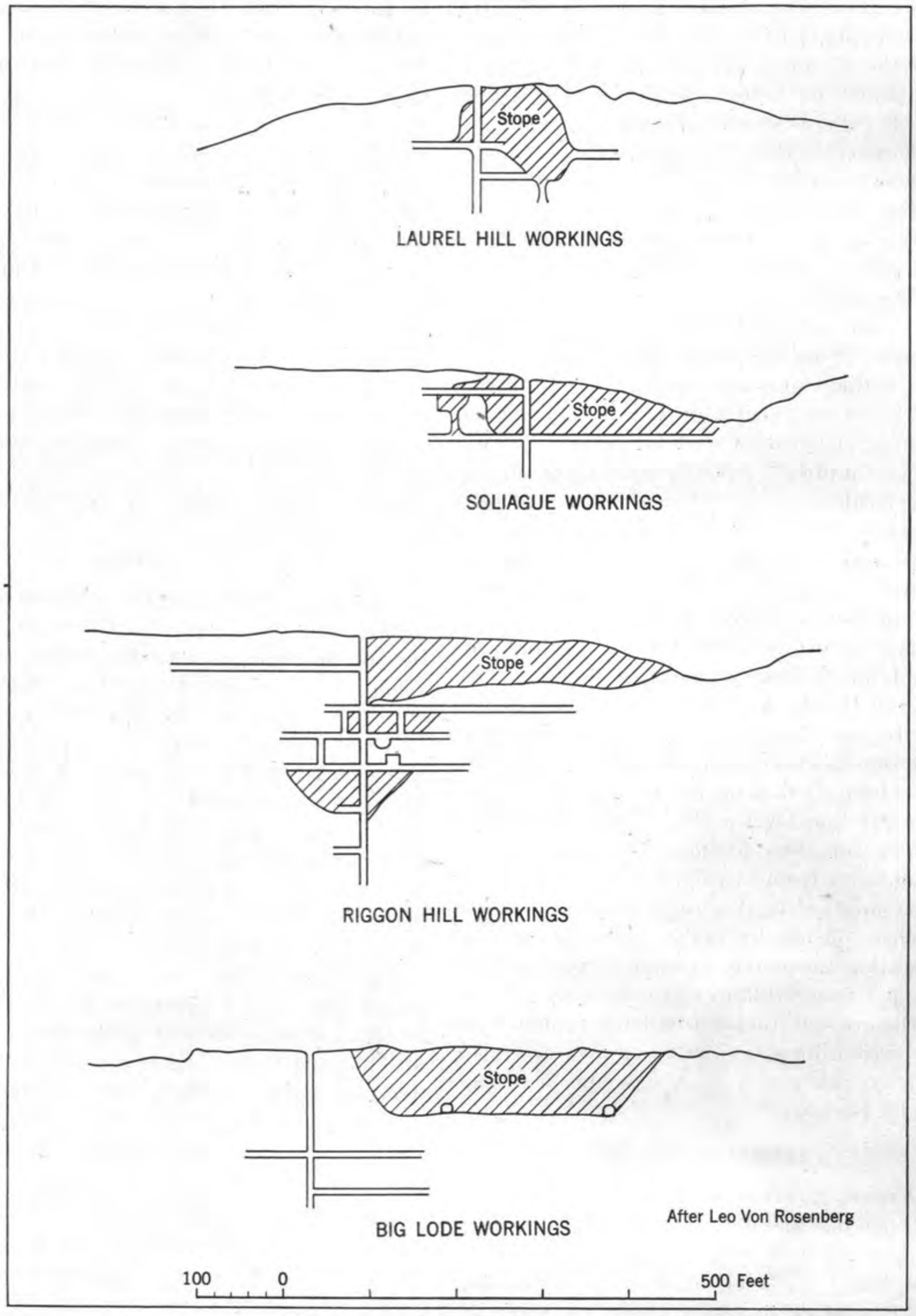


FIGURE 19.—Longitudinal sections, Russell mine, Montgomery County, N. C.

ings, for Kerr and Hanna[4] remark that "the most ardent friends of the mine do not claim any such values for the ores at the present depth (220 feet); nevertheless very rich pockets are even now found."

There is no record of any considerable activity at this mine since 1888. In 1934 a mill containing 10 stamps, a boiler, an engine, a roaster, and other accessories remained on the property, but it was rapidly going to ruin. Material on the dumps, presumably waste from the lode, is chiefly silicified schist containing stringers of quartz, locally associated with calcite. Much of the rock shows a dark-greenish tint due to finely divided chlorite. Minute grains of sulfides are disseminated through some of the rock.

[4] Kerr, W. C., and Hanna, G. B., op. cit., p. 200.

OTHER PROPERTIES

The Buck Mountain gold property [5] is 7 miles west of Troy, and about a quarter of a mile from the Uharie River. Two quartz veins, 25 to 50 feet wide, cut across the property and are well exposed in the side of Buck or Gold Mountain, which rises nearly 200 feet above the surrounding country. Tests by panning of the surface mantle over an area of about 50 acres below the outcrops of the veins showed from two or three colors to a pennyweight of gold to the pan. All the gold was rough, indicating that it had been moved but a short distance. Below the outcrop of the vein on Buck Mountain, fragments of quartz that showed free gold were picked up, and a small open cut on the vein exposed quartz containing free gold.

The Carter mine, about 3 miles east of Troy, is briefly described by Emmons [6] as being on a vein that contained much lime carbonate and a rare "telluret" of gold. Fuller descriptions are given by Pratt [7] and Hafer.[8] The mine is said to have produced $100,000 or more from workings less than 100 feet deep. Gold-bearing quartz was found in a vein that averaged 3 feet in width and contained some very rich streaks. Rock seen on the dumps in 1934 included a granular ("sugar") vein quartz containing a little sericite, which had a layered distribution representing the foliation of replaced schist.

At the Golconda mine, half a mile northeast of the Uwarra, development work was done from time to time between 1904 and 1910. The workings are described by Pratt [9] as including a shaft 150 feet deep with several levels, which explore a vein 4 feet wide. A 30½-ton lot of ore yielded 15.1 ounces of gold, and about $5 (¼ ounce) was lost in the tailings. The average recovery from other lots of ore milled in 1906, 1907, and 1910 ranged from $9 (0.45 ounce) to $12 (0.6 ounce) per ton.

The vein apparently lies east of, and parallel to, the projected course of the Iola vein. Material on the mine dumps indicates that the country rock is similar to that of the Iola mine, page 82.

At the Harbin placer mine, 2 miles southeast of Moratock, old workings disclose 2 to 6 feet of gold-bearing stream alluvium in a small valley and on a low bordering terrace (see fig. 20).

The Sam Christian placer mine, 4½ miles west of Wadeville, was worked intermittently for several years and yielded many nuggets. It was operated for a time by hydraulic methods with water pumped from the Yadkin River. The deposit consists of alluvium in former stream channels.

[5] Description from notes by J. H. Pratt.

[6] Emmons, Ebenezer, Geological Report of the Midland Counties of North Carolina, p. 169, Raleigh, H. D. Turner, and New York, G. R. Putnam Co., 1856.

[7] Pratt, J. H., The mining industry in North Carolina during 1906: North Carolina Geol. and Econ. Survey, Econ. Paper 14, p. 55, 1907.

[8] Hafer, Claude, Notes on the Carter mine: North Carolina Geol. and Econ. Survey, Econ. Paper 34, pp. 45–46, 1914.

[9] Pratt, J. H., op. cit., p. 54.

POLK COUNTY

In Polk County, N. C., and in the adjoining part of Spartanburg County, S. C., placers scattered over a considerable area drained by tributaries of the Pacolet River were mined many years ago. It is said that many of the deposits remain unworked because of a lack of available water.

RANDOLPH COUNTY

HOOVER HILL

The Hoover Hill mine [10] is east of Uharie River and about 12 miles north by west of Asheboro. Only the surface workings were accessible to examination in 1934. They consist of several cuts and pits distributed over an area of several acres, which contains also the Hawkins shaft, the Briols shaft, and other entries to the underground workings. The owner of the property in 1934 was Mrs. L. A. Briols of High Point, N. C.

The prevailing type of country rock is a dark-gray devitrified rhyolite of the volcanic series. Specimens

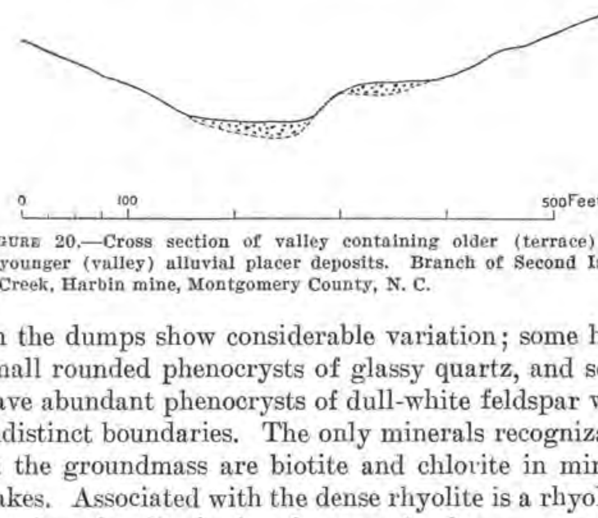


FIGURE 20.—Cross section of valley containing older (terrace) and younger (valley) alluvial placer deposits. Branch of Second Island Creek, Harbin mine, Montgomery County, N. C.

on the dumps show considerable variation; some have small rounded phenocrysts of glassy quartz, and some have abundant phenocrysts of dull-white feldspar with indistinct boundaries. The only minerals recognizable in the groundmass are biotite and chlorite in minute flakes. Associated with the dense rhyolite is a rhyolitic flow breccia. Pyrite in minute grains is a common accessory mineral. South of the Hawkins workings a gabbro dike cuts the rhyolite.

Specimens of lode material from the dumps include a breccia filled with white granular quartz and locally replaced by it. There is also a light-gray porcelain like quartz, enclosing a little pyrite, cut by veinlets of glassy vitreous quartz. As indicated by the disposition of the surface workings, the general trend of the lode is N. 33° E.

The deposit worked in the mine was discovered by Joseph Hoover in 1848. Shortly thereafter it was sold to McDowell, Woodfin, and Avery, of Buncombe

[10] Emmons, Ebenezer, op. cit., p. 139. Eng. and Min. Jour., vols. 44 to 57, 1883 to 1895, inclusive. Nitze, H. B. C., and Hanna, G. B., Gold Mining in North Carolina: North Carolina Geol. Survey Bull. 3, p. 57, 1896.

County, who worked it themselves for several years and also leased parts of it to tributors. Of this practice Emmons said in 1856:[11] "The system of leasing * * * in parts * * * has injured the owners of the property, * * * (and) has finally resulted virtually in its abandonment, until the obnoxious leases shall have expired."

After a long period of idleness the mine was bought by the Hoover Hill Gold Mining Co., Ltd., of London, England. This company began development work in May 1881, and erected a 20-stamp mill with suitable offices, storehouses, machine shops, and dwellings. It worked the mine actively, with varying success, until about the end of 1895, when it discontinued operations. In 1907 the company sold the mine to Mr. L. A. Briols for $8,500. In 1914 the mine was unwatered, and the old Briols shaft was retimbered to a depth of 130 feet. A small production was made in 1914, and again in 1917. The water was kept down until 1922, but since then the underground workings have been flooded.

There were two main entries, the Briols shaft and the Hawkins shaft. The Briols shaft, from which most of the work was done, was 350 feet deep, and levels were turned from it at 70, 130, 170, 230, 300, and 350 feet. Workings connected with the Briols shaft included three stopes extending to the surface, one of them being known as the Gallimore shaft. At the 130-foot level a crosscut extended 200 feet to the Provost ore body, which was explored by a drift 50 feet long, a raise 10 feet high, and a winze 55 feet deep.

Figures taken from general mining notes in the Engineering and Mining Journal during the period of operation from May 1881 to June 1895 indicate that the output of the mine amounted to approximately $300,000. The yearly production during that period, as known or as estimated from incomplete statistics, was as follows:

To June 16, 1883	$8,200
June 1883 to January 1884	23,000
1884	65,000
1885	68,400
1886	29,000
1887	7,000
1888	25,000
1889	26,400
1890	5,000
1891	8,000
1892	6,000
1893	12,000
1894	12,000
1895	5,000
Total	300,000

Allowing for gold recovered during the first period of operations (1848–81) and for later reworking of the dumps, the estimated total output of the mine was $350,000.

[11] Emmons, Ebenezer, op. cit., p. 139.

The ore was found in pockets and chimney-like shoots. The Briols shoot, which was the principal ore body, was 12 feet wide on the 350-foot level, 70 feet or more in length, and worth $8 to $10 per ton. It extended to the surface. At no great distance from the Briols shoot, six other ore bodies lying close together were worked through the Hawkins shaft. The Provost shoot, about 200 feet east of the Briols, was a quartz stringer 16 to 18 inches wide, but a thickness of 25 to 30 inches was milled.

The ore bodies occur in sheared and brecciated zones, of which there are several, all approximately parallel and striking northeastward. The maximum thickness of the zones was about 15 feet. Up to 1892 the main dependence of the mine was the Briols shoot, which is typical of the group. This body consists of a multitude of quartz seams ramifying in all directions through the sheared rhyolite—locally known as "slate". The quartz is mostly white and opaque, but that in the richest ore is transparent and bluish green. Although quartz seams are invariably present in the mineralized zones, they do not everywhere indicate pay ore.

The gold occurs, according to Winslow,[12] "free and in fine grains and dust generally distributed along the planes of contact, between the quartz and 'slate'. Only about 1 percent of sulfides is associated with the gold, so that it is practically entirely free milling, although, as the rock is exceedingly hard, it is by no means an easily worked one." Nitze and Hanna,[13] on the other hand, state that pyrite forms about 3 percent of the ore. No other ore minerals are known to be present.

The ore was "spotty," and the average grade of the ore milled varied considerably from month to month. Nitze and Hanna say that the Briols shoot averaged $8 to $10 per ton ($14 to $17.50 new price). Records show that the value of the ore milled decreased from $11.75 a ton ($20.50 new price) in August 1885, when the best part of the Briols shoot was being stoped, to $1.57 a ton ($2.75) in February 1887, when only marginal ore was being mined. Operations were suspended in May 1887, but they were resumed in the late summer, upon the discovery of new ore, which permitted continued operation of a 20-stamp mill for the next 8 years.

JONES-KEYSTONE

The Jones-Keystone mine is about 12 miles west of Asheboro and on the west side of Uharie River, opposite the Hoover Hill mine. The owner in 1934 was M. L. Wood, who lived nearby.

The principal workings are two large open-pits (fig. 21) and several shafts of unknown depth, which were not accessible when the mine was visited by the writers

[12] Winslow, Arthur, North Carolina mining notes: Eng. and Min. Jour., vol. 40, p. 218, 1885.

[13] Nitze, H. B. C., and Hanna, G. B., op. cit.

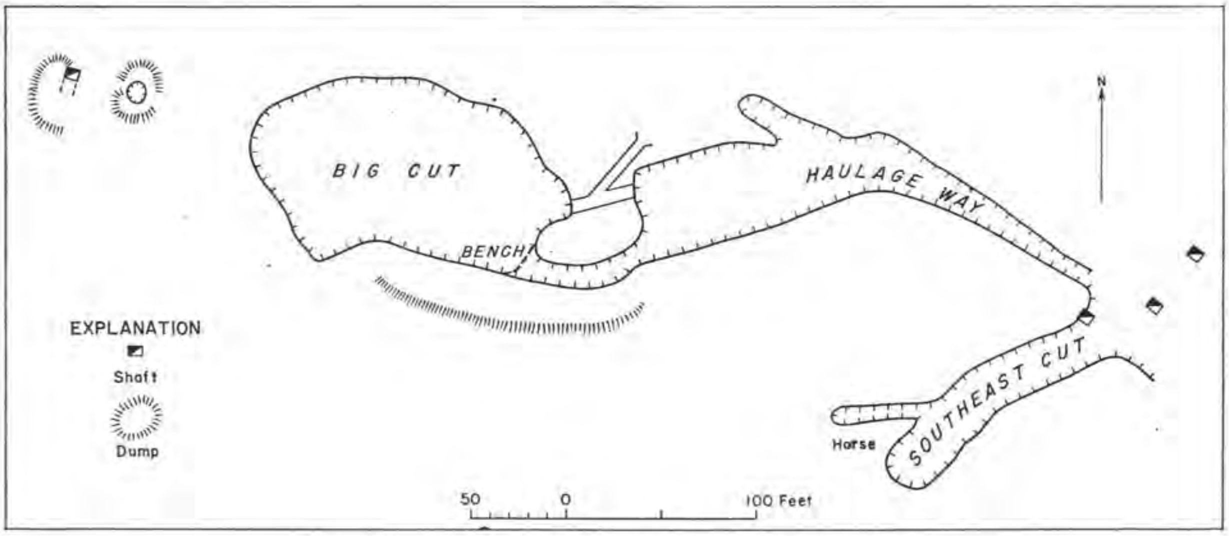


FIGURE 21.—Plan of Jones-Keystone mine, Randolph County, N. C.

in 1934. The mine was then idle and apparently had been so for a long time.

The country rock is a schist derived from tuffs of the volcanic series, more or less altered to saprolite. The average strike of the foliation is N. 45° E. and the dip 80° NW. The larger pit is in decomposed schist profusely stained with iron oxides and containing veinlets of limonite as much as 6 inches thick along many of the joints and cross fractures. Unoxidized material found in the smaller pit, to the southeast, contains much pyrite. Some specimens are largely composed of pyrophyllite, and some consist of a highly silicified tuff containing fragments of volcanic rock as much as half an inch in diameter. The silicified and iron-rich zones exposed in the pits constitute the ore bodies. They are respectively about 60 feet and 30 feet wide, are about 100 feet apart, and trend northeast.

The following summary of the history of the mine is condensed from available reports.[14] In 1852 the mine was in active operation and was equipped with a 30-horsepower steam engine, a 40-stamp mill, 30 washing bowls, a shaking table, and a 300-foot railroad for haulage from the pits to the mill. The stamp mill was probably one of the earliest in North Carolina. It was of primitive design, with stamps weighing only 150 pounds each. The bowls were given a reciprocating motion, which was supposed to settle the concentrates while the tailings passed off in a continuous stream of water. The ore was quarried in the large cut and delivered to the mill for 15 cents a ton. Tyson says that the recovery was low because much of the gold was exceedingly fine and passed out of the bowls with the tailings. The concentrates amounted to less than 1 percent of the ore. They were scraped from the bowls and passed over a shaking table, on which Tyson thinks that a great deal more of the gold was lost. All the ore milled consisted of soft material from the zone of oxidation.

The mine was shut down at the outbreak of the War Between the States, reopened in the late seventies, and operated to a small extent during 1880. After lying idle from 1881 to 1883, the mine was reopened in 1884, and a 10-stamp mill was installed. Again in November 1894 and in June 1895 the mine was reported to be in operation. After another period of idleness, operations were resumed in May 1896, and by October of that year a 40-stamp mill had been erected. The last activity reported occurred in 1903.

When seen by Emmons in 1856 the mine was a series of open quarries. The numerous gulches that mark the surface allowed easy access and cheap entry into the ore bodies, and the slopes facilitated transportation to the mill by means of gravity tramways. The deposit was described as "a mass of soft reddish talcose (sericitic) slate" through which gold was disseminated. The breast of ore exposed was 60 feet wide and 25 to 30 feet high. It was easily quarried and yielded an average of 15 cents a bushel (about 0.15 ounce per ton). Nitze and Hanna state that "gold is universally present in the soil of the region, but mining is confined to certain well-known belts, which are more richly charged with it." Occasional horses, or "bars," charged with finely disseminated iron pyrite, were found; being relatively unaltered, they were still solid and firm, but unless very rich they were usually avoided because of the comparative difficult mining and milling. Other horses, of barren material, occurred also. Two of the ore-bearing belts are described as being 50 feet and 110 feet wide respectively. The gold content varied markedly from place to place. Small rich seams were found, but the average material mined was of low

[14] Tyson, P. T., Report on the gold deposits and works of the Manteo Mining Company in North Carolina, Baltimore, 1853. Emmons, Ebenezer, op. cit., pp. 13, 131. Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pp. 58–59, 1896.

grade. Mining was profitable as long as the deposit contained rich seams to "sweeten" it. Reported mill recoveries ranged from $2 to $5 per ton (old price).

During the present examination a grab sample was taken of the pyrite-bearing material in the southeast cut. This sample assayed 0.04 ounce of gold per ton, equivalent to $1.40 with gold at $35 an ounce. Between 30,000 and 40,000 tons of material has been removed from the pits. If it was all milled and was all of the lowest tenor given, the total production was about $100,000 (5,000 ounces).

SAWYER AND NEW SAWYER

The Sawyer, 8 miles northwest of Asheboro, is an old mine, said by Emmons [15] to have been profitably worked before 1856. From his description it appears that the gold was found in five or six parallel "beds" (cleavage layers) of slate, striking northeast, which disintegrate at the surface to a fine white sand. The lode evidently should be classified with the mineralized zones.

From a description by Pratt [16] published in 1907 it appears that the Sawyer mine was in operation the previous year; the account states that a "recent" shaft 150 feet deep cut the "vein" at 100 feet depth, and that drifts 40 feet "each way" were turned at that level. Sulfides first appeared at a depth of 80 feet, pyrite occurring in scattered grains and fine-grained "little bunches." Cubes of pyrite as large as 1 inch on a side occurred in the walls. Samples of material exposed in open-cuts and other surface workings are said to have assayed $0.80 cents to $14 to the ton in gold.

Activity at the New Sawyer mine, about 3 miles northeast of the Sawyer mine, is mentioned in mining notes in the Engineering and Mining Journal issues of July 12 and November 1, 1902, and sampling was done there under the direction of H. D. McDonald in 1930. There are several mineralized zones on the property. As shown by the owner's assay maps, a zone 3 to 15 feet in width, exposed by open-cuts at five places in a stretch of 500 feet or more, assays 0.057 to 0.24 ounce of gold to the ton. Another cut shows an average of 0.046 ounce to the ton across a width of 87 feet. Shafts from 30 to 60 feet deep sunk on the richer parts of the lode found similar material, with here and there some especially rich ore.

SCARLETT

The Scarlett mine, just west of North Asheboro, includes two shafts and some small surface workings. It is said to have been opened about 1882 as a gold mine. After a few years, apparently, it was closed, and it has remained idle for most of the time since then. In 1906 and 1907, however, a production of nearly 8,000 pounds of copper, with a little gold and silver, was reported.[17] Some development work was done, also, mostly by the Tenvanoca Copper Co., between 1910 and 1918, and it is understood that in the period 1913–18 the mine produced considerable ore, which was shipped out of the State. In 1934 the underground workings were not accessible and the buildings were in ruins.

The country rock is a bedded tuff of the volcanic series, to which more or less silica has been added by hydrothermal processes. Some layers resemble gray to green hornstone, marked with bands representing coarser and finer layers in the original tuff. Specimens from the mine dumps show more or less chlorite, amphibole, chalcopyrite, and sphalerite, enclosed in the silicified mass. Sphalerite is the most abundant sulfide in an ore pile of 20 tons or more. The features described are much like those of typical contact-metamorphic deposits. Whether the lode is irregular, as such deposits commonly are, was not determined.

OTHER PROPERTIES

At the Allred mine, 10 miles northeast of Asheboro, there are a number of open-cuts distributed for a quarter of a mile or more along a northeast-trending belt 400 feet wide in rocks of the volcanic series. The deposit has been worked at various times both before and since the war of 1861–65. A small production for the period since 1921 is reported. In August 1934 Mr. A. J. Bowers was making a mill test on material from the upper part of the saprolite layer, using his patented variation of the amalgamation process. The material exposed contains seams of iron oxides and pseudomorphs of limonite after pyrite, some of which contain residual cores of the sulfide. A channel sample across a width of 8.5 feet assayed 0.02 ounce in gold to the ton, and a sample of the limonite-pyrite cubes assayed 0.47 ounce.

At the Redding mine, 4½ miles northeast of Asheboro, a sheet of alluvium 50 feet or more in width and 2 or 3 feet thick has been worked. In 1934 the deposit was being tested with a G-B portable washing machine. It lies in a small valley and consists of a clayey sediment containing small scattered water-worn pebbles.

ROWAN COUNTY

GOLD HILL GROUP

In the Gold Hill district of Rowan and Cabarrus Counties, N. C., 16 miles southeast of Salisbury, are several of the largest and most productive mines in the Southern Piedmont gold belt. Together, these mines form a group that has been more extensively developed than any other in the Carolinas. In 1934 and 1935, however, none of the mines in this district except the Whitney, which was partly unwatered and sampled in the summer of 1935, was active, or even accessible.

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[15] Emmons, Ebenezer, op. cit., p. 133.

[16] Pratt, J. H., The mining industry in North Carolina during 1906: North Carolina Geol. and Econ. Survey, Econ. Paper 14, pp. 42–44, 1907.

[17] Mineral Resources, U. S., 1906, 1907.

Descriptions of the mines are given in the following reports, which are listed in the order of their publication.

1853. Asbury, Daniel, Gold mines at Gold Hill, Rowan County, N. C., Mining Mag., vol. 1, pp. 69, 411–412.

1856. Emmons, Ebenezer, Geological report of the Midland counties of North Carolina, pp. 154–166, New York, G. R. Putnam Co., and Raleigh, H. D. Turner.

1874. Cram, T. J., Report upon the mine and mills, with estimates for the use, of the North Carolina Gold Amalgamating Co., 36 pp., map, Philadelphia.

1882. Eng. and Min. Jour., vol. 34, p. 86.

1883. Report of the Director of the Mint for 1882, pp. 627–629.

1896. Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pp. 85–91, maps.

1900. Ledoux, A. R., The Union Copper mine, Gold Hill, N. C.: Eng. and Min. Jour., vol. 69, pp. 167–170.

1901. Weed, W. H., Types of copper deposits in the southern United States: Am. Inst. Min. Eng. Trans., vol. 30, pp. 471–479.

1902. Weed, W. H., Recent development of southern copper deposits: Eng. and Min. Jour., vol. 74, p. 80.

1905. Eng. and Min. Jour., vol. 80, pp. 517–518.

1907. Nicholas, F. C., The Gold Hill copper mine and its development: Mining World, vol. 27, pp. 1001–1002.

1910. Laney, F. B., The Gold Hill mining district of North Carolina: North Carolina Geol. and Econ. Survey Bull. 21, 137 pp., maps.

To these reports should be added notes in many issues of Engineering and Mining Journal, reports of the Director of the Mint, and Mineral Resources of the United States, too numerous to cite individually.

The Gold Hill deposits were discovered between 1842 and 1844, and, except during the war of 1861–65, they were mined until 1915. Since then they have remained closed except for a little near-surface work, the sampling at the Whitney mine already mentioned, and occasional attempts to treat parts of the dumps.

The total production from these mines to 1935 has probably been about $3,300,000 in gold (reckoned at $20.67 an ounce) and $700,000 in copper, distributed as follows:

Production of gold and copper from the Gold Hill group, Rowan County, N. C.

Mine	Copper		Gold
	Pounds	Value	Value
Randolph mine			$1, 650, 000
Barnhardt and Old Field mines			730, 000
Honeycutt mine			125, 000
Troutman mine			400, 000
Union Copper mine	5, 000, 000	$675, 000	375, 000
Whitney group (1899–1906)			62, 500

About $15,000 should probably be subtracted from the total value given for gold and added to that for copper, to represent production of copper from mines other than the Union Copper. An unknown but probably small amount should be credited to silver.

The following description of the Gold Hill mines is condensed from previous reports, chiefly that by Laney.

The country rock of the district is a chlorite-sericite schist belonging to the volcanic series. Parting planes strike in general N. 30° to 45° E. and dip 75° to 80° NW. Laney concluded that the mineralized belt is part of a shear zone developed along a fault that separates schist on the east from intrusive granitic rocks on the west.

Most of the lodes are zones in which the schist is partly or completely silicified, though some of them are relatively free from quartz, and are distinguished from the country rock only by the presence of sulfides. The lodes trend, in general, northeastward with the parting planes of the schist, but at intervals an individual lode leaves one plane and crosses obliquely to another, generally toward the left as one looks along the strike. As a result the average trend of the lodes is some 10° or 15° more nearly northward than the dominant structure of the rocks. In a similar manner a given lode, when followed downward, is found to depart here and there from one cleavage plane and pass to an underlying one, so that the average dip of the lode becomes 10° to 15° steeper than the schistosity—that is, nearly vertical. Thus the lodes appear to be controlled by a set of fractures parallel to the border of the granite, which Laney believed to be a fault contact. Locally the lodes send off small branches along fractures that trend northwest. In places the walls, particularly along the lodes that strike northwest, are well defined and marked with striae, but in general the mineralized zone fades out in the adjoining rock and the boundaries of the lodes are indefinite.

The principal lodes are persistent along the strike, one of them, the Whitney (McMakin), being continuous for at least a mile, but they pinch and swell. Some of them attain maximum widths of 10 to 15 feet, and for considerable distances they average 3 to 6 feet in width. They are not displaced by faults to any noteworthy extent.

In addition to quartz, the Whitney lode contains carbonates (ankerite and calcite) and barite. The principal ore minerals throughout the district are chalcopyrite, gold-bearing pyrite, and native gold. Small amounts of galena and sphalerite are rather widespread, and in a lode exposed in the Silver shaft of the Union Copper group these minerals were abundant in an ore rich in silver.

The gold occurs in very minute grains and scales. As a rule, relatively high gold content goes with relatively low copper content, and vice versa. Its relations to other minerals indicate that the gold was deposited in the lodes after pyrite and chalcopyrite but before galena and sphalerite.

Weathering of the lodes to depths of 50 to 100 feet below the surface produced abundant iron oxides, which, in the Union Copper lode, form a heavy brown gossan. Cerussite (lead carbonate), pyromorphite (lead chlorphosphate), and manganese oxides are reported to occur in the upper part of the Whitney lode, and silver-bearing tetrahedrite in the lower part.

A shaft on the Randolph vein descends to a depth of 820 feet and is the deepest in the Piedmont gold belt of the Carolinas. Drifts and crosscuts on the 800-foot level aggregate 2,000 feet in length, and lateral workings from higher levels amount to several thousand feet more. The crosscuts at the 800-foot level penetrate 11 zones or veins along which mineralization has occurred. Most of these zones are small, and two of the larger ones, the Randolph and Barnhardt, are of low grade, but one, the North or W. G. N. vein, is workable. This vein was discovered by running a crosscut 360 feet northwest from the shaft, and a drift has been run along it. Where exposed in the drift the vein strikes N. 15° to 20° E. and averages 3 feet in width for a distance of 60 feet; it is cut but not displaced by two narrow diabase dikes. Samples from it assayed from $10 to $385 a ton in gold and less than 1 percent in copper. Production records of the mine, for the last period of operation, 1914–15, show a total of 7,250 tons of ore milled, from which were recovered 3,877 ounces of gold (an average of 0.53 ounce to the ton), 603 ounces of silver, and 23,112 pounds of copper. According to local miners all this ore came from the W. G. N. vein.

A map accompanying Laney's report shows stopes in the Randolph vein representing an ore body that extended from the 100-foot to the 700-foot level, with a pitch of about 75° SW. This body was 100 feet long at the bottom and 200 to 300 feet long above. Presumably the part above the 100-foot level—at least for a length of 500 or 600 feet—was worked out in the early days.

All accounts agree that in the upper levels the Randolph lode was very rich. Many assays and mill runs are cited that show values of $50 to $700 or more to the ton. In the middle levels rich streaks and spots occurred, but the average value was lower, near $20 or $30 a ton. At the 700-foot level workable ore had pinched out, and at the 800-foot level the lode, according to Laney, contained from a few cents to $2 a ton in gold and 1 percent of copper.

The Barnhardt lode is shown in Laney's maps as stoped for a length of 200 to 250 feet down to the 300-foot level, and as being of greatly reduced length 50 feet farther down. The Barnhardt was somewhat less rich in gold than the Randolph but contained more copper. Ore containing 8 percent of copper is said to have been found at a depth of 150 feet, which indicates that downward enrichment may have occurred, for somewhat lower down the copper content was 3 percent or less. A crosscut southwest from the Randolph shaft penetrates the Barnhardt (Miller) lode at a depth of 440 feet. In a drift on this level the lode averaged about 4 feet in width for 50 feet or more, and samples taken here assayed from 1½ to 3 percent of copper and from a few cents to $2 a ton in gold.

A lode known as the "Myers vein," penetrated by the northwest crosscut from the Randolph shaft at a depth of 800 feet, was narrow and of low grade. In a crosscut at the 600-foot level, however, it is said to have been 7 feet wide and of better grade.

A few hundred yards southwest of the Randolph shaft, two lodes parallel to the north vein but farther west than its projected intersection with the surface are developed by shafts, one of which, on the western lode, is 180 feet deep and connected with some 700 feet of drifts. Although details as to the size and value of these lodes are lacking, they are said to have been profitably worked in the oxidized zone.

The main shaft of the Union Copper mine, 600 feet deep, together with lateral workings, developed an ore body that was 130 feet long and 40 feet wide near the surface and 100 feet long and 15 feet wide in the middle on the 375-foot level. This body extended to a depth of 500 feet, where it was irregular and somewhat broken. Its strike in the upper levels was about N. 25° E., or some 15° more northward than that of the partings in the country rock. In places the ore body deviated from its general strike to follow parting planes in the schist, and on the third level a branch extended along a fracture striking N. 35° W. The main body pitched about 70° SW.; in places its walls were slickensided and showed striations parallel with the pitch. It consisted largely of very fine-grained quartz, which had partly replaced schist and locally had inherited the structure of the original rock.

The period of greatest activity at the Union Copper mine extended from 1899 to 1906. At an earlier period the oxidized and leached part of the lode near the surface was mined from an opening known as the "big cut," the reported yield of which was $300,000 in gold.

The Whitney mine, a mile south of the Gold Hill and Union Copper, comprised, in 1935, several old mines—the McMakin, Isenhour, or Fritz-Honeycutt, and Mauney. The main shaft, 700 feet deep, and lateral workings extending to a depth of at least 1,000 feet explore an indefinitely bounded zone 3 to 25 feet wide in which the vein minerals have penetrated the schist country rock along parting planes. This zone is not as highly silicified as some of the other mineralized zones in the Gold Hill district, but it contains many stringers, lenses, and knots of quartz.

Minute grains and crystals of gold-bearing pyrite are distributed through the lode, and stringers and bunches of pyrite occur with the quartz. Films of native gold, later than the pyrite, were deposited in some places between layers of schist.

It has been estimated that the large section of the lode explored by the main Whitney shaft and connected workings, below an enriched zone extending to a depth of 60 feet, originally contained 1,500,000 tons of ore, only a small part of which has been removed. In the course of development work, 4,950 tons of ore were extracted. About 0.22 ounce of gold to the ton was obtained from this ore by amalgamation. A small amount of low-grade concentrate was made, and the tailings averaged 0.04 ounce to the ton.

Old workings of the Isenhour and Mauney mines, all comparatively shallow, extend along the McMakin lode for several thousand feet. They are said to have disclosed some small, rich streaks.

During the summer of 1935 the old air shaft of the Whitney mine, reported to be about 700 feet deep, was cleaned out and unwatered to a depth of somewhat more than 245 feet by the Milton Hersey Co., Ltd., of Montreal, Canada. After the workings were made accessible and had been sampled by William T. May, the mine was again allowed to fill with water. A Brunton compass traverse of the upper levels was made by Mr. Bass and Mr. Simmons in 1935 (pl. 26), when somewhat more than 2,000 feet of underground drifts were accessible and an old stope was open nearly to the 372-foot level.

To judge from the course of the old Whitney surface workings, which can be traced almost continuously for more than a mile, the Whitney lode is a northeastward continuation of the lode developed in the old Isenhour mine, inaccessible in 1935. Where seen underground, the lode is a silicified shear zone, from a few feet to about 50 feet wide. It strikes about N. 30° to 35° E. and dips 75° to 85° NW., approximately parallel to the foliation of the enclosing rocks. The unaltered country rock appears to be generally a fine-grained dark-gray or black slate. Near the lode, much fine-grained sericite has been formed and much of the country rock is silicified. The lode consists of numerous quartz layers alternating with intensely silicified slate. Most of the quartz is fine grained, dense, and dark gray, but some layers of it are creamy or white. Its origin by replacement is well shown by the preservation of many structures characteristic of the slates. In some places the quartz readily breaks into sheets a quarter of an inch or so in thickness; this parting is thought to be largely inherited from replaced rock, as the quartz shows little or no crushing or other evidence of recent movement. Elsewhere in the mine, slips and small postmineral faults occur, and also slickensided surfaces and small bodies of breccia.

The ore remaining in the upper workings is "spotted" and generally of low grade. Laney reported in 1910 a developed reserve of 1,500,000 tons averaging about $2.50 (0.125 ounce) to the ton.[18] Assays of samples taken by the operators around the old stope indicate a considerably higher value than this, but elsewhere the ore in the upper levels averages 0.05 ounce or less to the ton.

REIMER

The Reimer mine, a mile east-southeast of Granite Quarry, is described by Nitze and Hanna[19] and by Nitze and Wilkens,[20] and the following information is taken from their reports.

In the early fifties the "brown ore" found near the surface was worked by crude methods for recovery of the gold. About 1881 a Davis chlorination plant was erected, but it burned down within a short time. Next a concentrating plant was built, from which the concentrates were treated in a chlorination plant south of Salisbury; but after operating for 2 years the concentrator also burned down. The development workings include three shafts and numerous drifts, which explore a block 150 to 165 feet deep and about 500 feet long. The mine was reopened in 1894 and worked until the fall of 1895, the ore being treated in a 20-stamp mill and a barrel chlorinator. Experiments made in 1895 with cyanide were unsuccessful. The mine has remained idle since then.

The deposit is a quartz vein in granite 1 foot to 9 feet or more in width, striking N. 75° W. and standing nearly vertical. Stope maps in the reports cited indicate two ore shoots; one is about 150 feet long (stope length) and pitches to the northwest; the other is smaller and is poorly defined. Sulfides, chiefly pyrite with a little chalcopyrite and pyrrhotite, apparently composed about 5 percent of the ore milled. The concentrate assayed $30 to $40 (1½ to 2 ounces) in gold to the ton. Much gold is said to have been lost in the tailings. The total recovery per ton was estimated at $4 to $5 (⅕ to ¼ ounce).

In 1934 none of the workings was accessible. Sampling done at that time showed that the mine dumps included considerable material containing 0.05 to 0.13 ounce of gold to the ton, and panning tests indicated that part at least of this gold was free.

OTHER PROPERTIES

The Bullion mine, 2¼ miles southeast of Granite Quarry, consists of caved and overgrown workings that extend for 500 feet along the outcrop of a prominent quartz vein. At the surface the vein contains large masses of limonite and here and there some unaltered pyrite.

[18] Laney, F. B., The Gold Hill mining district of North Carolina: North Carolina Geol. and Econ. Survey, Bull. 21, p. 108, 1910.

[19] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pp. 118–120, 1896.

[20] Nitze, H. B. C., and Wilkens, H. A. S., Gold Mining in North Carolina and adjacent south Appalachian regions, North Carolina Geol. Survey Bull. 10, pp. 91–95, 1897.

The Dutch Creek mines are just east of Dutch Second Creek and about 10 miles east of Salisbury, partly north and partly south of the road from Salisbury to Stokes Ferry. They apparently have been idle since about 1895, and in 1935 nothing remained of an old mill known to have been on the property. The country rock is a relatively siliceous granite, poor in biotite. Near the veins it is highly sheared and converted to a quartz-sericite schist. Kerr and Hanna [21] estimate that there are 20 known veins on the property. A map prepared in 1883 by J. J. Newman shows 11 or more veins within a stretch of less than a mile. They all strike northeastward, but at different angles, so that some of them intersect. Several shafts, few of them deeper than water level, and a large number of cuts have been made, chiefly on four veins known as the Katie, Hill, Tip-top, and Spring. These veins are said to range in width from 1 foot to as much as 18 feet, being thickest at intersections. Above the water table they contain abundant limonite, which below water gives place to pyrite, chalcopyrite, and specularite. Former operations were mostly confined to oxidized ore. The value of neither oxidized nor unoxidized ore is known.

The Gold Knob mines, 3½ miles northeast of Rockwell and 1 mile west of Dutch Second Creek, are on three veins that have been worked to some extent. The principal workings are on a quartz vein, which strikes about N. 48° E. and dips 45° SE. and is about 8 feet in maximum thickness. In 1935 it was accessible by way of a tunnel, in which a streak of limonite a few inches thick was visible on the hanging wall.

The Southern Belle mine, 6½ miles south of Salisbury and 1¾ miles east of the Southern Railway, is said to have been worked about 1905. The workings in 1935 consisted of a series of trenches, pits, and shafts distributed for 350 feet along a quartz vein 10 to 25 feet thick, which contains pockets and streaks of limonite.

RUTHERFORD COUNTY

In Golden Valley, an alluvial flat several acres in extent, worked over many years ago, was being tested in 1934 by C. H. Lowe and C. E. Pappy. A pit excavated to a depth of 8 feet with a hydraulic elevator exposed gravel, soil, and debris of former mining that panned a little fine gold.

On the extensive Rhyne estate, also in Golden Valley, a pit had recently been hydraulicked out by Jasper McCurry. Rather indistinctly stratified alluvium 6 to 8 feet deep, resting on a bedrock of schist, was exposed in the pit. Former hydraulic operations on this and adjacent parts of the Rhyne tract were said by Mr. McCurry to have produced $60,000 (3,000 ounces) in gold.

STANLY COUNTY

BARRINGER

The Barringer mine, half a mile southwest of Meisenheimer, has the distinction of being the first gold mine in the Southern Piedmont region to be opened on a lode. Its discovery is related by Rothe in a report [22] published in 1828. Gold had previously been mined on the Barringer farm from the alluvium of Long Creek and in particular from that in the narrow valley of a small tributary or "branch." As the work progressed Mr. Barringer observed that above a certain point on the branch no more gold was found. This suggested to him that the gold might have "come out of the hill." Acting on that idea he dug into the hillside opposite and found, within a few feet of the surface, a quartz vein rich in free gold. The first day he picked out 1,200 pennyweights of the metal. He continued to dig, and eventually excavated a pit 25 feet deep, in which he found additional pockets. When his total recovery of gold had risen to "1,600 to 2,000 pennyweights" his work was interrupted by an influx of water and slumping of the banks. Later he leased the ground to a group of men who were not experienced miners, and whose attempts to reopen it appear to have been unsuccessful.

The history of this mine during the ensuing 60 years or more is apparently unrecorded. A note in the Engineering and Mining Journal of January 9, 1892 (vol. 53, p. 95), asserts that in the past the mine had yielded as much as $40,000 from one pocket—an assertion that, after making due allowance for exaggeration, would seem to imply that considerable work had been done subsequent to Barringer's operations. In 1892 the mine belonged to Theo. Klutz of Salisbury. It was said that 75 pounds of ore taken from a small calcite vein at a depth of 40 feet on January 1, 1892, contained at least 5 percent of gold (possibly as much as 52 ounces).

Notes published at various times from 1902 to 1904 [23] show that the mine was bonded and developed by the Whitney Co., which reported finding a narrow shoot of ore that extended from the 40-foot to the 150-foot level and below. Some of the ore was so rich that the gold was melted out of it in crucibles. Ten bars of gold are said to have been shipped in 1904 within a few months; one of them weighed 20 pounds and was 950 fine. Laney [24] published in 1910 a plan and section of the workings, made by the Whitney Co. The mine then had a shaft somewhat more than 200 feet deep, from which drifts 100 to 200 feet long were turned at several levels, the deepest at 204 feet. Ore shoots adjoining a body of diabase are shown as ranging from 20 to 100

[21] Kerr, W. C., and Hanna, G. B., Ores of North Carolina: North Carolina Geol. Survey Bull. 2, p. 283, 1888.

[22] Rothe, C. E., Remarks on the gold mines of North Carolina: Am. Jour. Sci., 1st ser., vol. 13, pp. 215–217, 1828.

[23] Eng. and Min. Jour., vols. 74, 1902, p. 461; 75, 1903, pp. 164, 386, 611, 799; 76, 1903, pp. 104, 445; 77, 1904, p. 457.

[24] Laney, F. B., op. cit., pp. 111–112, pl. 13 B.

feet in aggregate length and extending from the surface to the lower levels.

HAITHCOCK, HEARNE, AND LOWDER

The Haithcock, Hearne, and Lowder mines, 2½ miles west of Albemarle, are adjoining properties said to have been worked now and then in a small way since the early days of mining. Activity at the Hearne was mentioned by Emmons [25] in 1856, who stated that "eight quarts of selected ore yielded $80 worth (4 ounces) of gold." In 1931 some development work was done at the Hearne mine by W. L. Cotton, who reported the finding of specimen ore containing $600 in gold (30 ounces). In addition, a small amount of gold was recovered with a 5-stamp mill from low-grade ore. The workings consist of trenches, pits, and shafts, none apparently deeper than water level, distributed along a northeasterly course for nearly a mile. They partly expose two veins, about 500 feet apart, that range from 2 to 6 feet in width and consist largely of milky-white quartz with some carbonate and iron oxides. Specks of native gold were visible in some of the specimens taken from the dumps. Most of the rock seen in the lode, however, appears to be barren or of extremely low grade; the rich ore apparently occurs in scattered pockets. The country rock is a greenish chloritic schist derived from a basic member of the volcanic series.

INGRAM

The Ingram placer mine, located on a branch of Mountain Creek, 4 miles east of Albemarle and half a mile north of the highway to Troy, is described in considerable detail by Nitze and Wilkens.[26] During the years 1892–94 it was worked intermittently by tributors, who are said to have found 16 to 17 pounds of nugget gold. In 1895 the property was bought by the Crawford Mining Co. of New York, by whom it was being worked at the time of Nitze and Wilkens' visit.

The deposit lies in a stream valley, on slate bedrock. It is composed of angular fragments of quartz and slate in a clayey matrix cemented with iron oxides, and is locally called "grit." In the middle of the valley the deposit is 1½ to 2 feet thick and is overlain by 2 to 4 feet of waste alluvium. Both the "grit" and the overburden thin out toward the sides of the valley, which is 100 to 400 feet wide. The mine workings have a total length of 3,000 feet (see fig. 22). Only coarse gold is said to have been found at this mine, the smallest particles being as large as pinheads. The two largest nuggets found are described as weighing about 10 pounds and 8 pounds 5 ounces respectively and as being very little water-worn.

On the hillside west of the placer deposit are several quartz veins. One of them, 3 feet thick, strikes northeast and dips steeply southeast. It is said to be barren for the most part, and although gold has been panned from parts of it, none comparable in coarseness to that in the placer was found. The greater part of the stream bottom has been worked by trenches and pits, and only small patches of unworked ground remain. A description of the methods used in recovering the gold is given by Nitze and Wilkens.

PARKER

The Parker mine, at New London, was among the first discoveries in the southern Piedmont region, and

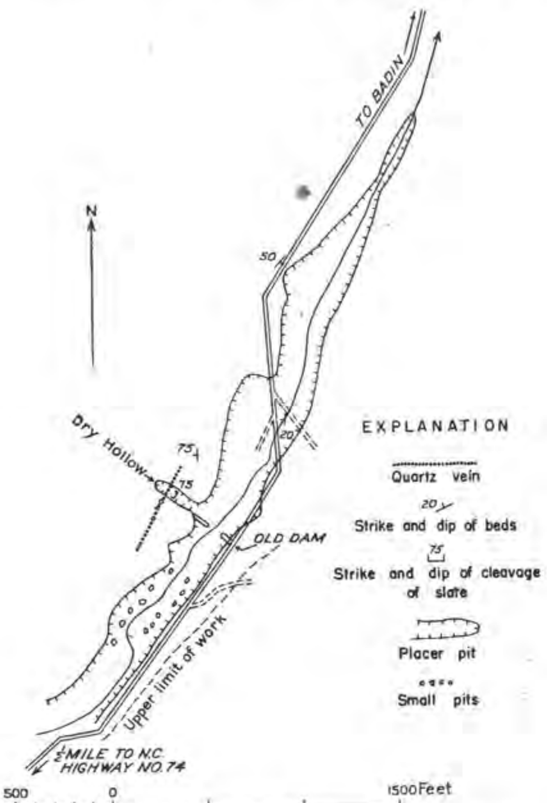

FIGURE 22.—Plan of Ingram mine, Stanly County, N. C.

like the Reed mine it proved very rich and productive during the early part of the mining period. It has been operated chiefly as a placer mine, but the more recent work has been done on lodes. According to Kerr and Hanna [27] a rich deposit 3 or 4 acres in extent was estimated to have yielded $200,000 (about 10,000 ounces). Much of the gold was in the form of nuggets, the largest one weighing 8 pounds 3 ounces 12 pennyweight.

From brief notes [28] published during the period 1887–1902, it appears that between 1887 and 1896 an English

[25] Emmons, Ebenezer, Geology of the Midland Counties of North Carolina, p. 167, Raleigh, H. D. Turner, and New York, G. R. Putnam Co., 1856.

[26] Nitze, H. B. C., and Wilkens, H. A. S., op. cit., pp. 91–95.

[27] Kerr, W. C., and Hanna, G. B., in Geology of North Carolina, vol. 2, ch. 2, 2d ed., pp. 258–259, Raleigh, Edwards and Broughton, 1893.

[28] Eng. and Min. Jour., vols. 43, p. 444, 1887; 49, p. 714, 1890; 50, p. 278, 1890; 52, pp. 369, 513, 686, 1891; 53, p. 520, 1892; 59, pp. 422, 590, 1895; 61, pp. 190, 287, 1896; 62, pp. 326, 615, 1896; 67, p. 125, 1899; 68, p. 498, 1899; 74, p. 764, 1902.

company worked the placer deposit extensively for a time and later did development work on some of the quartz veins. To obtain water for mining, this company installed a pipe line 4½ miles long,[29] through which water was pumped from the Yadkin River. The capacity of the pumping plant was 1,500,000 gallons in 12 hours, delivered against a head of 340 feet to a standpipe, from which a head of 90 feet for hydraulic mining was obtained. Several large cuts were sluiced out, and the value of the gravel worked is said to have ranged from 44 cents to $2.40 (0.022 to 0.12 ounce) per cubic yard. The company made an unprofitable attempt to work the unmodified saprolite, as distinguished from that which had been more or less concentrated by natural forces into placer. This material, with its included quartz veins, was first washed through sluices and then treated in a stamp mill by the Dahlonega method. It was claimed that the material reaching the mill contained 50 cents worth of gold to a ton (0.025 ounce), of which half was recovered in the mortars, the remainder being carried away by the overflow because of its extreme fineness.

In 1895 and 1896 two shafts were sunk to explore some of the quartz veins that had been uncovered in the course of placer mining. At a depth of 130 feet a crosscut from one of these—the Ross shaft—opened a vein (width not given) of quartz with iron and copper sulfides, said to assay from $3 to $12 a ton, presumably in gold. The other shaft, west of the Ross, explored a vein from which assays of $3 per ton at 85 feet and $7 per ton at 130 feet were obtained.

At the end of 1896 the property was reported to be "in liquidation." A little placer work was done in 1899 and again in 1902, when a 10-pennyweight nugget is said to have been found.

Early in 1935 tests to recover gold from the saprolitic material were made under the direction of E. M. Scott. In the course of this work an adit level was run through the saprolite to the westernmost of the old shafts. About 160 feet from the shaft (fig. 23) and 20 feet below the surface the adit penetrated a quartz vein at a place where it happened to contain a shoot or "pocket" that yielded several hundred ounces of coarse gold. In April 1935, shortly after all the ore in sight had been removed, a vein about 18 inches wide. split in the middle by a narrow horse of decomposed schist, was exposed in the adit. On one side of the adit there was a layer of massive white bull quartz, and on the other side there was quartz stained with iron and manganese oxides. A specimen said to have come from the rich "pocket" consists of quartz with numerous cavities, some of them containing oxides of

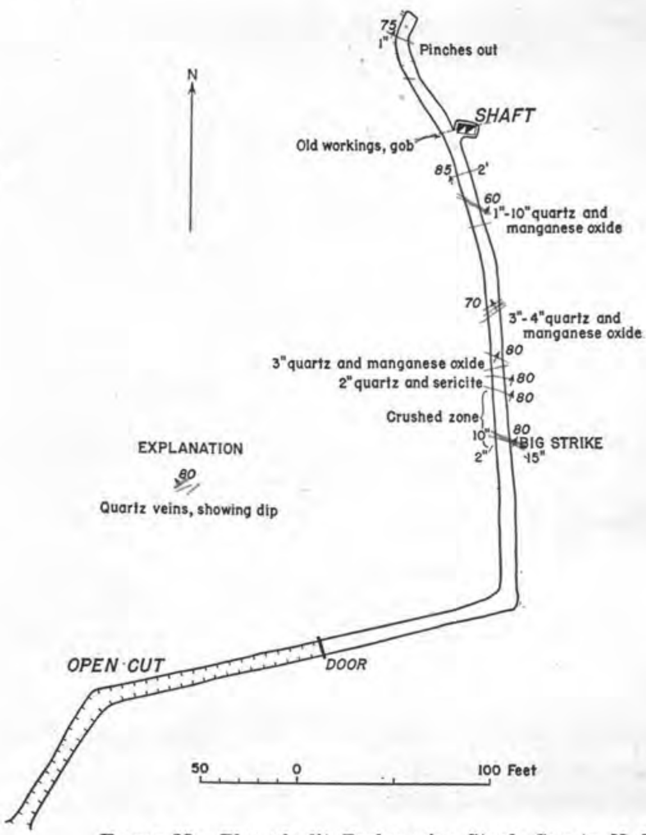

FIGURE 23.—Plan of adit, Parker mine, Stanly County, N. C.

[29] Nitze, H. B. C., and Wilkens, H. A. S., op. cit., pp. 54–56.

iron and manganese in small amount, together with coarse grains of gold that show crystal forms. The adit reached the shaft at a depth of 60 feet, where it was still above the lower limit of the saprolite. It passes through saprolite broken by numerous joints and seams, which are lined with manganese oxides (see fig. 24). Several quartz veinlets in addition to the one containing the rich pocket were penetrated, but none of them showed any visible gold.

Specimens from the dumps of the shafts indicate that the rock beneath the saprolite is a schist derived from lava and tuff of the volcanic series.

The placer deposit consisted of the upper part of the saprolite, which had moved more or less downslope as a result of the slowly acting process called "hill creep." This material ranged from a few feet to 6 or 8 feet in thickness, and the gold in it was presumably derived from an unknown thickness of material that has been eroded away. In most places at least half of the gold and half of the residual quartz fragments were concentrated in the lower part of the deposit, locally called the grit layer. If the available information is correct, the 3 or 4 acres of "rich" placer must have yielded at least \$5 ($\frac{1}{4}$ ounce) per cubic yard. Successive mining operations have left no placer material worth mentioning on the higher ground; the adjoining lowlands, however, may still contain some pay dirt here and there.

The saprolite contains numerous quartz veins in place besides those above mentioned. Most of them are small and not persistent. A few are a foot or two wide and fairly long, but all tend to pinch and swell irregularly. Most of them consist of little else than massive white quartz. Some show noteworthy amounts of iron oxides, and cavities from which sulfides may have been leached. Pockets of rich gold ore may of course be found in any of them, but on the whole such pockets appear to be very rare. Viewed broadly, the deposit appears as a magnified stringer lode, but available evidence indicates that no large part of it is rich enough to be workable.

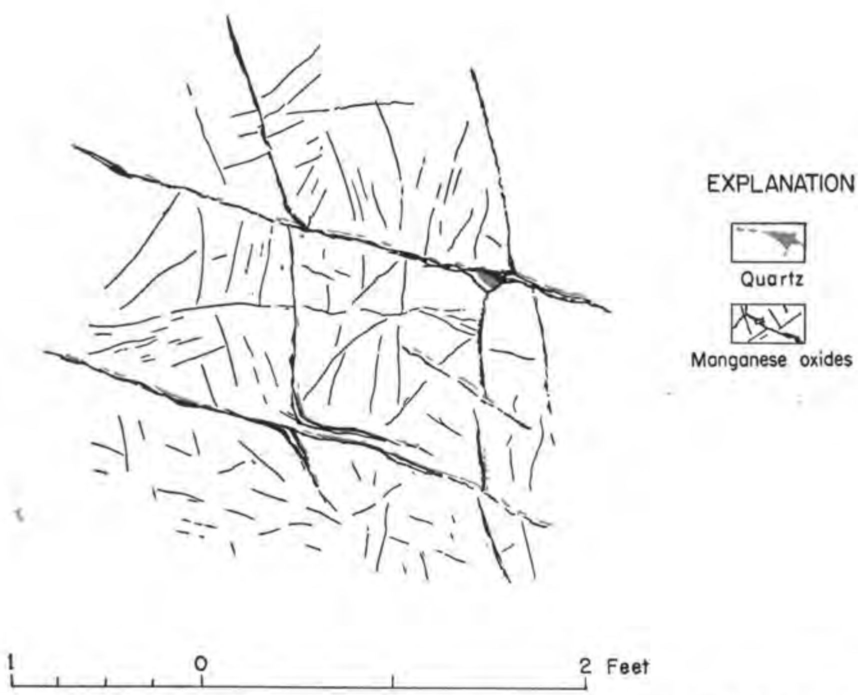

FIGURE 24.—Sketch of quartz veins along joints in saprolite, Parker mine, Stanly County, N. C. New tunnel at 50 feet below the surface. Red, quartz; black, manganese oxides.

THOMPSON

The Thompson mine, 5 miles east of Albemarle, was described by Pratt [30] in 1906 as comprising an open cut 30 to 40 feet wide, 100 feet long, and 25 feet deep and some smaller workings. The ore was treated in a 10-stamp mill, in which it was found difficult to separate the gold from the clay. In 1931 a new 10-stamp mill was built, and during the next 2 years the recovery of \$3,258 worth of gold (about 163 ounces) was reported. In this period the deposit was tested by diamond drilling. The extent of the workings and location of the drill holes in 1934 is shown on a plat prepared by C. W. Wheelock for the owners (see fig. 25).

The deposit is in a dense light greenish-gray slaty rock, derived from a fine-grained thin-bedded siliceous tuff of the volcanic series, associated with a massive

[30] Pratt, J. H., Mining industry in North Carolina during 1906: North Carolina Geol. and Econ. Survey, Econ. Paper 14, pp. 58, 59, 1907.

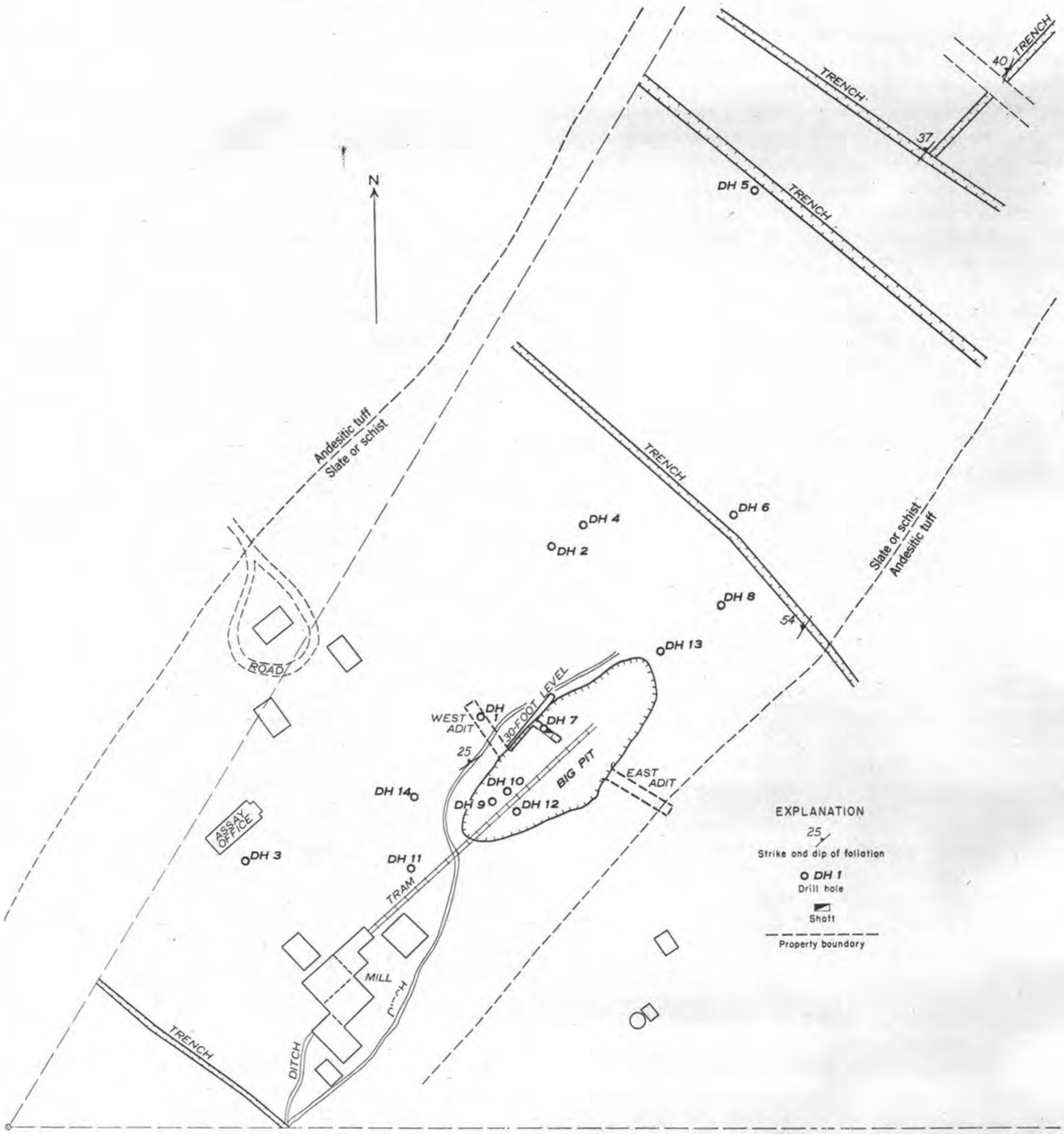

FIGURE 25.—Plan of surface workings, Thompson mine, Stanly County, N. C.

tuff of more basic composition. The slaty beds occupy a shallow valley about 300 feet wide, and the massive tuff forms low ridges on either side. The beds are folded, and fault movements have occurred along the margins of the salty rock. The average strike is northeast, and the dip ranges in general from 25° to 55° NW.

The lode is composed of irregular and indefinitely bounded masses of slaty rock that contain disseminated pyrite and pyrrhotite, or their oxidation products, and more or less gold. A small high-grade pocket, in a schistose body composed chiefly of quartz and chlorite, is said to have been found in a shaft sunk 33 feet below the floor of the pit. The rock most abundant in the dump of the shaft is composed of radiating needles of tremolite in talc.

Test-mill runs from different parts of the pit made in 1933 were reported to show an average value of $1.09 (0.05 ounce) in gold to the ton of the mill heads, from which a table concentrate worth $15.13 (0.7 ounce) was produced. Ore from the shaft having a value of $5.30

(0.26 ounce) yielded a concentrate worth $39.16 (1.95 ounces).

Fourteen drill holes located around the pit were put down to depths ranging from 22 feet to 153½ feet. For the most part the material penetrated assayed from 0.01 to 0.03 ounce of gold per ton, equivalent to 35 cents and $1.05 respectively at $35 an ounce. There were a few stretches of higher grade material and a few barren stretches. The richest core came from hole 7 between depths of 16 and 22½ feet. It averaged 1.73 ounces per ton and represented a small pocket that was afterward dug out. In addition, material assaying 0.06 ounce or more to the ton was found in the different holes at various depths as follows:

Assays of ore in different holes at various depths, Thompson mine, Stanly County

Hole No.	Depth (feet)	Average assay value (ounces per ton)	Hole No.	Depth (feet)	Average assay value (ounces per ton)
1	56 to 80	0.1	10	0 to 5	0.087
1	87 to 72	.243	10	33 to 40	.062
7	0 to 16	.09	11	15 to 23	.129
7	44 to 48	.25	11	84 to 87	.127
7	77 to 87	.095	12	0 to 8½	.116
8	38 to 44	.16	12	24 to 29	.093
9	25 to 30	.16	12	71 to 78½	.106

OTHER PROPERTIES

The Crowell mine, 1½ miles northeast of New London and near Bethel Church, is on a tract, crossed by Mountain Creek, that appears to have been worked long ago for placer gold. A lode is said to have been discovered about 1887 and worked for several years, the ore being treated in Chilean mills and, at one time, in a 5-stamp mill. According to Kerr and Hanna [31] the lode is 4 to 7 feet wide, with a narrow streak of ore, and the workings reach a depth of 125 feet. Surface openings are distributed along a course a little west of north for a distance of 230 feet.

The Eudy mine, 1½ miles northeast of Lambert and half a mile west of Big Bear Creek, was worked in a small way about 1895–1905. In 1932 some prospecting was done by Sidney Vaughn and K. W. Uhl. Two small quartz veins in slate have been worked from shafts 30 feet and 35 feet deep, respectively, and from shallower pits and cuts.

The Kimball Hill mine, northeast of Bethel Church and less than a mile east of the Crowell mine, includes three shafts, and a 60-foot tunnel that explores a quartz vein 4 to 6 inches wide, striking N. 55° E. Another narrow vein is said to have been found in the workings. W. L. Cotton, who operated the mine for a time in 1910, reports having obtained 8 pounds of "nugget rock" (quartz with coarse gold) from pockets in the veins. A specimen exhibited by Mr. Cotton is, by weight, about half quartz and half crystalline gold deposited in cavities.

Gravel at the Mumford placer mine, which is on a branch of Town Creek and a mile west of New London, was tested in 1933 by A. V. Wynne, of New London, with a G–B portable placer machine. This deposit, which lies in a stream valley, has been worked by pitting and sluicing for a length of about 900 yards and a width of 75 to 150 feet. It is said that the gravel worked was about 3 feet in average depth, and that most of the gold was concentrated in the lowest foot. Near the upstream end of the mine an open-cut extends 300 feet up a dry run. Mr. Wynne reported an average recovery of ½ dwt. per yard from the "valley-bottom grit" and of ¾ dwt. per cubic yard from the "dry-run grit."

UNION COUNTY

HOWIE

HISTORY

The Howie mine, 3 miles east of north of Waxhaw, is the largest gold mine in Union County. It was probably discovered before 1840 as the result of placer mining along a small stream. At first the lode was mined in small tracts by leasers, but about 1854 the property was taken over by Commodore Stockton, who operated it as a unit until the War of 1861–65. Stockton built a mill at the old Neddy shaft (pl. 27), and he worked the deposit mainly from that shaft and from what was later known as the Bull Face stope. Stockton also began the Cureton shaft, used as the main entry in 1935.

For a considerable time after the war details of the mine's history are lacking. A man named Reeves is said to have operated the mine from 1885 until 1890, when the property was bought from the Stockton heirs by Isaac and John Bates. According to R. W. Tysinger, who came to the Howie in 1889 and was familiar with its operations from that time to April 1935, considerable ore was treated under the direction of Isaac Bates in the old mill built by Stockton. This plant, however, was considerably out of date, requiring the expenditure of much hand labor to run 12 tons through it in one day. Bates soon ceased operating, and about 1894 Messrs. Callow and Gayford erected a cyanide plant with which they leached the mill tailings at a profit. They also excavated the Callow cut and other workings, including the Pansy shaft, named for Pansy Peyton, daughter of their mining engineer. Callow and Gayford were succeeded by the Colossus Gold Mining & Milling Co., which, under the direction of W. B. Shaffer, operated the mine for several years. The company enlarged and deepened the Cureton shaft, whose depth in 1935 was 365 feet, built a 500-ton cyanide plant, and made an unsuccessful attempt to treat run-of-mine material from the Callow cut. The high

[31] Kerr, W. C., and Hanna, G. B., Ores of North Carolina: North Carolina Geol. Survey Bull. 2, p. 259, 1888.

expense of building the new plant, together with other lavish expenditures, is said to have brought financial ruin. Be that as it may, the company suspended operations soon after the mill was built. During the years 1914–17 other operators are reported [32] to have treated considerable ore in a small cyanide mill. In 1934 the Condor Consolidated Mines, Ltd., of Canada, unwatered the Cureton shaft, and in the course of a year it sampled the accessible workings and prospected adjacent parts of the lode by diamond drilling. The operations were in charge of Bruce B. Craibbe; mine surveying and sampling was done by E. MacFarlane; and in the summer of 1934 the property was examined by J. G. MacGregor, of Toronto, Canada, and other engineers.

PRODUCTION

Few records of production from the Howie mine are available. In 1854 the mine was estimated to have produced $250,000 from workings less than 80 feet in depth.[33] In 1856,[34] when the mine was under Stockton's management, a profit of $18,000 to $20,000 a month was reported. Later the tailings are said to have yielded $36,000,[35] and milling operations on them from 1902 to 1935 produced nearly $38,000.[36] MacGregor,[37] in 1934, found that the mine had been officially credited with a production of 41,300 ounces of gold. Making allowance for losses in milling he assumed a gross production of 50,000 ounces.

DEVELOPMENT

The surface workings of the Howie mine are closely spaced along a belt from 100 to 300 feet wide and 2,800 feet long that trends about N. 60° E. (see pl. 27). In 1935 some of them were more or less filled in; others, in particular the Cureton, Bracy, Nigger, and Pansy shafts and the Shaffer and the Callow cuts, were open or had recently been cleared.

The Cureton shaft, situated in the middle section of the lode, is 365 feet deep, with levels turned at 147, 262, and 347 feet. These and connected workings that were accessible in 1935 aggregate about 3,500 feet in length and are confined to a part of the lode 800 feet long and 150 feet wide. Other, less extensive workings are accessible from the Bracy and Nigger shafts, in the northeastern part of the zone, and from the Pansy shaft, in the southwestern part.

ROCKS

The country rock is chiefly a fine-grained gray schist of the slate group, the parting planes of which generally appear lustrous with fine scales of sericite. Under the microscope the rock shows the texture of a fine-grained thin-bedded tuff. It is composed mainly of quartz and feldspar, with more or less biotite and secondary sericite, calcite, and epidote. Locally, it contains small grains of pyrite and pyrrhotite. The tuff apparently had the composition of a rhyolite or a dacite.

The schistosity strikes about N. 60° E. and dips steeply northwest. The rock is cut by a group of joints that strike about N. 35° W. and dip steeply southwest, and by another group of joints that dip very gently southeast. Minor thrust faulting has occurred along some of the latter.

Several basic dikes have been intruded along fractures that are similar in attitude to the joints of northwesterly strike. One dike about 16 feet wide is exposed in the Callow cut, and another of about the same width is exposed in a road cut north of the mine. Five or six others, from 2 to 8 feet wide, are penetrated by the underground workings. Most of them cut the veins at right angles, and in this respect they have the same structural relations as the Triassic diabase. A specimen from one of these dikes, however, is shown by the microscope to consist of sodic plagioclase, hornblende, and a little quartz and secondary pyrite and calcite; its mineral composition is therefore near that of quartz diorite, but the hornblende and sodic plagioclase are presumably secondary, as they are in certain facies of the Triassic dike at Goose Creek, Va. A small dike of aplite exposed in the Nigger shaft also occupies a northwest-striking fracture.

The schist has been decomposed to saprolite to a depth of 50 feet or more, and in this saprolite, claylike as it is, both the original bedding of the tuff and the later schistosity have been preserved (see pl. 4, *C*). The basic dikes are altered to stiff red clay, which at a moderate depth generally preserves the outlines of joint blocks and encloses cores of relatively fresh rock.

LODE

The Howie lode is an indefinitely bounded zone in which the schist has been largely replaced by very fine grained quartz, generally accompanied by a little pyrite and pyrrhotite and in places by gold. This body extends 2,800 feet or more on a course of N. 60° E., parallel to the foliation of the schist. The surface workings indicate that more or less replacement has occurred through a maximum width of 400 feet, but the ore bodies that have been mined are confined to narrower limits. The arrangement of the workings (pl. 27) suggests that the zone may be composed of three segments en echelon. The northeasternmost segment, 400 feet or more in length, is explored by the Bracy and Nigger shafts and by a string of surface workings. Adjoining it on the southeast is the main segment, which apparently is con-

[32] Mineral Resources, U. S., 1914–17, inclusive.

[33] Mining Mag. 1st ser., vol. 2, p. 70, 1854.

[34] Lieber, O. M., Report on the survey of South Carolina [First Annual Report] for 1856, pp. 56–58, Columbia, S. C., 1858.

[35] Graton, L. C., Reconnaissance of some gold and tin deposits of the southern Appalachians: U. S. Geol. Survey Bull. 293, p. 87, 1906.

[36] Data from U. S. Bur. Mines.

[37] MacGregor, J. G., Report to the Condor Consolidated Mines, Ltd., Toronto, Ontario, Aug. 2, 1934.

tinuous to the southwest end of the zone, 2,000 feet away. The Cureton shaft is near the middle of this body. A third segment, at the southwest end of the zone, lies southeast of the main segment. It is about 400 feet long and is explored by surface workings only.

In the weathered zone the lode consists largely of a light-brown soft rock, with ribs of hard, porcelain-white, very fine grained sugary quartz. The ribs are parallel to the foliation of the country rock and separated from one another by thin seams of iron oxide and clay. Below a depth of about 50 feet, the lode consists chiefly of a hard flinty rock, whose distinctly banded appearance is due to the alternation of lighter-colored quartz-rich bands with darker greenish or brownish material, in which chlorite or biotite is abundant. This rock appears to have been derived from tuff. The bands range in width from that of a mere seam to an inch or two, and are parallel to the foliation of the wall rocks (pl. 29, *A*). Locally the introduced quartz has followed folded bedding planes. In addition to quartz, scattered grains of pyrite have been introduced. The rock splits with difficulty along the bands, but it parts readily on the northwest-striking joints.

Quartz is not uniformly abundant throughout the full width of the lode, but is concentrated along relatively narrow zones, distributed throughout the lode. From 4 or 5 to a dozen or more of these quartz-rich zones are present in all cross sections of the lode that are exposed. The workings from the Cureton shaft have cut 11 of them in passing through a width of 150 feet (see pl. 28). The most southeasterly zone on the second level is developed for a length of at least 700 feet, and the Bull Face and Clark ore bodies have been stoped along it. Another zone, to the northwest, connects the Old Neddy and New Neddy ore bodies, and is explored for a length of at least 500 feet. Other zones appear to be less persistent.

ORE BODIES

The ore bodies are parts of the lode in which the gold-bearing seams are sufficiently numerous and rich to make the mass workable (see fig 26). The Bull Face ore body has somewhat the form of a flattened cylinder; it is 20 to 40 feet in longer diameter and at least 360 feet in pitch length (fig. 27). Its longer diameter is parallel to the plane of the lode, and its axis pitches about 70° northeast. The Clark, Old Neddy, and New Neddy ore

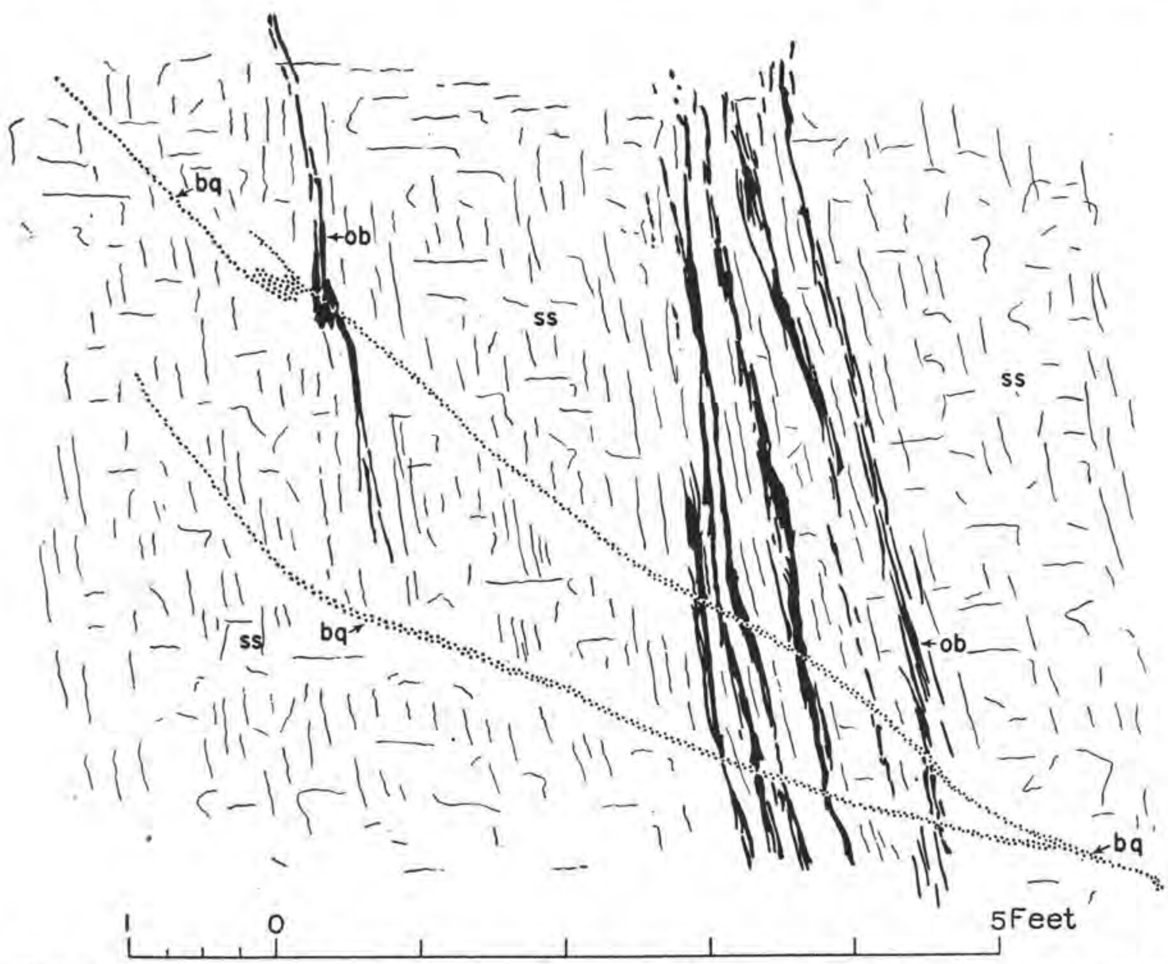

FIGURE 26.—Cross section of mineralized zone, Howie mine, Union County, N. C. Third level, southwest face of Egypt stope. *ss*, Silicified slate (volcanic series); *ob*, ore bands (gold-bearing quartz); *bq*, barren (bull) quartz veinlets.

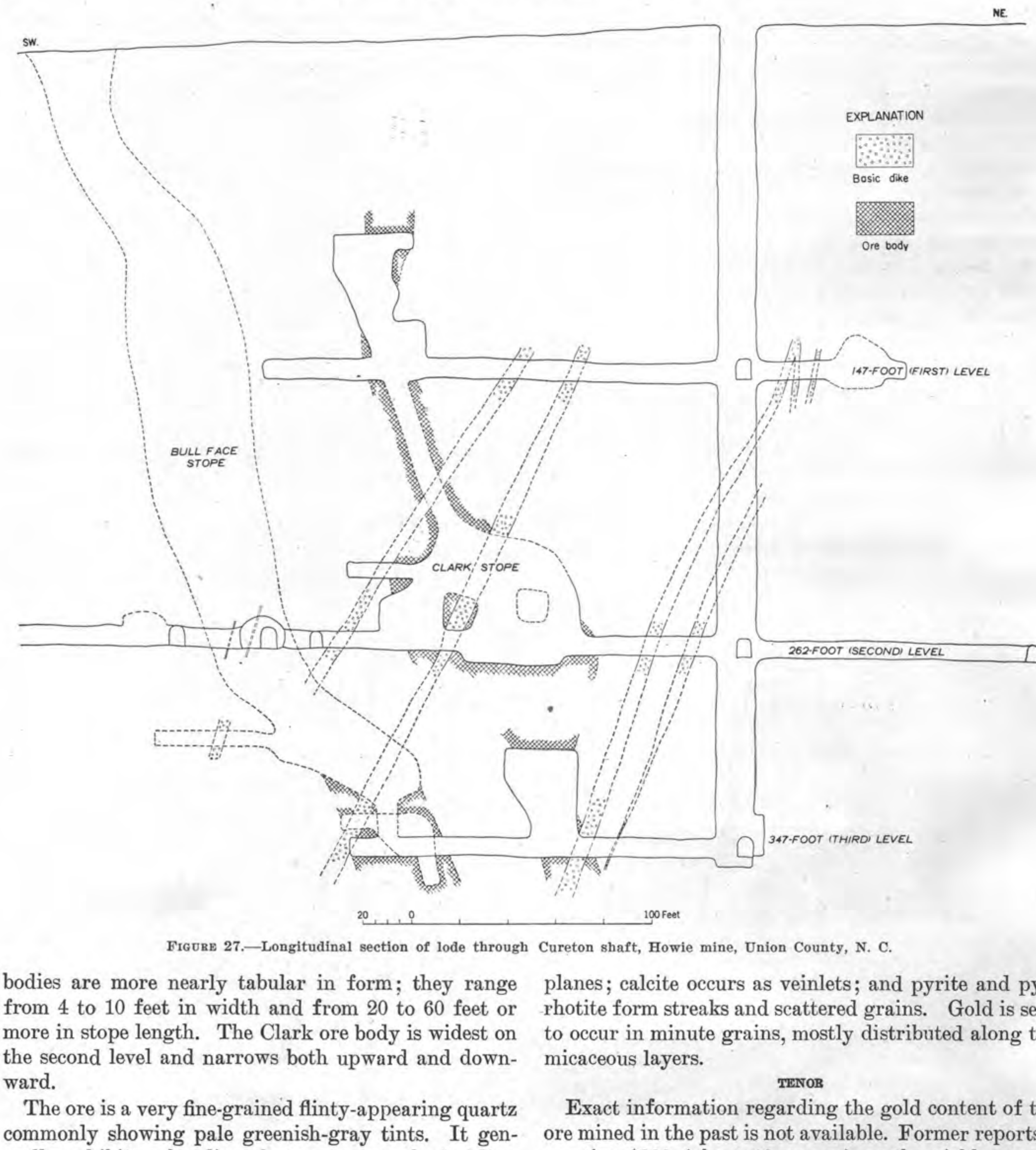

FIGURE 27.—Longitudinal section of lode through Cureton shaft, Howie mine, Union County, N. C.

bodies are more nearly tabular in form; they range from 4 to 10 feet in width and from 20 to 60 feet or more in stope length. The Clark ore body is widest on the second level and narrows both upward and downward.

The ore is a very fine-grained flinty-appearing quartz commonly showing pale greenish-gray tints. It generally exhibits a banding that represents the bedding or the foliation, as the case may be, of the original schist. When the rock is split along this inherited structure its flat surfaces have a glistening and somewhat greasy luster, and locally they have a yellow sheen, imparted by innumerable specks of gold too small to be seen individually with the unaided eye.

Under the microscope the ore is seen to consist mainly of introduced quartz. Biotite, chlorite, and sericite are distributed in bands that mark cleavage or bedding planes; calcite occurs as veinlets; and pyrite and pyrrhotite form streaks and scattered grains. Gold is seen to occur in minute grains, mostly distributed along the micaceous layers.

TENOR

Exact information regarding the gold content of the ore mined in the past is not available. Former reports [38] mention $200 (about 10 ounces) as the yield per ton near the surface. At moderate depths the ore yielded on the average 0.75 ounce of gold. From the measured volume of the stopes and surface workings and available knowledge of the production, MacGregor [39] concluded

[38] Emmons, Ebenezer, Geology of the Midland Counties of North Carolina, p. 1314. Raleigh, H. D. Turner, and New York, G. R. Putnam Co., 1856. Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina; North Carolina Geol. Survey Bull. 3, p. 105, 1896. Graton, L. C., op. cit., p. 189.

[39] MacGregor, J. G., Report to the Condor Consolidated Mines Ltd., Toronto, Ontario, Aug. 2, 1934.

that the average gold content of all the ore removed was 0.833 ounce per ton. His sampling of workings that extended from the Cureton shaft indicated that there remained in the Clark ore body about 1,900 tons of ore, containing 0.53 ounce of gold per ton, above the third level; probably 550 tons of 0.61-ounce ore above the second level; and possibly 1,200 tons of 0.33-ounce ore above the first level. In the Bull Face ore body, by his estimate, 720 tons of 0.60-ounce ore remained above the third level. Workings on the Neddy ore body were but partly accessible for sampling; on the second level, however, material that lay along the margin of a stope extending a short distance upward and 100 feet deeper to the west yielded 0.27 ounce of gold per ton for a width of 8 feet and length of 50 feet. This material obviously represents marginal ore that could not be mined at a profit during former operations. It contains somewhat less than half the average amount of gold per ton estimated by MacGregor for the ore that was removed from the Neddy stopes. Some rather high grade ore (2.50 ounces per ton) with a width of 8 feet was found several years ago at the bottom of the Neddy shaft. The sampling by MacGregor disclosed a small ore shoot, 4 feet to 10 feet long, a short distance north of the Cureton shaft. Its gold content ranged from 0.20 ounce per ton on the third level to 0.38 ounce per ton on the first level.

Drilling done after MacGregor's examination indicates the presence of ore at least 30 to 50 feet below the third level. Cores obtained at those depths beneath the Egypt stope assayed 0.28 to 1.29 ounces per ton, cores from an ore band southeast of the Bull Face assayed 0.01 to 0.75 ounce per ton, and cores from beneath the Clark ore body assayed 0.14 to 1.29 ounces per ton. The wide distribution of relatively small amounts of gold through the mineralized zone is shown by samples taken on each of the three levels across widths of 65 to 110 feet, exclusive of the ore bodies; the sample from the third level contained 0.016 ounce and that from the first level 0.055 ounce per ton.

ORIGIN

In the Howie mine, as elsewhere in the Southern Piedmont region, silicification accompanied by introduction of gold was probably an after effect of granitic intrusion. Although no granite crops out near the mine, the presence of an aplitic dike in the Nigger shaft (p. 98) suggests that there may be granite in depth. Basic dikes and their associated fractures are found in or near some of the ore bodies—on the second level, for example, two or three dikes cross or closely approach the ore bodies—others are found in low-grade or barren sections of the ore zone. The space relations of the dikes to the ore bodies are accidental, for the dikes are postmineral.

No satisfactory explanation has been found for the fact that the ore bands are richer or more numerous in some parts of the zone than in others. Only two premineral cross fractures that may have aided in localizing ore shoots have been recognized, one in the Bull Face, and one in the eastern part of the Neddy ore bodies, and both are small and nonpersistent. Apparently the composite ore bodies described are at places where premineral movements were more effective than elsewhere in opening spaces between the folia of the schist.

Oxidation and the removal of valueless material in solution probably accounts for some if not all of the enrichment of the superficial part of the lode. Some gold may have been carried down the lode in solution and redeposited in a lower zone, as suggested by the occurrence of flakes of gold and pyrite on joint faces, mentioned by Graton.[40] Such enrichment, however, does not appear to have been extensive; in fact none was observed on the lower levels.

LEWIS GROUP

About 10 miles northwest of Monroe, a number of mines that were inactive in 1934 are distributed along a northeastward-trending mineralized zone for a distance of about 3 miles (see fig. 28). Among them are the Lewis, Phiffer, Ore Hill, Mint Hill, Folger Hill, Davis, Moore Hill, and Hemby mines. Surface workings show that the zone is about 100 feet wide, and that in most places it contains from three to five parallel bodies of gold-bearing material. These bodies are from 1 foot to several feet wide, and are composed of vertical layers in which the original slaty rock of the volcanic series has been replaced to a greater or less extent by fine-grained quartz. The lode material is similar in appearance to that of the Howie mine. Free gold can be panned from several of the exposed layers, and samples representing several of the dumps (see p. 51) assayed from 0.05 to 0.06 ounce of gold to the ton. The production and the tenor of the ore mined are not known. Most of these mines were opened before the war of 1861–65 and worked to depths of 50 to 100 feet, below which water or the change to unoxidized ores, or both, generally discouraged further operations. A note in the engineering and Mining Journal of November 8, 1890, however, mentions activity at the Hemby mine, and says that the workings were then 160 feet deep, and had penetrated, at the 100-foot level, a body containing galena and chalcopyrite in the Huston vein. Nitze and Hanna[41] state that the Mint Hill ore body was mined from an open pit 60 feet long, 40 feet wide, and 50 feet deep, and that all the material taken out was milled. They report that a sample of rejected material at the Folger Hill mine assayed $4.13 (0.2 ounce) in gold and 22 cents in silver per ton.

[40] Graton, L. C., op. cit., p. 89.

[41] Nitze, H. B. C., and Hanna, G. B., Gold deposits of North Carolina: North Carolina Geol. Survey Bull. 3, pp. 102, 103, 1896.

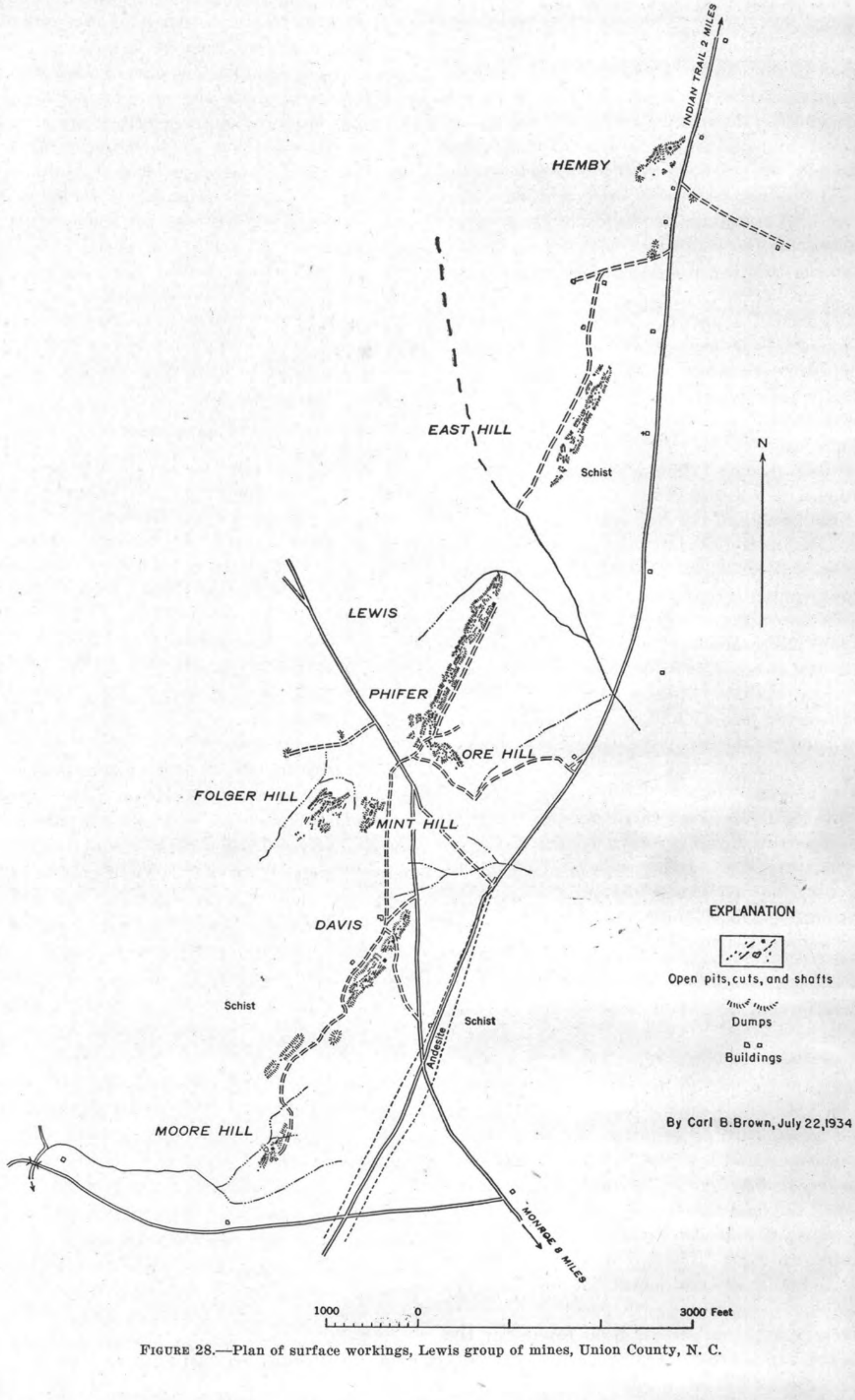

FIGURE 28.—Plan of surface workings, Lewis group of mines, Union County, N. C.

In 1934, preparations for further development work were being made by J. C. Blencowe and others.

OTHER PROPERTIES

The Black mine, half a mile east of Indian Trail, is described by Nitze and Hanna [42] (1896) as being on a quartz vein that contains streaks of ore ranging from a thin seam to 10 inches in thickness and composed of galena with a little sphalerite, pyrite, and chalcopyrite. Several assays are cited that show high values in gold. The workings are said to be 175 feet deep, and a production of $8,000 was estimated for 1904.[43]

The Bonnie Belle (Washington) mine, 1½ miles northwest of Mineral Springs, is about a mile east of the Howie mine. The workings, which were not accessible in 1934, include shafts and pits distributed along a northeast-southwest course for a distance of 1,200 feet or more.

From Nitze and Hanna's description [44] the lode appears to be a silicified zone in the schist, containing finely divided pyrite and chalcopyrite, and small specks of free gold on the principal cleavage planes. In 1894 a 20-foot shaft exposed an ore body 5 to 8 feet wide, the richest part of which was a 2-foot layer next to the hanging wall. The ore was being treated in a combination Chilean and drag mill with plates and a concentrating table. A sample of the mill heads assayed 0.206 ounce of gold and 1.42 ounces of silver per ton. The concentrate carried an ounce of gold and nearly 2 ounces of silver, the tailings a trace of gold and 1 ounce of silver.

The Brown Hill mine, a mile west of Stout and three-quarters of a mile southwest of the Seaboard Airline Railroad, is on a large quartz vein that crops out along a low ridge. The vein consists of a series of connected lenses. At one place it opens out to a width of 20 feet; at another place, in a shaft, it is less than 3 feet thick. Sulfide grains and rusty spots are sparingly distributed through the quartz.

The Crump mine, 4 miles north of Bakers, was worked about 1890. The workings, said to reach a maximum depth of 120 feet, include several shafts and pits distributed along two parallel lines about 150 feet apart. Material on the dumps indicated that these workings are in silicified zones containing quartz stringers and disseminated pyrite.

Nitze and Hanna [45] (1896) state that the general "run of mine" is apparently of very low grade, the "most promising sample" assaying $6.41 (0.32 ounce) of gold per ton, but that the mine is noted for its remarkable pockets and splendid and peculiar nuggets, in which nearly all the gold occurs.

[42] Nitze, H. B. C., and Hanna, G. B., op. cit., p. 99.
[43] Annual Reports of Bureau of Mint.
[44] Nitze, H. B. C., and Hanna, G. B., op. cit., p. 104.
[45] Nitze, H. B. C., and Hanna, G. B., op cit., p. 98.

The Butterfield mine appears to be on a northward extension of the mineralized belt developed at the Crump mine. The country rock is a dense dark bluish-gray slate that breaks into rectangular blocks along joints. The rock is impregnated with pyrite, largely in well-formed isolated cubes, some of them as much as one inch across.

The Crowell or Brightlight mine, located in the extreme northwest corner of Union County, is said to have been opened in June 1882 and developed to a depth of 80 feet before the end of the year. Some ore was produced, and was treated in a 15-stamp mill. The workings explore three quartz veins that strike northeastward and range from 1 to 4 feet in width.

To judge from material on the dumps, the veins contain more or less iron oxide in the weathered zone and pyrite below. Nitze and Hanna [46] give nine assays of the ore, ranging from $3.15 to $41.34 (0.157 to 2.067 ounces) in gold and $0.32 to $10.21 in silver to the ton, but do not say what ore bodies the samples represent.

The Fox Hill mine, three-quarters of a mile northeast of the north fork of Crooked Creek, consists of a large number of old pits and shafts distributed along a northeasterly course for a distance of 1,550 feet. The dumps contain iron-stained quartz, which here and there shows a little pyrite. The country rock is sericite schist derived from tuff of the volcanic series.

The Henry Phifer mine, 0.4 mile northeast of Stallings, is said to have been worked before 1888. After a long period of inactivity, it was reopened for a time in 1933. A plan of the underground workings made at that time by T. J. Orr, Jr., shows a drift about 260 feet long at the 70-foot level, extending north and south from a short crosscut to the main shaft. In 1934 the workings were under water. The lode is a quartz vein said to range from less than an inch to 6 feet or more in thickness. The country rock is granite. A small ore pile, said to have come from a raise, consisted of coarse milk-white quartz enclosing much pyrite, partly in scattered grains and partly in bunches some of which are several pounds in weight. A sample of this ore assayed 0.33 ounce of gold per ton.

About three-quarters of a mile northeast of the Henry Phifer mine is an opening on a quartz vein more than 6 feet thick, from which rock was quarried and crushed for road metal. The vein has a fairly flat dip and is easily quarried. It shows a few spots and streaks of iron oxides.

The Long mine, a quarter of a mile north of Bethlehem Church, includes shafts and pits on two hills about 350 feet apart. The dumps contain fragments of white quartz, in some of which there is a sprinkling of pyrite grains.

At the Moore mine, 1½ miles north-northeast of Mill Grove Church, two veins have been explored, one by

[46] Nitze, H. B. C., and Hanna, G. B., op. cit., p. 95.

the "Blue shaft" and the other by a shaft known as the Wentz. According to Nitze and Hanna,[47] (1896) R. J. Wentz, superintendent of the mine, describes the main lode as a quartz vein 5 feet thick, conformable with the foliation of the country rock, which is chlorite schist striking N. 50° E. It contains a 4-inch pay streak composed mainly of calcite with free gold. The quartz carried pyrite, galena, chalcopyrite, and sphalerite. The mine was at that time 80 feet deep. In specimens from the dump, Nitze and Hanna observed crustification and other evidences that the vein had formed in an open fissure. Two samples of the vein rock collected in 1934 contained no gold or silver.

A second vein is developed by the Wentz shaft and is said by Pratt [48] to be 180 feet deep and connected with a drift at the 90-foot level. This vein strikes N. 75° E., averages about 4½ feet in width, and consists of milky-white quartz enclosing fragments of the wall rock and a very little chalcopyrite. Ore from the dump of the Wentz shaft assayed 0.15 ounce of gold and 0.03 ounce of silver to the ton. A third vein, parallel to the second and about 150 feet north of it, is of similar character. It is explored by a 50-foot shaft.

The New South mine, about half a mile southwest of the Moore, is said by Nitze and Hanna [49] (1896) to have been profitably worked down to a depth of 25 feet. Below that the lode was unoxidized and contained disseminated pyrite, and the gold could not be profitably extracted by the methods then in use. Dumps remaining at this mine in 1934 consisted partly of greenstone schist with scattered pyrite and stringers of quartz and calcite.

The Wiley Rogers and Grady Rogers mines are comparatively recent discoveries, located 3 miles and 2½ miles respectively northwest of Waxhaw, both being very near the South Carolina State line. At the Wiley Rogers an inclined shaft has been sunk on a quartz vein, ranging from a small fraction of an inch to 6 inches in thickness, that in places yielded ore rich in free gold. The vein strikes northeastward, dips southeast, and breaks across the cleavage of the schist country rock, which belongs to the volcanic series. The ore was treated in a small mill of primitive design run by a Model T Ford engine.

At the Grady Rogers a 40-foot shaft exposes schist that for a width of 50 inches or more shows streaks of pyrite and chalcopyrite on foliation planes and contains scattered grains of galena.

The Smart (Bonnie Doon) mine, 1 mile northeast of Indian Trail, is said to have been worked from time to time since about 1835. The latest production reports were made in 1910 and 1911.[50] According to Nitze and Hanna,[51] the ore consisted of galena and pyrite in a quartz gangue, and formed the smaller part of a vein 3 to 4 feet thick. Other reports, including that of Pratt,[52] indicate that a shaft was sunk to a depth of 200 feet. A level turned from it at 60 feet extended 95 feet southwest and 126 feet south; one at 120 feet extended 100 feet southwest; one at 186 feet extended 90 feet southwest and 70 feet northeast. A small pile of ore remaining at the "Lead" shaft in 1934 showed considerable galena. A sample of this ore assayed 0.69 ounce of gold and 0.23 ounce of silver per ton.

The Stewart mine, half a mile north of Goose Creek, was described by Nitze and Hanna [53] as having, in 1894, two shafts 80 and 185 feet deep, connecting with drifts and stopes. These workings explored three veins or belts that contained disseminated pyrite and galena with stringers of gold-bearing quartz. One shoot of rich ore was found and worked out.

In 1934 the material on the dumps showed more or less iron oxide. Of a representative sample then collected. the 25 percent that passed through a ¼-inch screen assayed 0.8 ounce of gold and 0.24 ounce of silver per ton. The remaining 75 percent contained 0.02 ounce of gold and 0.07 ounce of silver per ton.

The Strothers prospect, about 2 miles northeast of Weddington, is in the granite belt, about 1 mile west of its contact with the schists. A vein 9 feet 7 inches wide is exposed in a shallow cut. Along the stream below, very fine gold is found in soil and alluvium to a depth of 16 feet. Below the alluvium is a blue sandy clay.

YADKIN COUNTY

The Dixon mine,[54] about 8 miles southeast of Yadkinville, the county seat, was discovered in 1894. It was developed through a 35-foot vertical shaft, from which level drifts were run to the northeast and southwest. At the foot of the shaft the vein was reported to be 4 feet wide and to average 0.35 ounce per ton (assay value). Work was continued for a short time only, but in 1913–14 the mine was again in operation, this time in conjunction with the neighboring Gross mine. A stamp mill and cyanide plant were erected, and work was continued for about two years, principally at the Gross mine.

The country rock is a mica schist intersected in places by diabase dikes.

The Gross [55] mine, about 7 miles southeast of Yadkinville and about 2 miles northeast of the Dixon mine, is in schist, which is partly soft and partly silicified. Quartz lenses and stringers ranging from less than an inch to 8 feet or more in width have formed along faults

[47] Nitze, H. B. C., and Hanna, G. B., op. cit., p. 95.

[48] Pratt, J. H., Mining industry in North Carolina during 1906: North Carolina Geol. and Econ. Survey, Econ. Paper 14, pp. 62–63, 1907.

[49] Nitze, H. B. C., and Hanna, G. B., op. cit., p. 98.

[50] Mineral Resources, U. S., 1910, p. 686; 1911, p. 884.

[51] Nitze, H. B. C., and Hanna, G. B., op. cit., p. 99.

[52] Pratt, J. H., Mining industry in North Carolina: North Carolina Geol. and Econ. Survey, Econ. Paper 14, pp. 61–62, 1907; Econ. Paper 23, p. 16, 1911.

[53] Nitze, H. B. C., and Hanna, G. B., op. cit., p. 96.

[54] Description from unpublished notes of J. H. Pratt.

[55] Description from unpublished notes of J. H. Pratt.

A. GOLD ORE, HOWIE MINE, UNION COUNTY, N. C.

Vein quartz (light) introduced along cleavage planes in "slate" (volcanic series).

C. OXIDIZED GOLD ORE FROM WEATHERED ZONE OF HARTMAN PIT, BREWER GOLD MINE, CHESTERFIELD COUNTY, S. C.

A breccia of silicified tuff cemented with iron oxides (volcanic series).

B. ROCK OF BREWER QUARTZ LODE, BREWER PIT AT 100-FOOT DEPTH, BREWER GOLD MINE, CHESTERFIELD COUNTY, S. C.

Angular bodies of glassy quartz in a matrix of fine granular quartz.

D. TOPAZ ROCK FROM OUTCROP NORTHWEST OF BREWER PIT, BREWER GOLD MINE, CHESTERFIELD COUNTY, S. C.

Replacement of silicified brecciated tuff (volcanic series). The rock is practically all topaz; dark areas are caused by traces of iron oxides.

and rifts in the schist. These bodies vary greatly in width along both the strike and the dip. Between them the schist has been more or less silicified and considerable gold-bearing pyrite has been introduced. The deposits are mineralized zones similar to those in Montgomery and Rowan Counties.

During 1913 and 1914 two veins on the property were explored by means of shafts, pits, and cuts. From the bottom of the deepest shaft, which is 100 feet deep, a 60-foot crosscut was driven which cut through one vein and is said to have penetrated an ore body 12 feet wide, which assayed \$15 (0.75 ounce) to \$18 (0.9 ounce) to the ton in gold. Another vertical shaft, 22 feet deep, encountered a vein 2½ feet wide, which was further explored by a winze 10 feet deep. The ore of this vein was said to average \$17.49 a ton. The second vein is explored by an open cut, 600 feet long and 20 feet or more in depth, probably made about 1912. Both veins have a general northeasterly strike and dip 45° to 60° NW.

SOUTH CAROLINA MINES

TABULAR SUMMARY

A tabular summary of mines in South Carolina from which gold is known or reported to have been produced is given below. All are within the Piedmont province. Descriptions of most of the properties are given in the reports cited below, or in the pages following the table.

Following are a few of the most pertinent publications:

1844. Tuomey, Michael, Report on the Geological and Agricultural Survey of the State of South Carolina, pp. 85–98, 279–286, Columbia, S. C., A. S. Johnston.

1857. Lieber, O. M., First annual report on the survey of South Carolina [for 1856], Columbia, pp. 42–57.

1858. Lieber, O. M., Second annual report on the survey of South Carolina [for 1857], Columbia, pp. 55–73.

1906. Graton, L. C., Reconnaissance of some gold and tin deposits of the southern Appalachians: U. S. Geol. Survey Bull. 293.

1908. Sloan, Earle, Catalogue of mineral localities in South Carolina: South Carolina Geol. Survey Bull. 2.

South Carolina gold localities

County	Name	Location
Abbeville	Cook	3 miles S. 46° W. of Lowndesville.
	Jones	5.8 miles S. 20° E. of Abbeville.
	Link	2 miles south of Beulah Cross Roads.
	Lyon	7.3 miles S. 5° E. of Abbeville.
	Neill	9 miles S. 2° E. of Abbeville.
Anderson	Henderson	6.4 miles S. 9° E. of Easley.
Cherokee	Crocker	9 miles southwest of Gaffney.
	Darwin (Wilkens [Wilkey], Phillips).	10 miles southeast of Gaffney.
	Flint Hill (Jas. Love, Kennedy).	10½ miles southeast of Gaffney.
	Hammet	3.8 miles southeast of Cowpens.
	Kennedy (Flint Hill)	10½ miles southeast of Gaffney.
	Love, Jas. (Flint Hill)	
	Love	0.8 mile southeast of Kings Creek Station.
	Love Springs (Palmer)	3 miles northeast of Cowpens.
	Nott Hill (Norris, Nuckolls).	12 miles south of Gaffney.
	Phillips (Darwin)	10 miles southeast of Gaffney.
	Wilkins (Darwin)	Do.
Chesterfield	Brewer	1½ miles S. 77° W. of Jefferson.
	Edgeworth (Brewer)	7 miles N. 70° W. of Ruby.
	Hendrix	3.9 miles N. 87° W. of Ruby.
	Kirkley	2.3 miles S. 10° E. of Jefferson.
	Leach (placer)	2 miles N. 54° W. of Jefferson.
Edgefield	Landrum	4 miles east of Pleasant Lane.
	Pioneer	Not located.
	Quattlebaum & Landrum.	12 miles N. 6° W. of Edgefield.
Greenville	Desoto	3 miles northwest of Princeton.
	Fountain Inn	Laurens County line 8 miles northwest of Greers.
	McBee (Carson)	7 miles north of Greers.
	Westmoreland	11 miles north of Greenville.
	Wild Cat	15 miles N. 15° E. of Greenville.
	Wolf and Tyger	7 miles north of Greers.
Kershaw	Lamar	9 miles northwest of Camden.
Lancaster	Belk	9 miles north-northeast of Lancaster.
	Blackmon (Blackman)	8 miles north of Kershaw.
	Brassington	3 miles east of north of Kershaw.
	Clyburn (Gay)	1½ miles north of Kershaw.
	Ezell (Izel)	3 miles north of Osceola.
	Funderburk	9 miles N. 49° W. of Jefferson.
	Gay (Clyburn)	1½ miles north of Kershaw.
	Gold Hill (Nisbet)	2 miles west of Osceola.
	Hagin	3 miles northwest of Osceola.
	Haile	3 miles northeast of Kershaw.
	Ingram	4.5 miles S. 76° W. of Jefferson.
	Johnson (Strand)	9 miles East of Lancaster.
	Knight	9 miles N. 69° W. of Jefferson.
	Nisbet (Gold Hill)	2 miles west of Osceola.
	Phiffer	8 miles north of Kershaw.
	Redding	2½ miles N. 42° E. of Heath Springs.
	Stevens	6 miles N. 79° E. of Lancaster.
	Strand (Johnson)	9½ miles east of Lancaster.
	Stroud	10 miles east of Lancaster.
Laurens		8 miles S. 35° W. of Laurens.
McCormick	Butler	3 miles south of McCormick.
	Dorn	At McCormick.
	Jennings	3 miles southwest of McCormick.
	Searls	5.5 miles southwest of McCormick.
	Self	2.5 miles south of McCormick.
Newberry		4 miles southwest of Prosperity.
Oconee	Cochran	3 miles southwest of Adams Crossing.
	Cox	4 miles north of Pulaski.
	Henckel	14 miles west of Walhalla.
	Jesse Lay	11.5 miles north of Walhalla.
	Pickens	1.5 miles southwest of Cherry.
	Sitton	5.5. miles south of Seneca.
	Eastern fork Cherokee	15.5 miles north of Walhalla.
	Keowee River	Between White Water and Toxaway Rivers.
	Kuhtman	15 miles north of Walhalla on middle fork Cheohee Creek.
	Sloan	0.2 mile north of Keowee Station.
Pickens	Calhoun	1 mile north of Calhoun.
Saluda	Yarborough	10 miles southwest of Prosperity.
Union	Bogan	8 miles N. 72° W. of Union.
	Mud (Harman)	3.8 miles S. 77° E. of Glenn Springs.
	Nott	4 miles east of Glenn Springs.
	Ophir (Thompson)	5 miles S. 70° E. of Glenn Springs.
	Thompson (Ophir)	Do.
	West	6 miles S. 60° E. of Glenn Springs.
York	Allison (Dickey, Wyatt)	½ mile north of Smyrna.
	Arrowwood	4.6 mile northwest of Hickory Grove.
	Bar Kat	3 miles west of Smyrna.
	Barnett	10 miles northeast of York.
	Biddle (Jingles)	12 miles northeast of York.
	Bolin	5 miles south of Kings Creek Station.
	Brown	3.2 miles southwest of Hickory Grove.
	Campbell	13½ miles northeast of York.
	Carroll (Ross)	3 miles southwest of Smyrna.
	Cassady (Hardin)	1¼ miles southwest of Smyrna.
	Clawson (Sutton)	4 miles N. 30° W. of Fort Mill.
	Darwin	3 miles southwest of Smyrna.
	Dickey (Allison)	½ mile north of Smyrna.
	Dorothy	4 miles southwest of Smyrna.
	Ellis	1.3 mile northeast of Ferguson mine.
	Ferguson	6 miles northeast of Smyrna.
	Hardin (Cassady)	1½ miles southwest of Smyrna.
	Horn	2 miles northeast of Ferguson mine.
	Jingles (Biddle)	12 miles northeast of York.
	La Peire	4 miles southwest of Smyrna.
	Little Wilson	5 miles northeast of York.
	Logan	8 miles northeast of Smyrna.
	Love	1 mile southeast of Kings Creek.
	Magnolia (Smith)	2 miles west of Hickory Grove.
	Martin	1 mile west of Smyrna.
	McCarter	6 miles northeast of Smyrna.
	McCaw	1.5 miles south of New London Station.
	McGill	2.5 miles south of Kings Creek Station.
	Mercer	1½ miles west of Hickory Grove.
	Parker	1 mile southwest of Magnolia mire.
	Ross (Carroll) (Wolf Creek).	3 miles southwest of Smyrna.
	Schlegelmilch	2½ miles northwest of Hickory Grove.
	Smith (Magnolia)	3 miles southwest of Smyrna.
	Terry	2 miles west of Smyrna.
	Wallace	1.7 miles north of Smyrna.
	Wallace (Wallis)	3 miles northeast of York.
	Wheat	4 miles southwest of Smyrna.
	Whisenant	6 miles southwest of Kings Creek Station.
	Wilson	6 miles northwest of York.
	Wyatt (Allison)	½ mile north of Smyrna.

CHESTERFIELD COUNTY

BREWER

The Brewer mine, situated about 1½ miles west of Jefferson, comprises both placer and lode workings, distributed for nearly a mile along the ridge between Little Fork Creek and Lynch's River (see pl. 30). The property covers 1,380 acres and was owned in May 1935 by Mrs. Mae Clyburn of Lancaster, S. C.

HISTORY

A placer deposit, said to have been discovered in 1828, was mined continuously for many years, and these operations led eventually to the discovery of the lode. By 1843, according to Tuomey,[56] as many as 200 persons, in groups of 3 to 6, were mining, each group being confined under the terms of a lease to a plot 12 feet square. Only the placer deposit and the softened superficial parts of the lode were mined under these conditions. The ore was washed in rockers without any noteworthy attempts at grinding. Chilean mills and arrastres were used later, and presumably the leasing system was then modified to permit larger operations. In the late 1850's the mine is said to have been operated by Commodore Stockton. Apparently there was little activity thereafter until the years succeeding 1880, when a large part of the placer deposit was reworked by hydraulic methods, water being pumped from Little Fork Creek. A 5-stamp mill was built near the creek in 1886 and enlarged to 40 stamps in 1889, and a chlorination plant was added in 1892. Within a year or two, however, the plant was closed, owing partly, it is said, to lawsuits for damages caused by tailings. Since then there have been only spasmodic operations, including a cyanide test that met with little success. In 1935 a 10-stamp mill at the smaller of the two main pits on the ridge was being operated part of the time by H. J. Hartman. Nothing except the foundation remained of the 40-stamp mill built at Little Fork Creek. The mill was being supplied with water pumped from the creek through the old pipe line, nearly 2,000 feet long, that was installed by the placer operators.

PRODUCTION

No records of the earlier production from the Brewer mine are available, but the approximate output since 1890 is estimated at $150,000, from the reports of the Director of the Mint and the annual volumes of Mineral Resources of the United States. Most of this amount appears to have been recovered during the years 1890–93, when the 40-stamp mill was in operation. Reworking of the Tanyard placer is said[57] to have yielded $1 a square yard. The total area mined as placer is about 185,000 square yards (pl. 30), of which the part known as the Tanyard occupies two-thirds or more. The amount recovered during the first working of the Tanyard is not known, but it probably was at least two-thirds as much as from the second working, making a total recovery of about $250,000 from the two operations. The placer areas other than the Tanyard comprise patches around the outcrop of the lode and strips extending from these patches down the natural drainage channels. These additional areas may be assumed to have yielded, in round numbers, at least $1 a yard, or $50,000 in all, making the total placer production about $300,000. This, added to the estimated production from the lode, gives a total of $450,000 for the property.

DEVELOPMENT

In addition to the placer workings, the Brewer mine includes two large open pits, the Brewer and the Hartman (pl. 31), and many smaller surface openings distributed along a wide belt that trends northwestward. From the bottom of the Brewer pit a drainage and working tunnel 1,050 feet long extends eastward, reaching the surface about 60 feet above Little Fork Creek. Several adits, one of them 430 feet long, extend in different directions from the Brewer pit.

ROCKS

The Brewer mine is in schistose rocks derived from bedded tuffs of the volcanic series. To the north and west, at distances of a mile to a mile and a half, these rocks give place to granite (pl. 32). In other directions, at distances of 1 to 3 miles, they are overlain by Coastal Plain sediments. In the southern half of the Brewer mine area (pl. 30) the rocks generally show a well-marked foliation that strikes N. 70° E. and dips 65° to 70° N., but about 1,000 feet northeast of the Brewer pit the foliation strikes N. 80° W. and has a steep dip to the north. Elsewhere the schistosity is obscure.

Exposures of the schist in the Tanyard pit and at other places in the southern part of the area show narrow alternating lighter and darker bands, like those that mark the bedding in fine-grained tuff of the volcanic series in other areas. Locally the banding is emphasized by iron oxides. It is crossed by the foliation and is believed to represent the bedding of the original rock. These schists consist mainly of quartz and sericite, but in places they contain much pyrophyllite.

Certain outcrops, numbered 1 to 4 on the map (pl. 30) are composed largely of secondary quartz and hence are more resistant than the average country rock.

Outcrop 1 is a discontinuous ledge that in places stands several feet high. Its weathered surface is nearly white and shows indistinctly the pattern of a fine-grained breccia. The rock splits readily along

[56] Tuomey, Michael, Report on the Geological and agricultural survey of South Carolina, p. 96, Columbia, S. C., A. S. Johnston, 1844.

[57] Production of the precious metals in the United States, 1880: Report of the Director of the Mint, p. 176, 1881.

foliation planes, which show a pale-pink color and glisten with extremely fine micaceous flakes. Under the microscope the rock is seen to be a finely granular aggregate, about 90 percent quartz and the remainder chiefly sericite. Some of the sericite forms groups of shreds which may represent grains of altered feldspar. Small grains of secondary epidote and a dust of iron oxides are present.

Outcrops 2 and 3 are less prominent but otherwise much like outcrop 1. Locally they are peppered with spots of red to brown iron-oxide, some of which have cubical and other angular forms indicating derivation from pyrite. From outcrop 3, on the north bank of Little Fork Creek just below the old mill foundation, specimens were obtained that show scattered black grains of chloritoid, which is a silicate of aluminum, magnesium, and iron.

Outcrop 4 stands out prominently at the south side of the Tanyard pit, where it is cut across by a ravine. It consists of a dense, fine-grained, light-gray to reddish-gray siliceous rock. Where most deeply cut by the stream channel this rock shows scattered grains of pyrite. Less prominent parts of this outcrop show in some places the pattern of a breccia, in which the fragments are outlined with films of iron oxide associated with glistening flakes of a micaceous mineral; in other places it shows narrow stripes of brown iron oxide, of which some represent bedding and others fill small diagonal slips. Still another kind of rock in this outcrop is marked with a pattern of irregular broken lines and streaks of iron oxide, the intervening areas being white as if leached. Under the microscope, 80 to 95 percent of the rock from different parts of outcrop 4 is seen to consist of quartz. The quartz occurs partly in small original grains, which are embedded in, and locally penetrated by, an aggregate of still smaller grains of quartz. Associated with the later quartz are scattered shreds of sericite and specks of iron oxide and rutile. Some specimens contain tiny grains of epidote and zoisite and a little feldspar, and some contain pyrite and a few partly rounded zircons. North of the Tanyard pit the rocks in outcrop 4 are even more highly siliceous than those just described, and their bedding and foliation are obscure. It is these rocks that constitute the Brewer lode.

The widespread hydrothermal alteration whose effects are described above may plausibly be regarded as effects of the granitic intrusion. As the granite area is approached the alteration appears in fact to become more pronounced. In the contact zone at Little Fork Creek is a bluish-gray hornstone showing indistinct bands that appear to represent the bedding of the original rock. Microscopically this rock is found to consist mainly of fine-grained quartz, accompanied by considerable biotite, some chlorite, apatite, epidote, and magnetite, and a little orthoclase and sericite.

In the southern half of the Brewer area the beds strike N. 70° E. and dip 25° to 40° N. They are about 2,000 feet in aggregate thickness and form the south limb of a syncline (pl. 30), the axis of which crosses the Tanyard pit. A slight change in the strike of the beds just north of the axis suggests that the trough deepens westward. Farther north, in the area that should be largely occupied by the other limb of the syncline, the structure could not be made out. Joints and faults were observed only in the Brewer pit and its vicinity; they are described on p. 110.

LODE

The Brewer lode is an indefinitely bounded mass that forms a large part of the ridge between Little Fork Creek and Lynch's River. Exposures in the Brewer and Hartman pits and the northern part of the Tanyard pit (pl. 31) indicate that the lode is 200 to 300 feet wide and extends about N. 50° E. for 1,000 feet or more. The outline of the Brewer pit shows that the lode has a tendency to branch toward the northwest. Northeast of that pit, as shown by many workings and a few outcrops, the lode turns to the northwest and, somewhat diminished in width, continues in that direction for 1,200 feet or more to the highest part of the divide. The downward extent of the lode is unknown, but it exceeds that of the workings, one of which is 140 feet deep and has not reached the bottom of the lode.

Quartz rock.—The Brewer lode consists chiefly of very fine grained quartz. Below the oxidized zone the rock is generally dense and compact; in places it appears almost like flint. Most of it shows rather distinct patterns representing the original structures of the rock, presumably a tuff or a schist, that the quartz has partly or completely replaced. The most common pattern is that of a breccia with fragments up to an inch or two across (pl. 29, *B*). Other patterns are made up chiefly of bands or lines that represent the bedding or foliation of the original rock. The color of the quartz, viewed in the mass, ranges from very light to dark-bluish gray according to the relative scarcity or abundance of included sulfide grains, chiefly pyrite. Under the microscope the quartz is seen to be, in the main, an aggregate of very small irregular grains with here and there a cluster of coarser grains. In some of the coarse-grained clusters, still larger grains form rounded islands or nuclei, apparently representing original grains that have been enlarged by later addition of quartz. Sericite occurs in tiny flakes between quartz grains. Pyrite is abundant in disseminated crystals, most of them very small, and topaz is present in scattered minute grains.

Weathering has altered the lode in most places to depths of 40 to 60 feet, and in a zone of shattering that crosses the southeastern part of the Brewer pit its effects are noticeable as far down as the bottom of the pit, which is there 140 feet deep. In the upper parts of the weathered zone much of the quartz rock is disintegrated to a sand with a grain size comparable to that of a fine scouring powder (about 0.01 mm). Large bodies of such material are exposed in the Brewer and Hartman pits and in several other workings. In some exposures, what appears to be solid rock is in fact so disintegrated that when lightly tapped with the hammer it crumbles to a mass of loose sand.

Large parts of this sandy material are snow-white, as if completely leached of whatever iron the unweathered rock may have contained, while other parts are more or less iron-stained. Some samples of the white sand from the south side of the Brewer pit were shown by the microscope to contain as much as 15 percent of topaz grains, but others contained no topaz. Alternating with the sandy material, and constituting perhaps the larger part of the oxidized zone, are relatively solid masses composed of massive quartz fragments cemented together with iron oxides (pl. 29, *C*). The texture of this material is similar to that of the unoxidized breccia.

The northwest branch of the lode, as exposed in workings that do not extend below the oxidized zone, consists mainly of quartz rock, which is similar to that described above and is likewise partly disintegrated into sand. It contains, however, a body of topaz rock, which is described below.

Minerals in the ore.—The unoxidized parts of the lode generally appear to contain from 2 to 5 percent or more of fine-grained pyrite. This mineral is unevenly distributed, most of it forming an irregular mesh surrounding angular bodies that resemble fragments of a tuff or breccia. A little pyrite occurs also in other parts of the rock as scattered grains. The great majority of the grains are very small—0.1 millimeter or less in diameter. A few with cubical form are comparatively large—about 1 millimeter in diameter.

Enargite (sulfarsenate of copper), mostly in small irregular black grains showing a perfect cleavage, is sparingly scattered through considerable areas of rock exposed around the north side of the Brewer pit. A few grains are as much as 10 millimeters long. The following minerals, though not seen during the present examination, have been reported to occur at Brewer mine: covellite (copper sulfide),[58] cassiterite (oxide of tin),[59] bismuth ochre (bismite), and native bismuth.[60] The northeast side of the Brewer pit shows, near the bottom, bright blue-green crusts of chalcanthite (copper sulfate), and there and elsewhere a little sulfur has formed on surfaces of rock rich in pyrite. Both minerals are the result of recent weathering.

In the unoxidized parts of the lode, most of the gold is apparently contained in pyrite, but small particles of free gold are reported to occur. In the oxidized zone, finely divided free gold is found both in the rock disintegrated to a white sand and in the rock cemented with iron oxides.

Topaz rock.—The northwest branch of the Brewer lode, though consisting partly of the quartz rock already described, is in places composed almost exclusively of very fine grained topaz almost unmixed with other material—a fact that makes the deposit literally unique.[61] In other regions topaz is known chiefly as an accessory or minor constituent of such rocks as granite or schist. It usually occurs in isolated crystals, some of them very large and some, of the widely known transparent brown or yellow variety, having the quality of gems. Of all topaz-bearing rocks that have been described, the one most resembling that of the Brewer mine is the "greisen" found at Silver Mine, Mo.[62] This is described as a gray "siliceous looking rock," and the microscope shows it to consist mainly of finely granular topaz and quartz, in which variable quantities of sulfides and other late minerals are disseminated.

The largest body of topaz rock observed crops out at the top of a slope about 500 feet northwest of the center of the Brewer pit (see pl. 31). It projects 2 or 3 feet above ground and is exposed over an area of about 12 by 30 feet, its longer dimension trending northeastward. Several smaller bodies crop out nearby. A small pit about 40 feet north of the large outcrop exposes several irregular veins and bunches of topaz rock enclosed in the quartz rock of the lode, which is here altered by weathering to a fine sand (see fig. 29).

In an area of an acre or more surrounding these outcrops, loose fragments of topaz rock were once abundantly distributed through the surface mantle. They are now largely collected in the waste heaps of former gold-mining operations, of which they commonly form from 50 to 90 percent. Outside this area of concentration such fragments are somewhat sparingly scattered for a considerable distance southward down the general slope. Several of them were observed (pl. 30) in the Tanyard pit, about 1,500 feet to the south. Most of the fragments are somewhat waterworn and a few are well rounded. The rock is very resistant to weathering, and remains firm where the associated quartz rock has broken down completely to sand.

Within an area lying 400 to 1,000 feet or more to the northwest of those described above, and at a greater altitude, other bodies of topaz are indicated by the oc-

[58] Becker, G. F., Gold fields of the Southern Appalachians: U. S. Geol. Survey 16th Ann. Rept., pt. 3, p. 279, 1895.

[59] Clarke, F. W., and Chatard, T. M., Am. Jour. Sci., 3d ser., vol. 28, p. 25, 1884. Becker, G. F., op. cit., p. 308.

[60] Tuomey, Michael, Geology of South Carolina, p 97, Columbia, S. C., A. S. Johnston, 1848.

[61] Pardee, J. T., Glass, J. J., and Stevens, R. E., Massive low-fluorine topaz from the Brewer mine, S. C.: Am. Mineralogist, vol. 22, pp. 1058–1064, 1937.

[62] Singewald, J. T., Jr., and Milton, Charles, Greisen and associated mineralization at Silver Mine, Missouri: Econ. Geology, vol. 24, pp. 569–591, 1929.

currence of moderately abundant fragments in the surface mantle (see pl. 30).

The total amount of topaz rock observed in outcrops and waste heaps is several hundred tons.

In general appearance the topaz rock resembles the undecomposed quartz rock of the lode. In fact the two look so much alike that in the field they are not easily distinguished except by the relatively high specific gravity of the topaz rock (about 3.5) as compared with that of quartz (about 2.6). Some of the topaz rock, like some of the quartz, shows the pattern of a breccia (pl. 29, *D*), and some shows lines or bands representing other structures of the country rock that the topaz has replaced. In texture the topaz rock resembles chert. Weathered surfaces are generally light gray but somewhat stained with iron oxides. In many specimens the light-gray material forms only a thin surface layer and the interior is a deep carnelian red. Apparently the red color is an iron stain due to the oxidation of minute inclusions, but the amount of iron present is very small; the light color of the surface layer is the result of leaching.

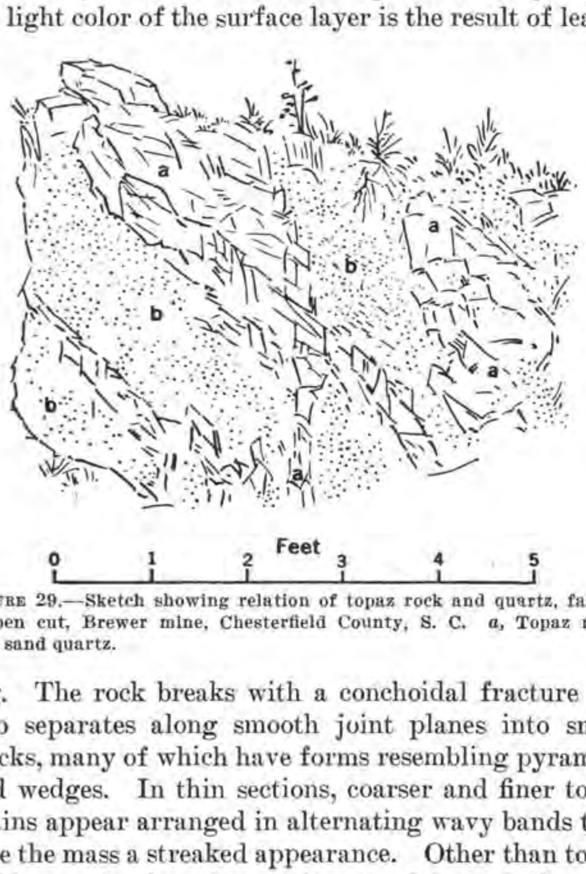

FIGURE 29.—Sketch showing relation of topaz rock and quartz, face of open cut, Brewer mine, Chesterfield County, S. C. *a*, Topaz rock; *b*, sand quartz.

The rock breaks with a conchoidal fracture but also separates along smooth joint planes into small blocks, many of which have forms resembling pyramids and wedges. In thin sections, coarser and finer topaz grains appear arranged in alternating wavy bands that give the mass a streaked appearance. Other than topaz and iron stain, the only constituents of the rock observed are scattered small grains of sulfides.

The topaz rock is not described as such in previous reports on the Brewer mine; it apparently was regarded as flinty quartz along with the rest of the lode. Graton,[63] however, doubtfully recognized the occurrence of small topaz crystals within the quartzose part of the lode. He describes a rock of which the "only recognizable original constituents are sparing grains of quartz and abundant phenocrysts of a mineral whose identity has not yet been established. * * * The quartz is penetrated by numerous prismatic crystals, apparently of secondary origin, possibly topaz." This unknown mineral, as shown by an uncompleted examination by Dr. W. F. Hillebrand, had about the same specific gravity as topaz (3.57) and resembled it in composition except that it contained less fluorine.

As already mentioned, microscopic examination shows the presence of scattered grains of topaz in specimens from other parts of the lode than the body of topaz rock described. A boulder about 18 inches in diameter, found near the eastern edge of the Tanyard pit among the mining debris, consisted of a snow-white granular mass so friable that it was broken up by a few light taps of the hammer. Originally the boulder must have been firm, for evidently it had been transported and showed some signs of being waterworn. The microscope shows that this rock is composed of clear colorless grains of topaz, most of them rounded but a few showing forms that suggest crystal outlines. Some grains contain a few minute inclusions, probably of quartz, and specks of an unidentified dark yellow-brown mineral. No inclusions of gas or of liquid containing bubbles which are generally common in topaz were seen. The mass is held together merely by the interlocking of the grains, all cementing material having apparently disappeared. In texture the aggregate is somewhat coarser than the topaz rock northwest of the Brewer pit. If the ore minerals were removed from a specimen of the greisen from Missouri figured by Singewald and Milton,[64] the remaining porous mass would have about the same texture as the topaz boulder described.

The chemical composition of the topaz rock, as determined in the laboratory of the Geological Survey, is as follows:

Topaz rock from the Brewer mine, South Carolina

[R. E. Stevens, analyst]

	Percent
Silica (SiO_2)	33.00
Alumina (Al_2O_3)	56.76
Iron oxide (Fe_2O_3)	Trace
Water (H_2O)	2.71
Fluorine (F)	13.23
	105.70
Less oxygen (O)=F_2	5.57
	100.13

Specific gravity 3.517.

The material contains a little more water and less fluorine than any topaz heretofore described. So far as known, the topaz most like it in these respects occurs in a specimen from Minas Gerais, Brazil, an analysis of

[63] Graton, L. C., Reconnaissance of some gold and tin deposits of the southern Appalachians: U. S. Geol. Survey Bull. 293, pp. 90, 91, 1906.

[64] Singewald, J. T., Jr., and Milton, Charles, op. cit., p. 574, fig. 4.

which, given by Penfield and Minor,[65] shows 2.45 percent of water and 15.48 percent of fluorine. The smallest percentage of fluorine found in topaz, as given by Dana,[66] is 16.04. Spectroscopic tests of the Brewer mine topaz rock, made in the Survey laboratory by George Steiger, showed the presence of traces (0.001 ounce per ton or less) of silver, tin, and germanium. Beryllium and lead were doubtfully present, but not even traces of arsenic, boron, bismuth, cadmium, zinc, or antimony were detected. An assay by E. T. Erickson of a sample from the outcrop northwest of the Brewer pit gave 0.01 ounce of gold to the ton.

Structure.—Several groups of fractures cut the lode rock in different directions (pl. 33). In the Brewer pit, a group striking northwestward and dipping steeply northeast is represented by large smooth joint faces (pl. 34, *A*) that show no evidence of movement. A second group, striking northeastward and dipping about 40° SE., is accompanied by veins of barren white ("bull") quartz. A group complementary to the other two, consists of fractures having a northeasterly strike and a northwest dip. This last group, which is prominent in a zone about 100 feet wide extending along the southeast side of the pit, is roughly parallel to the prevailing structural trend in the region, and most of its members appear to coincide with planes of schistosity. At the northwest side of the zone, fault movement along one of the fractures is indicated by grooves or flutings (pl. 34, *B*). Another fracture, at the southeast side, shows fault striae and is accompanied by a layer of breccia several feet thick. At the north side of the pit, a fault is exposed that strikes nearly west and dips steeply north, and at the northwest side of the pit there is a group of joints, marked by smooth rock faces, that trend a little west of north and dip steeply east. A north-dipping fault and a breccia zone are crossed by the tunnel extending north from the Brewer pit.

Three groups of fractures nearly at right angles to one another appear in the Hartman pit, but they differ somewhat in direction from any of those in the Brewer pit. None shows distinct evidence of faulting.

ORE BODIES

Those parts of the lode which contain enough gold to be classified as ore appear to be indefinitely bounded and of irregular form. According to Nitze and Wilkens[67] the best ore mined from the Brewer pit formed lenslike bodies 10 to 30 feet wide. As plotted on their map, these bodies trend northwestward and are closely grouped in the area of the pit. Some are shown also in the north drift. Neither this nor any other very definite arrangement of ore shoots is indicated by the present exposures, but the distribution of the old workings along the northwest branch of the lode suggests linear bodies of northwesterly strike.

Except at the Brewer pit, the operators have selectively mined the softer material, and to judge by the form of the workings the ore bodies, as pointed out by Graton,[68] were about as irregular as the cavities in a much-weathered limestone.

In 1897, Nitze and Wilkens,[69] apparently referring to the Brewer pit, stated that the better grade of ore assayed \$5 to \$7 (0.25 to 0.35 ounce) per ton, and that the average run of mine was about \$3 (0.15 ounce). No other records are available of the ore milled from this pit, or of that from the older surface workings.

The following assays of samples collected during the examination in 1935 are to be regarded only as qualitative tests. They represent selected areas or kinds of rock and not measured quantities.

Assays of samples from the Brewer mine, South Carolina [1]

[Assayed by Theodore Erickson, U. S. Geological Survey]

Sample No.	Locality	Description	Gold (ounces per ton)	Value ($35 per ounce)
1	Northwest side of Brewer pit.	Quartz with minute grains of pyrite.	0.13	\$4.55
2	Lower south and west side; combined samples.	-----do---------	.10	3.50
3	From northwest, southeast, and southwest sides of pit; combined samples.	-----do---------	.045	1.58
4	Surface northwest of Brewer pit.	Oxidized ore----	.31	10.85
5	Hartman pit----------	Flinty rock from waste pile.	.02	.70
6	-----do--------------	Mill heads, oxidized ore.	.05	1.75

[1] None of the samples contained silver.

Spectroscopic tests of the above samples by George Steiger showed no platinum or palladium, although positive results would have been obtained if either of these metals had been present to the amount of one-thousandth of an ounce per ton.

Crude concentration tests made by panning parts of certain of the foregoing samples, crushed to pass through a 20-mesh screen, gave the following results:

Sample No.	Ratio of concentration	Gold in concentrate	
		Ounces per ton	Percent
1------	40 to 1-------------------	2.26	43
3------	100 to 1------------------	2.16	43
5------	60 to 1-------------------	.60	47

[65] Penfield, S. L., and Minor, J. C. On the chemical composition and related physical properties of topaz. Am. Jour. Sci., 3rd ser., vol. 47, p. 387, 1894.

[66] Dana, J. D., System of mineralogy, 6th ed., p. 495, 1892.

[67] Nitze, H. B. C., and Wilkens, H. A. J., Gold mining in North Carolina and adjacent Southern Appalachian regions: North Carolina Geol. Survey, Bull. 10, pp. 144, 146, 1897.

[68] Graton, L. C., op. cit., p. 92.

[69] Nitze, H. B. C., and Wilkens, H. A. J., op. cit., p. 144.

The concentrates consisted almost entirely of pyrite with a little enargite and quartz. Considerable sulfide not freed from quartz in crushing to 20 mesh was lost in the tailings.

A sample of the pyrite-bearing part of the silicified rock at the south of the Tanyard pit, described as bed 4, assayed 0.01 ounce of gold per ton.

Beyond the limits of the Brewer pits but within the area mapped in detail are several outcrops of massive iron oxide. One of these "gossans" (pl. 30) extends S. 40° E. from the mouth of the drain tunnel for about 1,000 feet up a slope. Near the upper end it is 200 feet wide. A sample from the dump of an old shaft at that point assayed 0.01 ounce of gold to the ton (about 35 cents). Light-colored flakes of a micaceous mineral are irregularly scattered through the gossan; parts of it, however, appear to be nearly pure limonite. Smaller gossans of similar character crop out about 1,500 feet northwest of the one described.

ORIGIN

The great extent to which the rocks at the Brewer mine have been hydrothermally altered is shown particularly by the unique occurrence of topaz in large quantity, by widespread silicification, and by extensive development of pyrophyllite and sericite. These alterations are regarded as effects of an intrusive magma, perhaps represented by the granite nearby. The folding and the development of schistose structure probably accompanied the intrusion of the magma, and may have been largely the result of the intrusive action. In the absence of definite details it may be assumed that structural movements opened the rocks, at the site of the Brewer and related deposits, sufficiently to permit relatively easy movement of the solutions that deposited the lode and the accompanying minerals. All these minerals, including gold, appear to have been introduced after the development of the sericite schists. Their deposition was followed by the introduction of barren quartz veins and the development of topaz. The exposure and wearing down of the lode by weathering and erosion formed the placer deposit, and the same processes may have caused an enrichment of the upper parts of the lode, which have mostly been mined out. The existing remnants of the placer deposit, including the debris in the Tanyard pit, are of local origin, and their character suggests deposition and sorting by sea waves. Probably the placer is a remnant of an ancient beach. Its overburden of barren sand is an outlier of the Coastal Plain and evidently represents marine offshore deposits.

RESERVES

An unworked area of surface mantle, 3 or 4 acres in extent, between the Tanyard and Brewer pits and below the outcrop of the lode may contain a valuable placer deposit. Several pits in this area expose considerable bodies of disintegrated quartz rock, resembling that from which Mr. Hartman reported, in 1935, a recovery of about $2 a ton (0.06 ounce) in gold. The presence of richer ore in part of the northwest branch of the lode is indicated by the assay of sample 2 given on page 110. The unworked parts of the lode contain a large amount of the quartz rock. They include fairly large bodies of rock disintegrated to sand, similar to that from which Hartman extracted $2 per ton. Samples from the Brewer pit, previously listed, represent considerable parts of the faces exposed below the oxidized zone. They indicate a content of 0.02 to 0.05 ounce of gold to a ton, but no definite estimate of its volume can be made, since the mass can be measured in two dimensions only. The mineralized body is very favorably situated for mining on a large scale; whether the gold can be profitably recovered from the unweathered rock is a problem for metallurgists. The iron gossans are probably the cappings of considerable bodies of pyrite.

The occurrence of topaz in quantity offers a resource new to industry. It has been given further study by Fries,[70] and has been investigated as a possible substitute for imported kyanite by the United Feldspar and Minerals Corp.

EDGEFIELD COUNTY

LANDRUM

The Landrum mine, in the northern part of Edgefield County, about 4 miles east of Pleasant Lane, was being developed in the summer of 1934 by the Southern Gold Mines Corp. under the direction of H. W. Ingalls. This and the adjoining Quattlebaum mine are on a lode that was worked as early as 1856; the subsequent history and production of these mines are unknown. The Landrum mine had been idle for some time before 1932, when some development work was begun. The older workings of this mine, together with those of the northern part of the Quattlebaum mine, extend along a northeasterly course for a distance of 1,300 feet. They partly expose a lode, composed of quartz with more or less iron oxide, that is parallel to the structure of the country rock, which belongs to the volcanic series. The recent workings (pl. 35) include a tunnel driven along the lode and a shaft that was being sunk in September 1934 and that had then reached a depth of 100 feet. The tunnel begins near the bottom of an open cut and follows the vein for a distance of 500 feet at a level about 40 feet below the outcrop. Along this tunnel the lode ranges in width from a foot or less to 10 feet. In some places it consists of barren-looking "bull quartz" and in other places of cellular quartz with iron oxides. The average of a number of assays of samples that were supposedly representative of the lode as exposed in the

[70] Fries, Carl, Topaz deposits near the Brewer mine, Chesterfield County, S. C.: U. S. Geol. Survey Bull. 936-C, 1942.

tunnel is 0.15 ounce per ton, equivalent to about $5.25 at a price of $35 an ounce.

LANCASTER COUNTY

BLACKMON

The Blackmon mine, about 8 miles north of Kershaw, has been described in detail by Graton.[71] It was being operated at the time of his visit under the direction of O. J. Thies, and the ore was being treated by amalgamation in a 20-stamp mill. The workings had then reached a depth of 180 feet and included several levels. Mill tests were being made in June 1935.

The ore occurs in a zone of sericite schist adjoining a body of quartz monzonite porphyry. It is characterized by small quartz lenses, containing small particles of free gold. Weathering has converted parts of the schist, particularly next to the porphyry, to soft and slippery kaolin. The gold-bearing material has a maximum width of 35 feet, and has been opened along the strike (northeastward) for 300 feet.

Its recoverable gold content was said by Graton to be $2 (0.10 ounce) per ton. In 1902 and 1906 nearly 750 ounces of gold was produced, the recovery averaging 0.053 ounce per ton.[72] In 1935 two large open-cuts were accessible, and ore partly weathered to a powder was being mined at the end of one of these cuts. A sample yielded, on panning, several particles of gold, estimated to indicate a content of about 0.05 ounce per ton; they were in a residue of heavy red sand consisting mainly of iron-stained ilmenite.

Specimens of the lode rock obtained below the strongly weathered zone consist of waxy, gray-white to green schist, glistening brilliantly with sericite flakes. A partial analysis made in the laboratory of the Geological Survey gave the following result:

Green crinkled schist from Blackmon mine, South Carolina

[J. G. Fairchild, analyst]

	Percent
Silica (SiO_2)	57.78
Alumina (Al_2O_3—includes P_2O_5 if present)	29.46
Iron oxides (as Fe_2O_3)	.50
Magnesia (MgO)	Trace
Lime (CaO)	Trace
Rutile (TiO_2)	1.12
Potash (K_2O)	7.26

The high potash content is noteworthy as indicating the abundance of sericite, and as lending some support to the local belief that the mill tailings make a valuable fertilizer.

HAILE

The Haile mine, 3 miles northeast of Kershaw, is one of the largest and most productive gold mines in the Southern Piedmont. Only two other mines, or groups of mines, belong in the same class, namely, the Gold Hill group in North Carolina and the mines on Findley Ridge at Dahlonega, in Georgia.

In 1935 only the surface workings of the Haile mine were accessible to examination. Much information, however, about the workings now inaccessible and about the history, production, and other features of the mine is given in the reports listed below.

1844. Toumey, Michael, Report on the Geological and Agricultural Survey of the State of South Carolina, p. 23, Columbia, S. C., A. S. Johnston.

1848. ——— Geology of South Carolina, pp. 95–96, Columbia, S. C., A. S. Johnston.

1854. Mining Mag. vol. 1.

1856. Lieber, O. M., Survey of South Carolina, 1st Annual Report, pp. 60–62, 2d ed., 1858. Columbia, S. C., R. W. Gibbes.

1880–1900. Director of the Mint, Production of Precious Metals, 1880, p. 176; 1881, p. 469; 1882, p. 638; 1883, pp. 656–657; 1884, p. 443; 1885, p. 189; 1886, p. 238; 1887, p. 251; 1889, pp. 204–205; 1890, p. 193; 1891, p. 233; 1893, p. 107; 1895, p. 102; 1896, p. 184; 1897, p. 193; 1898, p. 130; 1899, p. 169; 1900, p. 182.

1883. Spilsbury, E. G., Gold Mining in South Carolina, Am. Inst. Min. Met. Eng. Trans., vol. 12, pp. 99–106.

1887. Spilsbury, E. G., Notes on the general treatment of the southern gold ores: Am. Inst. Min. Met. Eng. Trans., vol. 15, pp. 767–775.

1888. Phillips, Wm. B., The chlorination of low-grade auriferous sulphides: Am. Inst. Min. Met. Eng. Trans., vol. 17, pp. 313–322.

1890. Thies, Adolph, and Metzger, A., The geology of the Haile mine, South Carolina: Am. Inst. Min. Met. Eng. Trans., vol. 19, pp. 595–601.

Thies, Adolph, and Phillips, W. B., The Thies process of treating low-grade auriferous sulphides at the Haile gold mine, Lancaster County, S. C.: Am. Inst. Min. Met. Eng. Trans., vol. 19, pp. 601–614.

1895. Becker, G. F., Gold fields of the southern Appalachians: U. S. Geol. Survey 16th Ann. Rept., pt. 3, pp. 306–308.

1897. Nitze, H. B. C., and Wilkens, H. A. J., Gold mining in North Carolina and other Appalachian States: North Carolina Geol. Survey Bull. 10, pp. 125–143.

1901. Lakes, Arthur, Mines and Minerals: vol. 21, pp. 55–57.

1906. Graton, L. C., Gold and tin deposits of the southern Appalachians, U. S. Geol. Survey Bull. 293, pp. 77–78.

1908. Sloan, Earle, Mineral localities of South Carolina: South Carolina Geol. Survey, Series IV, Bull. 2, pp. 59–74.

1918. Watkins, J. H., Pyrite Mining at Kershaw, S. C.: Eng. and Min. Jour., vol. 106, pp. 517–521.

1921. Schrader, F. C., Pyrite at the Haile mine, Kershaw, S. C.; U. S. Geol. Survey Bull. 725, pp. 331–345.

Additional information concerning the Haile mine is contained in several of the annual volumes of Mineral Resources of the United States, particularly in the volumes for the years 1910–16.

HISTORY

Mining was begun in gravels along the streams by Benjamin Hale, the owner of what is now called the Haile property, in 1828 or 1829. Gold-bearing material also extended up the hillsides, and the mining of the material led to the discovery of the lodes. For the next

[71] Graton, L. C., op. cit., pp. 92–94.

[72] Mineral Resources U. S., 1902, 1906.

A. NORTHWEST JOINT FACE, BREWER PIT, BREWER GOLD MINE, CHESTERFIELD COUNTY, S. C.

B. CORRUGATIONS ON FAULT PLANE, BREWER PIT, BREWER GOLD MINE, CHESTERFIELD COUNTY, S. C.

C. HAILE PIT, HAILE GOLD MINE, LANCASTER COUNTY, S. C.

Standing remnant of diabase dike in foreground.

D. BUMALO PIT, HAILE GOLD MINE, LANCASTER COUNTY, S. C.

Northeast side. Mineralized zone in schist.

20 years the lodes were mined by leasers, each leasehold being an area 50 feet square. The deepest workings were 25 feet deep, and the ore was treated in rockers and arrastres, and in a 5-stamp mill which was erected in 1837 by a Frenchman named Gugnot. Later, as the workings became deeper, the increasing proportion of sulfides in the ore caused difficulty in recovering the gold and operations became unprofitable. Lieber records that in 1858 only a few gleaners were at work, chiefly engaged in rewashing old sands and gravels. As a result of exposure to the weather, quantities of iron sulfate (copperas) and sulfur had formed on the dumps of pyrite ore thrown aside. The greatest depth of the mine workings was 93 feet.

Now and then during the next 30 years, experiments were made to recover the gold from the sulfide ore, but none achieved any marked success. The most extensive of these operations was carried on between 1882 and 1887 by E. G. Spilsbury, who built a 20-stamp mill, experimented with several methods of roasting the concentrates, attempted to recover the gold by the Designolle process,[73] and had experiments made with a view to smelting the ore to a matte containing gold.

Spilsbury obtained no satisfactory results, but in January 1888 the mine came under the management of Capt. Adolph Thies, who successfully applied a modification of the chlorination process[74] which he had developed shortly before at the Phoenix mine in Cabarrus County, N. C. Capt. Thies and his son Ernest A. Thies, who eventually became the active manager, operated the mine for 20 years, during which it became the leading gold producer of the South and an outstanding example of profitable recovery of gold from low-grade ore. In August 1908, Ernest A. Thies was killed and the mill wrecked by a boiler explosion. After this tragedy the property was operated intermittently by different persons. In 1911 the plant was refitted, and in 1913 vats for the treatment of tailings with cyanide were added and as these operations proved unprofitable, the mine was closed.

Between 1915 and 1919, as a result of the war demand for sulfur, the pyrite bodies on Red Hill were mined, first by A. K. Blakeney and afterward by the Kershaw Mining Co. Then for a period of 14 years the mine remained inactive, except for occasional small operations in the nature of gleaning. In 1934 the Haile Gold Mines, Inc., began development work and built a mill, and during 1935 this company treated a considerable tonnage of oxidized ore by amalgamation.

PRODUCTION

Lieber, writing of the Haile mine in 1858, says that it was worked very profitably for years, and he mentions that nuggets worth from $300 to $500 each were found. No records were kept, however, and it is impossible to obtain reliable information about the early production.

An estimate made by E. G. Spilsbury in 1882 that production up to that time had been more than $1,250,000 is quoted by Graton,[75] who adds that about $2,000,000 was said to have been produced since then, "making the estimated total production (to 1906) about $3,250,000." In the period 1902–17 the reported production from about 186,000 tons of ore amounted to 20,618 ounces of gold and 610 ounces of silver, worth together $427,077 [76] or about $2.30 per ton of ore. Since 1917 the total gold production for the State was 354 ounces, worth $7,100, most of which doubtless came from the Haile mine. From the foregoing data the total production of the Haile is estimated at $3,500,000.

DEVELOPMENT

The Haile mine has extensive open-pits and underground workings, but only the pits were accessible in 1935. The largest of them are the Haile and Bumalo pits at the southeast and the New Beguelin pit at the northwest. These and a number of smaller openings are distributed along two zones, about 1,500 feet apart, that trend northeastward (pl. 36).

The underground workings are described chiefly in the reports by Nitze and Wilkens, by Graton, and by Sloan, listed on pages 5, 7, 8. They consist of shafts, crosscuts, and drifts that by 1906 aggregated about 6,000 feet in length. A large amount of stoping also had been done. Operations were continued for several years after 1906, and during those years the workings may have been considerably extended.

Most of the underground workings are in the southeastern or Haile zone within a section about 1,000 feet long that includes the Haile and Bumalo pits. The lowest level described is at a depth of 350 feet, or about 450 feet down the slope of the lode. East of the Bumalo pit a winze was sunk 130 feet deeper.

The Haile pit was opened to a depth of 200 feet, but the ore from the lower part was taken through a crosscut to a shaft (No. 4) and hoisted. The Bumalo pit was 100 feet deep and connected with stopes that extended down to the 270-foot level. The drifts, crosscuts, and stopes in the vicinity of the Haile and Bumalo pits extended under an area of about 3 acres. Drifts on three levels were driven east of the Bumalo pit for about 500

[73] The Designolle process consists of treating the roasted sulfide concentrate in an iron cylinder with a solution of mercuric chloride ($HgCl_2$). The resulting chemical reaction sets free the mercury, which, being in a nascent state, grasps the gold more readily than under conditions of ordinary amalgamation. At the Haile mine the process is said to have failed because of an excess of iron-oxide slimes.

[74] The Thies process consists essentially in treating the roasted sulfide pulp in lead-lined cylinders with bleaching powder (chloride of lime) and dilute sulfuric acid. The resulting chloride solution is separated through a sand filter and the gold precipitated with iron sulfate ($FeSO_4$).

[75] Graton, L. C., Reconnaissance of some gold and tin deposits of the southern Appalachians: U. S. Geol. Survey Bull. 293, p. 77, 1906.

[76] Data from U. S. Bureau of Mines.

feet or more to a large dike. Two shafts on Red Hill reach a depth of 100 feet. The Blauvelt and Beguelin pits, in the northwestern or Beguelin zone, were 120 feet deep and connected with stopes extending 60 feet deeper. Drifts connected these three pits at different levels; one at the 180-foot level was driven to a point 200 feet southwest of the New Beguelin pit. A shaft on Chase Hill was 120 feet deep, with levels turned from it at 60 feet and at the bottom. The probable position of some of these workings is indicated on plate 36.

Several drill holes are irregularly spaced along or near both zones, most of them being on Red Hill. One, described as a well and as lying midway between the Haile and Bumalo pits, is 400 feet deep. The others range from 100 to 275 feet in depth.

In 1935 the outlines of the pits (pl. 36) differed considerably from those of 1897 as mapped by Nitze and Wilkens. The Haile pit had been greatly enlarged toward the northwest, owing to the necessity of removing the mass composing the hanging wall as mining was continued down the dip of the lode. The Bumalo pit had about the same area as formerly, but the opening had been shifted somewhat to the northeast by excavating at one end and filling at the other. The Blauvelt and Beguelin pits had been greatly enlarged, and the New Beguelin pit had been opened later than Graton's visit to the mine in 1905.

ROCKS

The principal country rock at the Haile mine and vicinity (pls. 32 and 37) is a light-gray schist, belonging to the volcanic series, the wavy parting surfaces of which generally glisten with minute silvery scales of sericite. Specimens of unweathered rock obtained from the Bumalo pit show narrow alternating lighter and darker bands that mark the bedding. In a road cut along the State highway nearly a mile southwest of the mine, exposures of weathered rock show extremely thin layers like the bedding of a varved clay.

In the Bumalo pit and other exposures a wavy cleavage or schistosity, with a northeasterly strike and steep northwesterly dips, is so pronounced as to largely obscure the bedding. The bedding can be made out, however, at one place in the northeast end of the Bumalo pit, where it is bent into small close folds, the axial planes of which appear to be parallel with the cleavage. At the highway exposure the cleavage is less prominent than the bedding, which exhibits very small crenultations superimposed on larger folds that strike northeastward. In the mine the rock is seen to be cut by prominent widely spaced joints that trend northeast and dip about 45° SE., cutting across the cleavage. Another joint system, which includes the fractures along which the diabase dikes were intruded, strikes northwest and is vertical or dips steeply to the northeast.

Microscopic examination by Becker and by Graton shows that the schist is largely composed of very fine-grained quartz and sericite, but that a few original grains of feldspar and biotite remain. These facts together with the appearance of the bedding suggest that the rock was originally a fine-grained waterlaid tuff or volcanic ash. Graton believed its original composition to have been that of a granite or monzonite. Analyzed specimens from less altered parts of the slate series are similar in composition to granite or monzonite, but samples from the vicinity of the Haile mine contain more alumina and potash and less silica than are found in those rocks. The composition of a bed of gray banded schist exposed in the Bumalo pit is shown by the following partial analysis:

Composition of schist from Haile mine, South Carolina

[J. G. Fairchild, analyst]

	Percent
Silica (SiO_2)	41.46
Alumina (Al_2O_3, plus any P_2O_5 present)	32.24
Iron (as Fe_2O_3)	.50
Magnesia (MgO)	None
Lime (CaO)	None
Rutile (TiO_2)	.74
Potash (K_2)	9.18

About 3 miles northeast of the Haile mine is a small area of granite, presumably continuous beneath the cover of Coastal Plain sediments with a larger granite area to the north. The contact between this granite body and the slate series is concealed by the overlying sediments, but evidently lies less than 3 miles northeast of the Haile mine.

Several basic dikes of northwesterly trend cross the area. The largest extends along the valley of Lynch Creek. Several are well exposed in the mine (pl. 34, *C*). One, penetrated by workings beneath the Bumalo pit, dips about 70° NE.; the others range between that attitude and vertical.

Horizontally bedded marine sand with a few layers of clay occupies a large part of the mapped area (pl. 36). At the edge of the Beguelin pits this material is 10 feet thick; elsewhere its thickness is as much as 40 feet. Comparatively shallow deposits of stream aluvium, including a patch of mill tailings, lie along Ledbetter Creek, which drains the Haile area.

LODES

The gold-bearing lodes explored by the Haile mine are zones in which the schist has been more or less replaced by very fine-grained quartz and pyrite (see pl. 34, *D*). Along parts of the zones pyrite has been introduced, alone or with a very little quartz, but these minerals are comparatively poor in gold.

The known ore bodies are practically confined to two zones about 1,500 feet apart (fig. 113), which trend northeastward parallel to the prevailing rock structure. Each zone is from 100 to 200 feet wide and 1,800

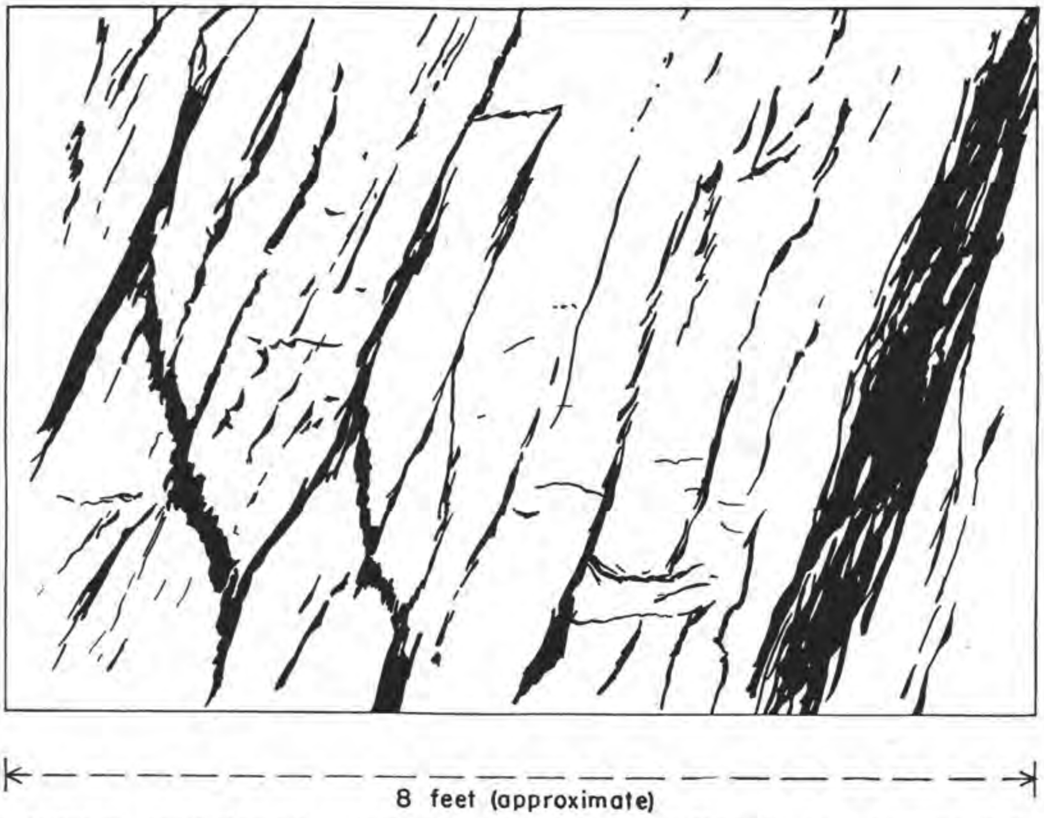

FIGURE 30.—Sketch of banded ore, northeast face of New Beguelin pit, Haile mine, Lancaster County, S. C.

feet or more in length, possible extensions being concealed by the cover of Coastal Plain sediments. The separate ore bodies within these zones range from mere stringers to masses several hundred feet in length and depth and 100 feet or more in width. As a rule the mineralization fades out into the country rock and the ore bodies have no very definite boundaries. Considered in detail the ore bodies are made up of stringers or sheets, which are sharply defined in some places (see fig. 30) but generally appear to grade into the adjoining rock.

In the lode rock the foliation of the schist is usually marked by streaks of sericite. Ore that has not been weathered is described by Graton as a hard bluish rock usually showing a lustrous fracture due to unreplaced sericite. It contains disseminated pyrite, much of it too fine-grained to be seen with the unaided eye. Under the microscope the rock is seen to consist mainly of small quartz grains among which swarms of minute pyrite crystals are scattered. It contains residual shreds of sericite. Pyrrhotite is said to have been found sparingly in the Beguelin ore body, and molybdenite forms veinlets in pyrite-rich layers in the Haile body and in some of the Beguelin ore. Considerable zinc, probably combined as sulfide, was contained in a mass of pyrite found in the northeast corner of the Blauvelt pit at a depth of 75 feet.

Some of the gold in the sulfide zone occurs as thin flakes in molybdenite seams in the Haile and Beguelin ore. It is also said to form films, associated with radial pyrite, along joints in ore from the Beguelin pit, and thin sheets along cleavage planes in the country rock. The presence of free gold throughout the sulfide zone is also indicated by the fact that part of the gold in the unoxidized ore is recovered by amalgamation, though most of it must be in specks too small to be seen with the unaided eye. Coarse grains of native gold can be seen in a specimen of ore from a lower level of the Haile in the possession of Mr. O. J. Thies.

In the weathered parts of the lodes, iron oxides are more or less abundant. The silicified rock is disintegrated to such an extent that it generally shows a fine sugary texture, and in places it can easily be crushed into a fine sand. A body of oxidized ore freshly exposed in 1935 by mining in the New Beguelin pit is made up of seams and stringers containing iron oxides, and at a depth of 30 feet it contains some unoxidized pyrite. A quartz-sericite rock that separates the stringers is almost completely disintegrated into sand.

DIMENSIONS OF ORE BODIES

The parts of the lodes that have been mined as ore include five large bodies and several smaller ones, most of which are described as having lenslike forms. In the Haile zone, the Haile ore body as mined is 250 feet long and about 70 feet wide at the surface. It extends about 350 feet down the dip, but information as to its width and length on the lower levels is incomplete. It is split by a horse of country rock that extends from a point 130 feet below the surface down to the bottom of the workings. The Haile ore body tapered out to the northeast but ended rather abruptly at the southwest. The Bumalo ore body, which is also in the Haile zone, is offset a few feet to the east of the Haile ore body and overlaps it for a short distance. The Bumalo deposit is about 250 feet long at the surface and 40 to 60 feet wide. It is described as raking to the northeast and tapering out on the 270-foot level at a dike which is about 300 feet east of the pit (pl. 36); its extreme pitch length is therefore between 300 and 400 feet. An ore body on Red Hill, mentioned by Graton, was mined from pits to a depth of 60 feet and had a maximum width of 100 feet.

There were a few small ore bodies in the hanging wall northwest of the Haile pit. One, 30 feet in diameter and 65 feet in pitch length, extended above and below the 185-foot level; several "streaks" were exposed in a raise from the 270-foot level; and a 75-ton body was mined on the 200-foot level. Southwest of the pit a chimney of ore 15 feet in diameter extended from a depth of 20 feet to a depth of 42 feet.

The ore body mined from the Blauvelt and Beguelin pits is 400 feet long at the surface, exclusive of the dikes that cut across it. It is perhaps 70 feet in average thickness and extends down 180 feet. The ore body mined from the New Beguelin pit is about 120 feet long, 50 feet wide, and 80 feet deep. Additional ore bodies, presumably not large, were mined from the workings on Chase Hill. The two pyrite bodies mined on Red Hill are described as lenses which together contained 8,500 tons.

From the incomplete information about the workings and ore bodies that has been given above, the minimum volume and tonnage of the principal ore bodies mined may be roughly estimated as follows:

	Volume (cubic feet)	*Equivalent tonnage*
Haile	6,000,000	460,000
Bumalo	4,500,000	345,000
Blauvelt-Beguelin	5,000,000	384,000
Total	15,500,000	1,189,000

If one-quarter of this ore came from the oxidized zone and averaged 0.5 ounce per ton, and if the remainder carried 0.15 ounce per ton, the total gold content would about equal the total output estimated for the mine.

TENOR

The ore taken from the Haile mine during the earlier periods of operation is described as rich, but no definite information as to its gold content is available. In 1883 Spilsbury [77] estimated that the ore mined from the surface to a depth of 75 feet averaged $11 (0.55 ounce) per ton. In 1887 the same author estimated $6 (0.3 ounce) per ton as the average for ore mined during the preceding 5 years. Ore mined in 1900, according to Lakes,[78] averaged $4 (0.2 ounce) per ton, and by 1906 the average, as given by Graton,[79] had dropped to $3 (0.15 ounce). The progressive decrease was ascribed by Graton partly to the mining, in later years, of material that was earlier left behind as worthless and partly to an actual decrease in value with depth. In the years 1902, 1905, 1906, and 1908 the gold recovered per ton ranged from $2.07 (0.1 ounce) to $3.10 (0.15 ounce) and averaged $2.32 (0.115 ounce).[80] During that period, according to Graton, the gold recovered amounted to a little less than 80 percent of the assay value, which was therefore about $3 (0.15 ounce) per ton. During intermittent operations between 1909 and 1914 the recovery per ton was generally less than $2 (0.1 ounce). In 1935 the assay value of a considerable quantity of ore mined from the east face of the New Beguelin pit ranged from 0.15 to 0.4 ounce per ton.

The foregoing are averages for comparatively large bodies, parts of which, of course, were richer. According to assays recorded by Graton, certain rich streaks or layers found in different parts of the mine, to a depth of at least 200 feet, contained from $12 (0.6 ounce) to $40 (2 ounces) per ton. Assays of some relatively small bodies outside the main Haile and Bumalo workings showed $5 (0.25 ounce) or somewhat less. At a depth of 100 feet a crosscut northwest from a shaft about 300 feet southwest of the Haile pit is reported to have passed through 130 feet of material that assayed from 50 cents to $2 (0.025 to 0.1 ounce) per ton. Material from a 400-foot well drilled about midway between the Haile and Beguelin pits contained pyrite and traces of gold. Low-grade material is said to have been found below a depth of 100 feet by drilling on Red Hill and Chase Hill. A sample collected to represent a composite of several stringers of iron oxide in the face of the New Beguelin pit contained according to the operator 1.1 ounces of gold per ton.

PYRITE BODIES

The unoxidized quartz-pyrite bodies mined for gold contained from 2 to 30 percent of pyrite. Outside of these ore bodies, much pyrite, associated with only a small proportion of quartz, has been added to the schist in the Haile and Beguelin zones. Watkins [81] and Schrader [82] describe two bodies of pyrite on Red Hill that were mined in 1915–18 by A. K. Blakeney as lessee, one 20 by 30 feet, the other 18 by 25 feet, in horizontal

[77] Spilsbury, E. G., Gold mining in South Carolina: Am. Inst. Min. Eng. Trans., vol. 12, p. 101, 1884.

[78] Lakes, Arthur, The Haile gold mines: Mines and Minerals, vol. 21, p. 56, 1901.

[79] Graton, L. C., op. cit., p. 82.

[80] Data from U. S. Bureau of Mines.

[81] Watkins, J. H., Pyrite mining at Kershaw, S. C.: Eng. and Min. Jour., vol. 106, p. 517, 1918.

[82] Schrader, F. C., Pyrite at the Haile mine, Kershaw, S. C.: U. S. Geol. Survey Bull. 725, pp. 331–345, 1921.

section. The reported yield of these bodies, to a depth of 100 feet where they pinched out, was 8,500 tons. Drill holes indicate that pyrite is generally present in abundance in the unworked parts of the Haile zone. In the northeastern part of the Beguelin zone, dumps at the shafts on Chase Hill show much pyrite. Certain layers of schist from 20 to at least 50 feet in width are said to contain 20 percent or more of disseminated pyrite. These pyritic deposits are reported to be low in gold, and the pyrite grains are so small that some difficulty was experienced in concentrating them.

BARREN QUARTZ VEINS

Veins of coarse-grained barren white quartz are scattered through the area surrounding the Haile mine (see pl. 37). They trend northeastward as a rule, and range in size from stringers to bodies 50 feet or more in width and several hundred feet long. One exposed in the Bumalo pit dips steeply northwest, cutting the foliation and the ore body at an acute angle. Some of the veins are lightly stained with iron oxides, and in one of them a little coarse pyrite was observed. As indicated by the one at the Bumalo pit, these barren veins are later than the ore bodies.

COMPOSITION OF MINE WATERS

The Haile and the Bumalo pits are filled to the local drainage level with water of a deep reddish-brown color, which has a strongly acid taste that is due to ferric sulfate in solution. A sample taken from the Bumalo pit in April 1935 was examined in the Geological Survey laboratory, with the following results:

Composition of water from Bumalo pit, Haile mine, South Carolina[1]

[R. C. Wells, analyst]

Reaction to litmus	Strongly acid
Free chlorine	Not detected
Free sulfuric acid (H_2SO_4)	None[2]
Chlorine (Cl) in chlorides	0.010 gram per liter
Iron (Fe)	0.035 gram per liter

[1] No copper, selenium, or tellurium was detected.

[2] The acid reaction is due to ferric sulfate. No ferrous sulfate is present.

Before it was pumped out, the Beguelin pit was filled to overflowing with water of a pale bluish-green tint, which apparently was due to algae or other plants. A sample collected in April 1935, when the pit had been about half emptied, gave a very slight alkaline reaction when tested in the Geological Survey laboratory. It contained 0.011 gram per liter of chlorine in the form of chloride, but no free chlorine, free sulfuric acid, iron, copper, selenium, or tellurium.

ORIGIN

The Haile ore bodies appear to have been formed by replacement along groups of closely spaced fractures that had the same or nearly the same strike and dip as the foliation of the schist. The dominant rock structure doubtless influenced the direction of the fractures, but did not control it entirely, for, as shown in the Beguelin pit (fig. 30), some of the fractures break across the foliation.

The writers of this report regard these deposits as of hydrothermal origin and probably related to intrusive granite, such as that exposed a short distance to the northeast. Previous workers believed that the diabase dikes were the source of the ore bodies or had enriched them. It is now known, however, that the dikes are younger than the lodes, so that their association with the lodes is merely accidental and any changes they may have caused in the lodes are indirect.

At the Haile mine, as elsewhere in the region, the ore was rich at the surface and, except perhaps for some narrow bands or stringers, became leaner with increasing depth. Apparently during the process of weathering, the upper parts of the lodes were enriched with gold from the parts that had been worn away. The enriched zone consists of completely disintegrated material at the top, which was worked as a placer. Next below was oxidized "free milling" ore and under that was sulfide ore, which may have been somewhat enriched with native gold carried down in solution. The dikes may have helped the process of oxidation and enrichment by affording waterways along their margins.

RESERVES

In May 1935 a face of ore about 30 feet wide was exposed in the northeast end of the New Beguelin pit. Other dimensions of the ore body were not definitely shown. Available information indicates, however, that ore probably forms a large part of the block of ground remaining between the New Beguelin and Beguelin pits, and that it extends to a depth comparable to that of adjacent bodies already mined, namely 150 feet or more. Ore was said to have been penetrated southwest of the New Beguelin pit by several drill holes and by the drift extending 200 feet beyond the pit in that direction. It is also possible that new ore bodies may be found near the surface beyond the points at which the mineralized zones pass under the cover of Coastal Plain sediments.

It appears probable that in the aggregate a very large amount of gold-bearing material remains in the zones described, both within the depths reached by the workings and below. What parts of this material are workable remains to be determined by drilling or other exploratory work.

McCORMICK COUNTY

DORN

The Dorn mine, which is in the western and northwestern parts of McCormick, is on a mineralized zone that trends northeast in sericite schist. The workings (fig. 31) extend northeast-southwest over a linear dis-

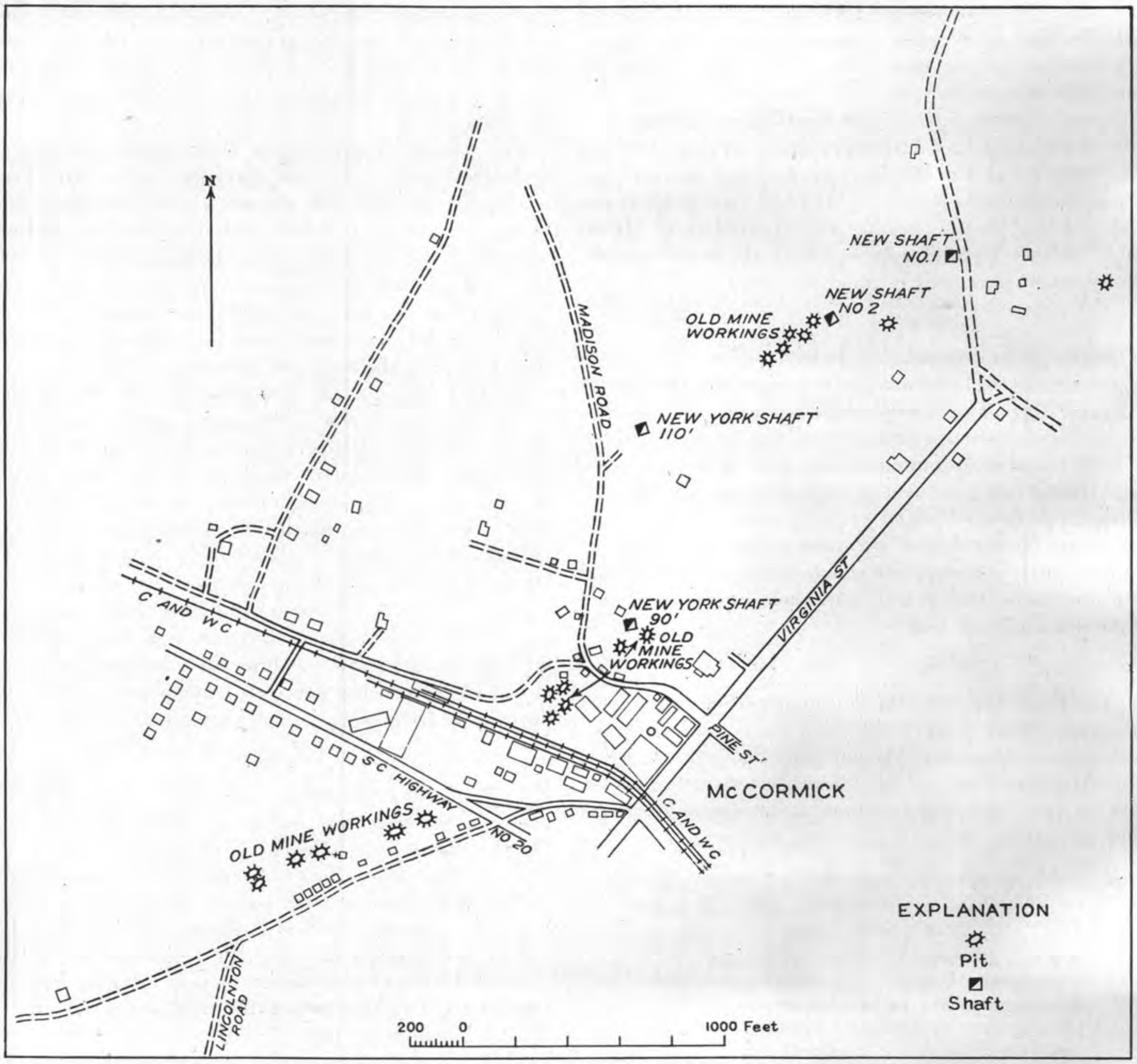

FIGURE 31.—Plan of surface workings, Dorn Mine, McCormick, McCormick County, S. C.

tance of about 3,000 feet, the most extensive being just west and north of the business section of the town. The mine is described in the following reports, of which Lieber's provides the most of the early history.

1853. Mining Mag., vol. 1, p. 513, Whitney, J. D., The metallic wealth of the United States, p. 133, 1853.

1854. Mining Mag., vol. 2, p. 309.

1860. Lieber, O. M., Survey of South Carolina, 4th Ann. Rept., pp. 73–86.

1867. Taylor, J. W., Gold mines east of the Rocky Mountains, 39th Cong., 2d sess., H. Ex. Doc. 92.

1897. Nitze, H. B. C., and Wilkens, H. A. J., Gold mining in North Carolina: North Carolina Geol. Survey Bull. 10, p. 77.

1908. Sloan, Earle, Mineral localities of South Carolina: South Carolina Geol. Survey, Series IV, Bull. 2, pp. 25–27.

After doing considerable work that appears to have been unsuccessful, Dorn, the original owner of the property, struck a body of rich ore in February 1852 in ground now penetrated by the southwestern part of the workings. It is said that by the end of June 1853, $300,000 worth of gold had been mined from an excavation a little over 300 feet long, 12 feet deep, and 15 feet wide, and that the expense of removing the ore and recovering the gold was only $1,200. The ore was worked at the rate of 15 bushels a day, in a Chilean mill driven by 2 mules.

Apart from this spectacular 15-month period of high production and the much less successful efforts made for a number of years thereafter, the Dorn mine has seen little activity. Mint returns from South Carolina jumped from $19,000 in 1850 to $126,982 in 1852, after which they abruptly declined. Lieber reported a yield from the Dorn mine of $72,000 in the 2 years ending January 1, 1859. The mine was dormant from about 1880 until 1932. Common report puts the total production at $900,000.

The development work done in 1932 and afterward was carried on by the North American Gold Mines, Inc., under the direction of H. W. Ingalls. Operations were confined to the extreme northeast part of the zone, where the No. 2 shaft was sunk to a depth of 185 feet, including a 10-foot sump. A working level was turned at a depth of 175 feet, and about 675 feet of drifts and crosscuts had been driven at the time the mine was examined (see fig. 32).

Outcrops in and about the old workings show only sericite schist. As exposed by later crosscuts to a width of 50 feet or more, the country rock also includes a dikelike body of basic intrusive rock 10 feet thick, and a zone 16 feet wide of light-gray rock containing knotlike grains of quartz and feldspar, called "birdseye porphyry" by the miners. With the exception of a basic sill, 4 feet thick, cut by the south crosscut 60 feet from its intersection with the main drift, the country rock of the mine is white, light-gray, and very light green sericite-chlorite schist, the chlorite being subordinate. Extremely fine-grained secondary quartz is widespread but only moderately abundant, and there is much disseminated pyrite.

Lieber describes the schists as highly silicified, but that is by no means the case in the subsurface exposures of the newer workings. The vein is said to have had a strike of N. 78° E., and to have widened from 18 inches at the surface to 14 feet at a depth of 10 feet below the water level. Lieber discusses and sketches faults whose displacement he evidently thought to be horizontal, but such faults are not to be found in any accessible workings. Faulting was probably invoked by Lieber to explain offset zones of ore in the old workings; the distribution of the surface workings indicates a lode separated into three sections, offset with respect to one another but not necessarily by faulting. The ore bodies that were mined are described as dikelike in form, 8 to 50 feet in diameter, and arranged in overlapping fashion. Although the ore bodies are popularly called "dikes," all descriptions, particularly Lieber's, indicate the lenticular type of lode. Oxidized ore extended to a depth of 50 or 60 feet, and fine-grained quartz was present in the richer material. Lieber mentions both glassy vein quartz and granular quartz, but neither was found in the newer workings. Below the weathered ore was a layer of rich copper sulfide.

Drifts on the 175-foot level explore a lode made up of stringers, which are a foot or more in aggregate thickness but are distributed through a 5-foot width of the schist lying next to the basic dike. These stringers are composed almost entirely of galena, sphalerite, and chalcopyrite, which together form a loosely coherent mass. The sulfides tend to replace the chloritic schist selectively. An engineer employed by the company reported that samples from the sulfide veins, representing aggregate widths of 4 to 15 inches, contained in round figures from 6 to 12 percent of lead, 25 to 40 percent of zinc, 2 to 3 percent of copper, 13 to 17 ounces of silver, and 1 ounce of gold to the ton. At one place a body of later barren quartz is exposed next to the sulfide veins, but its relation to them appears to be merely accidental.

Northeast and east of the main lode are outcrops of a lode rich in manganese oxides and a pit from which considerable manganese ore was mined during World War I. Lieber mentions the common occurrence of psilomelane and pyrolusite, both of which interfered with amalgamation. He says that the "manganese vein" can be traced to the Savannah River, and he was told that it could be traced across the river.

YORK COUNTY

BAR KAT

During parts of 1933 and 1934 development work was done by the Bar Kat Mining Co., under the direction of J. R. Elmendorf, on a group of gold-bearing quartz veins in York and Cherokee Counties, about 3 miles west of Smyrna.

The property contains at least eight veins, which trend northeastward nearly parallel to the structure of the country rock (see fig. 33). No records of the mine's production are known to exist, but the extent of the old workings suggests that a considerable amount of gold may have been recovered from the weathered zone.

Workings made by the Bar Kat Co. include a shaft 200 feet deep and two tunnels respectively 150 and 300 feet long (fig. 34). As shown by open-cuts and pits, individual veins persist along the strike for at least 100 to 200 feet each and range from 1 to 4 feet or more in width. Six of them are arranged in pairs spaced 40 or 50 feet apart. One pair is about 200 feet southeast and a second about 100 feet northwest of the shaft; the third pair begins about 200 feet north of the shaft. A fault striking northwest may have cut the third pair off from one of the others and shifted it relatively to the northwest, for a line passing about 100 feet northeast of the shaft marks the northeast end of the first two pairs and the southwest end of the third. In addition, a vein is exposed beyond Beech Branch about 1,000 feet south of the shaft, and still another about 400 feet north of it.

A level driven southeast from the shaft cuts a small quartz vein, not recognized at the surface, containing

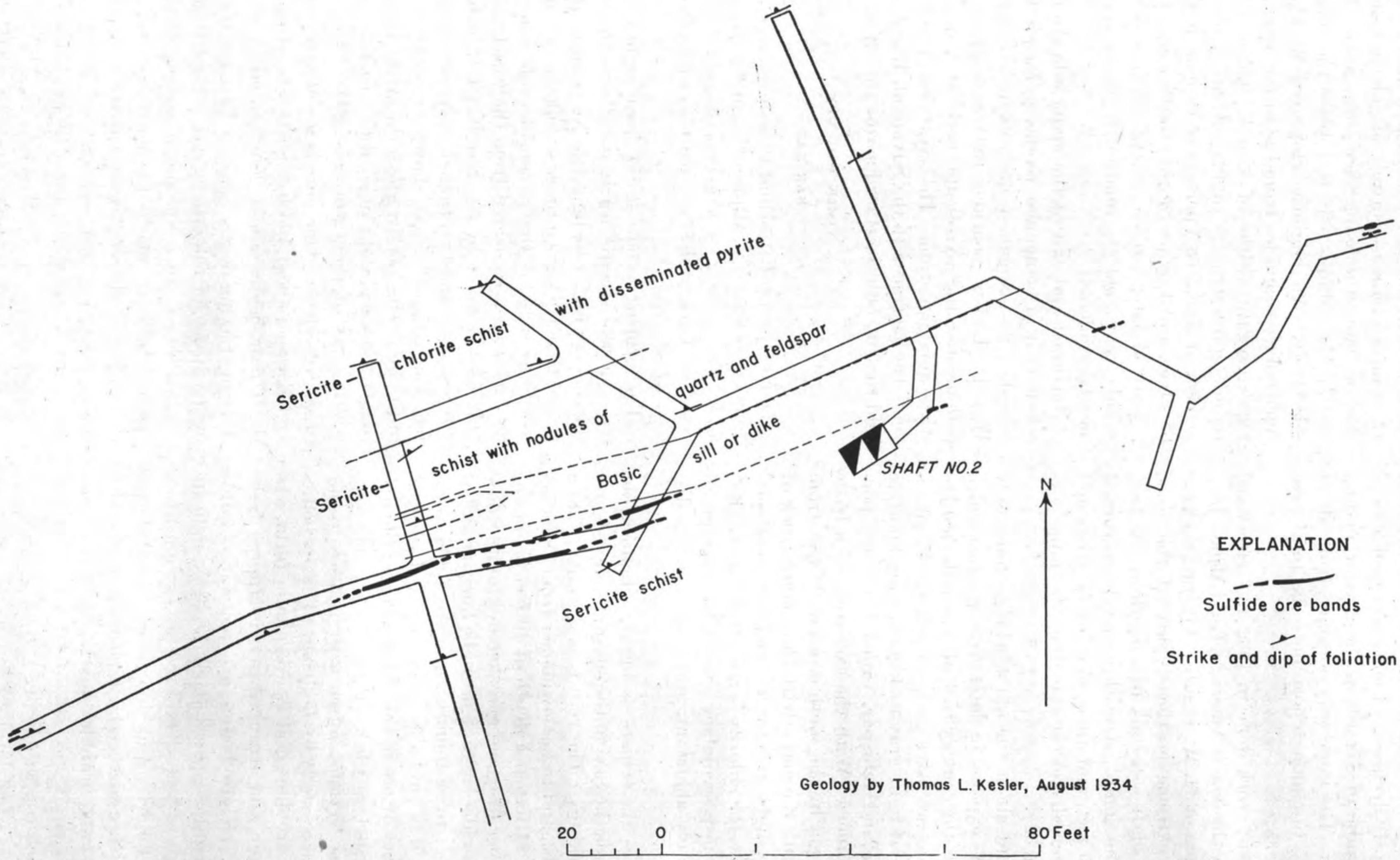

FIGURE 32.—Plan of 175-foot level, Dorn mine, McCormick County, S. C.

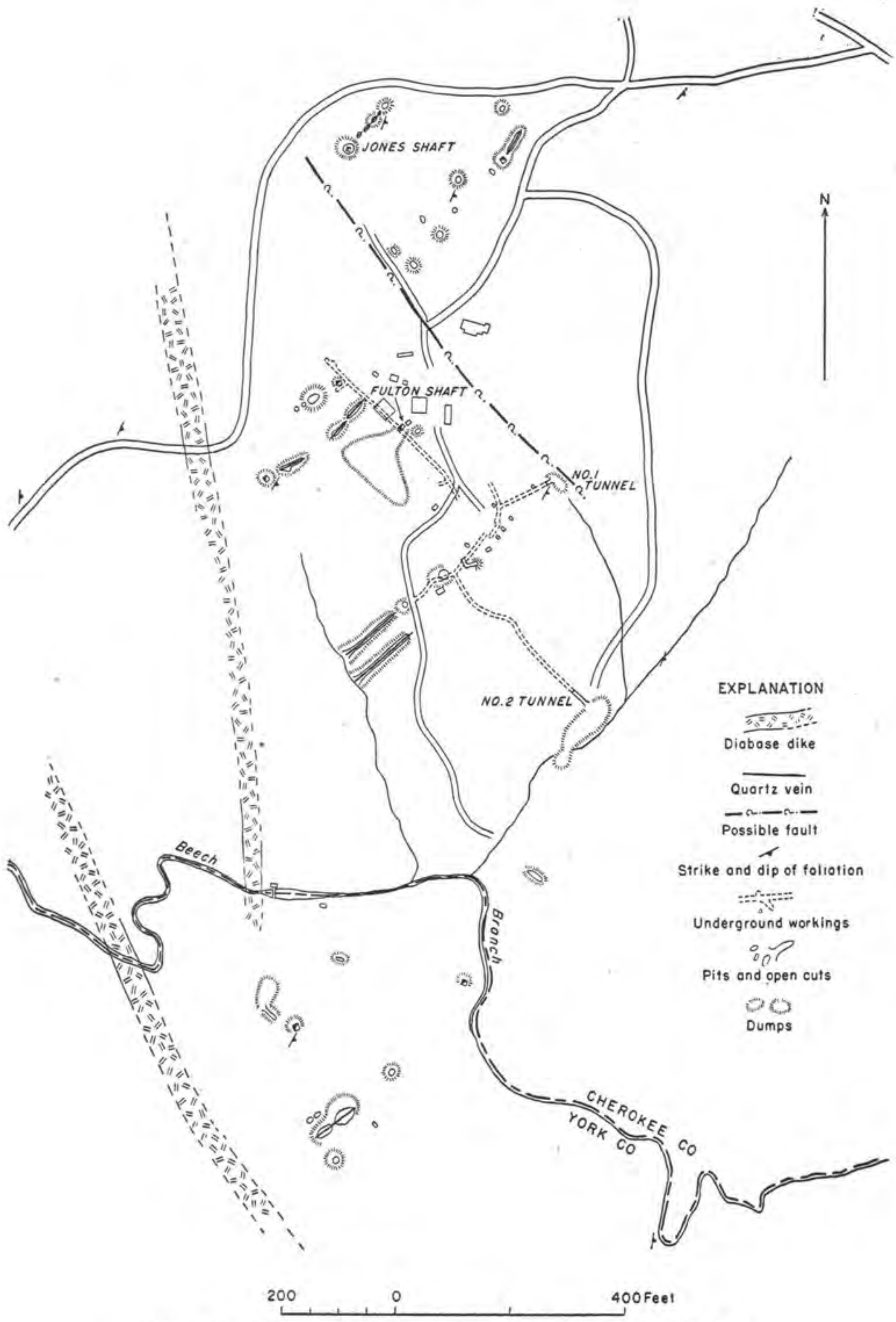

FIGURE 33.—Map of Bar Kat mine, Cherokee and York Counties, S. C.

scattered bunches of pyrite. A level extending northwestward penetrates a wide zone of breccia cemented with quartz and with veinlets of a manganese-bearing carbonate. This zone appears to represent the pair of veins exposed at the surface 100 feet northwest of the shaft. The tunnels explore the pair of veins south of the shaft and show them to contain local concentrations of pyrite below the weathered zone. Samples that consist largely of pyrite cobbed from these veins assay from 0.5 to 5 ounces or more of gold to the ton.

DICKEY

The Dickey or Allison mine is 0.7 mile north of Smyrna and 1,000 feet east of Canaan Church. Early prospecting on the deposit was confined to the immediate vicinity of a prominent outcrop of vein quartz

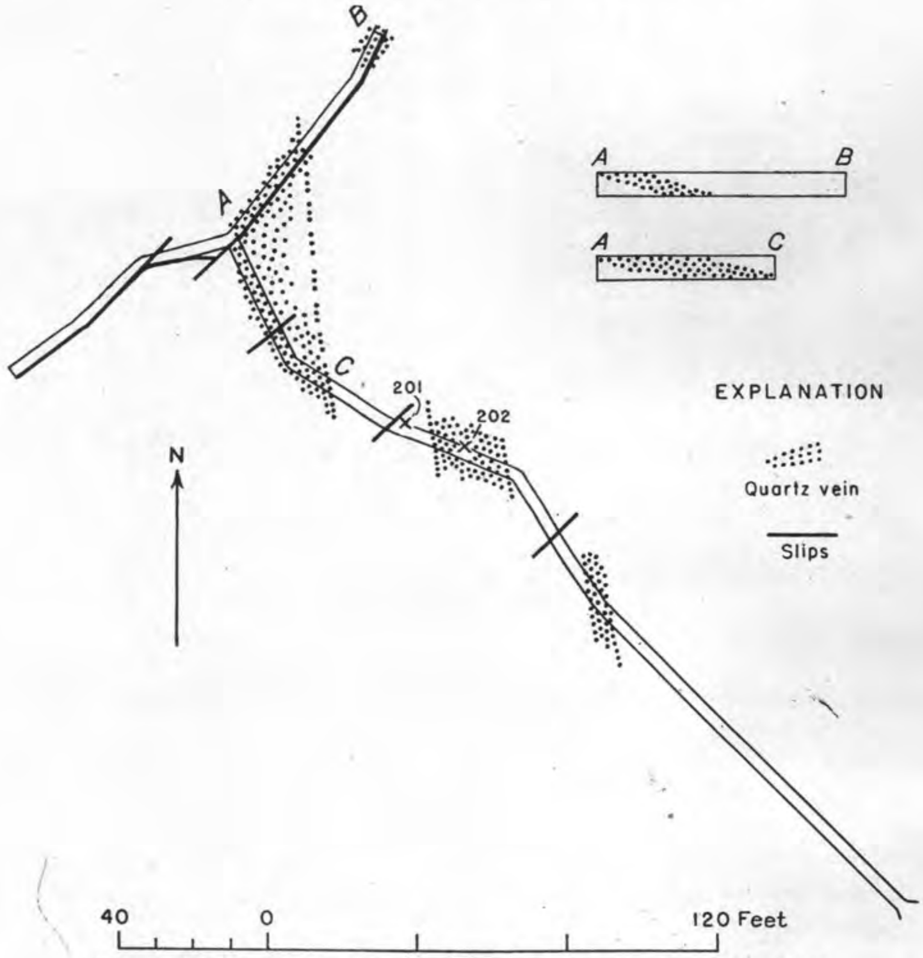

FIGURE 34.—Plan and sections, No. 2 tunnel, Bar Kat mine, York County, S. C.

containing irregular bodies of iron oxide. The workings examined in 1934 consist of two tunnels one 85 feet and the other 350 feet in length driven southward from the valley of a small stream. The tunnels follow sharply defined stringers and veins which locally pinch and swell. For the most part the veins strike N. 43° E., parallel to the layering of the wall-rocks, but they cut across it in places. They contain thin remnants of the wall rocks, consisting of partly silicified sericite schist. As exposed throughout both tunnels, the country rock is made up of parallel layers a fraction of an inch to several feet in thickness but mostly less than 6 inches thick. The layers dip in undulatory fashion from 30° to 60° southeast. They are sharply defined and differ distinctly in color. Their prevailing colors are white, buff, brown, light gray, dark gray, and greenish gray. Sericite has crystallized parallel to their surfaces.

The ore consists of masses bearing pyrite and iron oxide, within the veins. Owing to a lack of pronounced general silicification, and of recrystallization beyond the stage at which sericite is formed, the wall rocks are weak and cave readily in mining.

At most places in the Smyrna mining district there is no direct evidence regarding the relation between foliation and original rock structures. The veins are usually found in the more coarsely crystalline rocks, particularly those which are granitic in general character.

OTHER PROPERTIES

The dumps of two pits at the Barnett mine, about 2 miles northwest of Nanny's Mountain, contain several tons of vein quartz with iron oxides.

The Brown mine, described by Graton in 1906, is 3 miles southwest of Hickory Grove. It contains a 3-foot quartz-pyrite vein that was exploited before 1905 and yielded considerable gold ore. The vein is made up of overlapping segments a few feet apart.

Two shafts at the Cassady mine, 1¼ miles southwest of Smyrna, are sunk to a depth of 20 feet on branching veins that strike N. 10° E., parallel to the foliation of the granitic country rock. Ore from the veins consists of quartz enclosing pyrite and chalcopyrite, which tend to be arranged in bands.

The Campbell mine, 1½ miles northeast of the Jingles, consists of several pits on an outcrop of rather barren looking quartz 150 feet or more in length.

The Darwin mine, about 3 miles west-southwest of Smyrna, is mentioned by Graton [83] as an "old mine" at

[83] Graton, L. C., Reconnaissance of some gold and tin deposits of the southern Appalachians: U. S. Geol. Survey Bull. 293, p. 106, 1906.

which little was to be seen except the outcrop of a northeast-trending quartz vein 5 or 6 feet wide. In 1910, ore containing gold, silver, and copper was reported [84] to have been shipped from this mine in the previous year. At that time the workings included a shaft 76 feet deep. An aggregate production of 201 ounces of gold, recovered from 214 tons of ore—about 0.94 ounce per ton—was reported [85] for 1909 and 1910. In 1934 no evidence of recent work was seen and only barren-looking quartz remained scattered about the workings.

The Dorothy mine, a short distance northeast of the Schlegelmilch mine, consists of several old pits and caved shafts distributed for a distance of 500 feet. The dumps contain considerable quartz with iron oxides.

At the Ellis mine, 1.3 miles northeast of the Ferguson mine, a tunnel is driven 125 feet on a vein that strikes N. 45° E., ranges from 1 to 2 feet in width, and consists of quartz with a considerable amount of pyrite and chalcopyrite.

The Ferguson mine, in the northwest corner of York County, about 3 miles west of Bethany Church, contains several pits and five old openings recognizable as caved shafts. From descriptions by Keith [86] and Graton,[87] it appears that ore consisting of pyritiferous vein quartz fairly rich in gold was found in four roughly lenticular bodies bordered by mineralized, silicified schist constituting ore of lower grade. Associated minerals were calcite, magnetite, and ilmenite. The country rock is a schist containing layers rich in hornblende. The workings are distributed for a quarter of a mile along a northeast-trending belt parallel to the schistosity. In 1912 a production of 30 ounces of gold from 32 tons of ore was reported.[88]

The Hardin mine, 1½ miles southwest of Smyrna, consists of shafts and pits said to have been worked for a few years following 1908. In 1934 a small amount of ore, consisting of quartz enclosing iron oxides remained on the dump.

At the Horn mine, about 2 miles northeast of the Ferguson mine, three recently (1935) excavated shafts expose silicified schist cut by many stringers of quartz and enclosing some larger bodies of glassy quartz containing pyrite and chalcopyrite. In 1915 a production of 102.56 ounces of gold from 67 tons of ore was reported.[89]

At the Jingles mine, 2½ miles northeast of the Barnett, several pits and a trench 150 feet long expose vein quartz containing oxides of iron and some pyrite.

At the G. W. La Peire prospect, about 4 miles southwest of Smyrna and 1¼ miles south of the Darwin mine some small pits and a 20-foot shaft had recently (1934) been excavated. These workings explore a group of quartz-pyrite veins, which trend northeast, parallel to the foliation of the granitic country rock.

The Love mine, described by Graton in 1906, is a mile southeast of Kings Creek. It is on a northeast-trending quartz-pyrite vein, 3 feet wide, in schist. Inclined shafts 30 to 50 feet deep were sunk in it at intervals for 1,000 feet. The vein contains pyrite cubes, some of them as much as 1 inch across. A production of several carloads of ore was reported.

On the Magnolia property, about 2 miles west of Hickory Grove, a crosscut tunnel and other development workings were made in 1934 by Myers and Austerman, and the tailings from an old mill were treated with cyanide for the recovery of gold. Old surface workings expose, for a distance of 700 feet, a quartz lode trending N. 30° E., in places 50 feet wide. A wavy or contorted banding in the quartz suggests that it has replaced the schist country rock. Irregular areas and streaks of iron oxide appear in places, and at one place the recent (1934) workings exposed a streak a foot or more in width containing much chalcopyrite; elsewhere, however, the lode is nearly pure quartz.

The McCaw mine described by Graton in 1906, is 2 miles southwest of Smyrna. It is on a quartz vein 2 feet wide that strikes N. 50° E. and contained pay ore in bunches.

The McGill mine, described by Graton in 1906, is on the northeast extension of the Ross and Carroll lode. It has yielded pockets of ore rich in sulfides.

The Mercer mine, 1½ miles west of Hickory Grove, includes several pits made on a group of veins striking N. 70° E., in foliated granite. The vein rock consists of quartz enclosing pyrite and chalcopyrite.

At the Parker mine about a mile southwest of the Magnolia mine, several old pits and trenches expose a northeast-trending zone that contains a group of parallel quartz veins. A sample of the quartz with iron oxides found on the dumps and assayed in the laboratory of the Geological Survey showed 0.32 ounce of gold per ton. In 1911 a production of 183.82 ounces of gold from 300 tons of ore was reported.[90]

The Ross and Carroll or Wolf Creek mine, 3 miles southwest of Symrna, was mentioned by Graton [91] in 1906 as being on a vein 2½ feet wide (which forms a ridge) and is opened up for a quarter of a mile by several pits. Ore containing pyrite had been treated in a stamp mill but the recovery was low. Considerable quartz containing iron oxides and some pyrite lay on the dumps in 1934.

Workings of the old Schlegelmilch mine, about 2½ miles northwest of Hickory Grove, extend northeast for about 1,000 feet along a belt parallel with the foliation

[84] Mineral Resources, U. S., 1910, pt. 1, p. 688.
[85] Mineral Resources, U. S., 1909, 1910.
[86] Keith, Arthur, and Sterrett, D. B., U. S. Geol. Survey Geol. Atlas, Gaffney-Kings Mountain folio (No. 222), p. 8, 1931.
[87] Graton, L. C., op. cit., pp. 96–99.
[88] Mineral Resources U. S., 1912.
[89] Mineral Resources, U. S., 1915.
[90] Mineral Resources, .U S., 1911.
[91] Graton, L. C., op. cit., p. 106.

of the country rock, which is amphibolite schist. They include a large number of pits, three of which are recognizable as shafts choked by caving. Only a moderate amount of quartz remained on the dumps in 1934.

The mine was described by Graton [92] (1906). According to him the workings include a shaft 100 feet deep with drifts on a quartz vein that strikes N. 35° E., parallel to the foliation of the enclosing rock. Near the surface the vein is fairly regular and about 2 feet wide. Below 70 feet it is separated into lenslike segments, which Graton illustrates by a sketch made at the 85-foot level. The quartz carries gold-bearing pyrite. Next to the vein the wall-rock is altered, as shown by the development of sericite, calcite, biotite, and chlorite, and of scattered cubical grains of pyrite. The vein was stoped above the 45-foot level for a distance of 200 feet. It is said to have pinched out at the bottom of the shaft. The other veins, northwest of the one described and parallel to it, were worked to some extent.

At the Smith mine, about 3 miles southwest of Smyrna, development work, probably in 1926 or 1927, includes a shaft, which was not accessible in 1934. It is said to be 100 feet deep and is equipped with a gasoline engine, hoist, compressor, etc. The dump contains quartz with iron oxides.

At the Terry mine, about 2 miles west of Smyrna, development work was being done in 1934 under the direction of H. A. Guess. Old open cuts at least 600 feet in aggregate length expose two parallel northeastward-striking veins in the Carolina gneiss. The extent of these old workings indicates that considerable gold may have been produced from the weathered zone. The work in 1934 was being done from a shaft 140 feet deep near the southeast or main vein; a crosscut had been driven to the other vein and both had been drifted upon. As exposed on the 135-foot level the veins are well defined, are from 1 to 4 feet wide, and consist of quartz with streaks and bunches of gold-bearing chalcopyrite and pyrite.

On the Wallace No. 1 property, 1.7 miles north of Smyrna, a shaft was sunk 60 feet in 1934, and two 50-foot drifts in opposite directions were driven from the bottom. These workings explore a quartz vein, 2 to 4 feet thick, that strikes N. 33° E., parallel to the foliation of the gneissic wall rock, with which it is also conformable in dip. The walls of the vein, though relatively clean-cut, are interrupted by short tabular veinlets that extend from the main vein at right angles. In the faces of both drifts the vein is broken into angular bodies connected by thin seams.

The vein quartz, which is coarse and vitreous, encloses detached fragments of wall rock and erratically distributed pyrite. Inclusions of chlorite, biotite, and platy magnetite are common, and there are bodies of calcite, mostly along the walls. All these minerals occur, though less abundantly, in the gneissic wall rock.

The Wallace No. 2 property, about 3 miles northeast of York, contains two sets of workings. One consists of 14 pits and trenches, distributed along a northeast-trending belt for a distance of 1,200 feet or more. The other set, comprising about half as many openings, is a continuation of the same belt that begins about 1,500 feet farther northeast. The trend of the belts is about N. 10° E., and the workings are on a group of quartz veins that lie parallel to the northeast-striking schistosity of a granitic rock.

At the Wheat mine, about 4 miles west-southwest of Smyrna, more or less vein quartz, enclosing iron oxides and pyrite, remains on the dumps of several old pits.

The Wilson mines, 6 miles northeast of York, were described by Graton [93] in 1906, largely on the basis of information supplied by C. W. Latimer, who was in charge of the property at the time.

The Wilson mine was opened in the 1840's, and the ore worked in an arrastre-type mill, the sulfide-bearing rock being first roasted. Since then the mine has been idle except for two periods, one in 1885–86 and the other in 1896, during which nearly $39,000 was recovered with the aid of stamp mills. The workings, said to be 90 feet deep, are distributed along a belt 100 feet wide and 500 feet long, in an area of slatelike rocks resembling the volcanic series. The main vein is described as 4 feet or more in width, and is said to contain abundant chalcopyrite in places.

The Little Wilson mine, about a mile southwest of the Wilson, is in a large body of quartz that, as observed in a 90-foot shaft, contains finely granular pyrite arranged in rude bands parallel to the walls.

GEORGIA MINES

LODES AND RESIDUAL PLACERS

The gold deposits of Georgia are widely scattered, but all are in the northern part of the State. Approximately 500 properties are reported to contain gold in lodes or placers, or both. Plate 38 shows the distribution of the known deposits, and the table below lists the known deposits, by counties, giving their location as well as could be determined. Much, but not all, of the land in northern Georgia is divided into large districts, which are further subdivided into lots of 40 or 160 acres each. Most of the available lot maps are inaccurate, and lot corners are rarely known to local people, and rarely found in the course of field work. On the map, plate 38, it is not feasible to show the locations of the deposits by lots. Fortunately it is otherwise with the land net near Dahlonega, in Lumpkin County, which has been resurveyed by Prof. J. C. Barnes, of the North Georgia College, and marked with permanent corners.

[92] Graton, L. C., op. cit., pp. 101–103, fig. 14.

[93] Graton, L. C., op. cit., p. 107.

Most of the gold-bearing areas in northern Georgia are in Lumpkin County, which is probably more widely known for its gold deposits than any other part of Georgia. At most of the lode mines of northern Georgia the first work was done by hydraulic or other operations that come under the head of placer mining. The upper parts of the lodes were in the saprolite zone and were worked as residual placer deposits, but at the base of the saprolite these deposits graded into solid lodes. The lodes and the closely related residual placer deposits are therefore described together. Alluvial placers are grouped separately.

Georgia gold localities

[Asterisks indicate properties not visited]

County	Name	Location (lot No.)	District
Bartow	Allatoona mine (Tudor)	928-929, 948	21
	Avery*	947	21
	Eiseman*	Next to Robertson	------
	Glade prospect	878-879	21
	Goings property*	808	21
	Gold Branch placer	947-948	21
	Howard*	1224	21
	McDaniel prospect	1075	21
	Robertson*	1097	21
Caroll	Astinol*	Next to the Clompton	------
	Bonner prospect	94, 99	11
	Chambers prospect	195	6
	Clompton (Clopton)	194	6
	Davis prospect	4 miles southwest of Villa Rica.	------
	Hart prospect	165	6
	Hixon prospect	166	6
	Jones placer	189	6
	Lassetter prospect	187	6
	Southern Klondyke	194, 223	6
	Stacy prospect	158, 163 ?	5
Cherokee	Bailey property*	971	15
	Bell property*	900	15
	Bentley prospect	104 (?)	21
	Burt's prospect*	Northeast of lot 805	3
	Burty prospect No. 1	738-739	3
	Burty prospect No. 2	776	3
	Casteel property*	204	15
	Cherokee mine	428	15
	Clarkson prospect	225	15
	Coggins (Case & Campbell)	210-211	15
	Cox property	1½ miles west of Creighton mine.	3
	Creighton (Franklin) mine	398, 465-466, 473	3
	Culp property	301	15
	Evans (Cobb)	792-793	15
	Georgianna prospect	989, 990	21
	Granville prospect	1027	21
	Haynes prospect No. 1	348-349	15
	Haynes prospect No. 2	208-209	15
	Keeter placer	276-278, 227-230	15
	Kellogg prospect	1113	21
	Kitchens prospect	823, 834	21
	La Belle prospect	157, 204-205	15
	Latham (Chester) prospect	804-805	3
	Latham (Stringer) prospect	1 mile northwest of Union Hill.	3
	Lovingood prospect	431	15
	Macou prospect	158	15
	McCandless prospect	61	15
	McGill property	234	14
	McLain property	721, 723	21
	M. D. Smith prospect	731-732, 709, 782, 753, 853	15
	Nesbit prospect	205-206, 228, 277	2
	Old Bell cut	834	21
	Owl Hollow (Davis) prospect.	22	15
	Poor prospect	825-827	21
	Priest placer	935, 938, 1007	21
	Putnam placer	350	15
	Richards property*	Opposite side of Fowler Creek, at Sandow prospect.	3
	Roach prospect	North of Whorley prospect	15
	Rudicil prospect	10	2
	Sandow prospect	741	3
	Sixes	150, 212, 221, 284	15
	Southern Star (Cox) properties.	901	21
	Standstill property*	848	20
	301 (Farrar) mine	301	15
	Tripp property*	959	21
	Turner prospect	804	2
	Westbrook placer	157-158	2
	Whorley prospect	459-460, 405-406, 478	15
	Williams property	1120	21
	Williamson placer	1020	21
Cobb	Fisher prospect	300	16
	Freeman mine	Part of same operation as Hathaway and Kemp mine.	20
	Garrison property	65	20
	Hamilton prospect	14	20
	Hathaway and Kemp properties.	50	20
	Mason prospect	342	20
	Payne, Kendrick, Randall, and House properties.	49, 50, 66, 67	20
	Van prospect	24	20
Coweta	Bingham property	3½ miles southeast of Moreland, on Bear Creek.	------
	Bowers prospect	3 miles southeast of Moreland.	------
	Clarke and Hill property	5 miles northwest of Welcome at bend in Chattahoochee, northwest corner of county.	------
	Hardagree property*	3 miles down Chattahoochee from Clarke property.	------
Dawson	Baby placer	442, 480-482, 491-492, 542	13
	Barrett (Dolly McGehee)	1068 (?)	4
	Church lot	304	13
	Crawford property	1¼ miles northwestof Barrettsville.	------
	Dawson gold mines	Etowah River, north side near Ochonal Bridge.	------
	Ellsworth (Fraction) properties.	547, 554, 559, 564	13
	Emerson property (placer)*	McClure Creek	------
	G. E. Russell property	435	13
	Hammond prospect	321 (?)	13
	Hayes prospect	1¾ miles west of Kin Mori mine.	------
	Howard prospect	442, 446, 472, 507, 434	13
	Kin Mori mine	861-862, 908-911, 926-929, 976-979.	4
	Long property	2¼ miles southeast of Dawsonville.	------
	Looper property	1041	4
	Magic prospect*	369-370, 376, 424-425, 432, 483, 490.	------
	McGuire prospect	912, 925	4
	McIntosh placer*	East of Palmour prospect	13
	Missing Link prospect	427, 431	13
	Morse property*	West bank of Etowah River, near Lumpkin County line	------
	Palmour prospect	323, 325, 360-361, 380-383, 416-418, 438-439.	13
	Scott (Old Steele) property	4⅕ miles west of Dawsonville.	------
	Shelton prospect	239, 241	13
	Spike Hill prospect	425 (?)	17
	Thompson property	3⅓ miles south of Dawsonville.	------
	Turner prospect	376	13
Douglas	Bagget property	1 mile east of Winston	------
	Carnes property	1 mile west of Winston	------
	McManus property	205	2
	Owen prospect	181	2
	Pine Mountain mine	206	2
	Prospect	1¾ miles northeast of Villa Rica.	------
	Roach placer (Fowler)	11, 1 mile south of Hico	2
	Triglone placer	181, 204	2
	212 prospect	212	2
Elbert	Brown property	3 miles southwest of Bowman.	------
	Ginn placer	2 miles northwest of Bowman.	------
	Hall, Moss, and Pulliam placers.	Headwaters of Dean Creek near Bowman.	------
Fannin	Granny Hill (Ganet) prospect.	Ridge south of Noontootly Creek.	------
	Hackney placer	1 mile west of Blue Ridge	------
	Rantze Hill property	287	7
Forsyth	Ad Campbell property	Not on map	1
	B. L. Fowler property	434-435 (?) 1 mile northwest of Herdsville.	3
	Buice property	1081	2 (?)
	Charles prospect	77	3
	Collins and Adams prospect	484 (?) 2⅓ miles northeast of O'Cee.	1
	Cowpens Branch placers	Cowpens Branch	1
	Faver prospect	701 (?)	2
	Little prospect	406 (?)	1
	Lyons lot	1259 (?)	3
	Montgomery prospect	5 miles southeast of Cumming.	------
	Settles property*	934, Not on map	2
	Strickland prospect	867-868	3
	Suwanee Mountain property.	1054 (?)	3
	W. T. Fowler placer	1193	3
	Young Deer Creek placer	Young Deer Creek	14
	Zamoda gold prospect	1194 (?)	3
Fulton	Fuller prospect	2 miles east of Roswell	------
	G. W. Green placer prospect	255	1
	John Creek placer tributary	1½ miles north of Warsaw	------

Georgia gold localities—Continued

County	Name	Location (lot No.)	District
Fulton	Little and Goodwin property.	38	17
	Lizzard Lope School prospect.	662. 1½ miles southeast of Lebanon Bridge.	
	Mason (Gold) lot	614. 2 miles east of Roswell.	
	McClure prospect No. 1	255	1
	McClure prospect No. 2	337	1
	Nunnaly prospect	257	1
	Prospect	3 miles east of O'cee	
	Roberts estate	38 (?)	17
	Seven branch and Gold mine branch.	2½ miles east of Roswell	
Gilmer	Cartecay (Lucky Eight) property.	139	6
	Holt placer	South of White Path mine on Little Turniptown Creek.	
	Prospect	288	7
	Turkey Pen property*	Not on map	7
	Whitaker property*	236	10
	White Path mine	271	10
Greene	Prospect	4½ miles northeast of Union Point.	
Gwinnett	Brogden prospect*	258	7
	Harris prospect	273	7
	Hawking placer	272 (?)	7
	Level Creek placers	Level Creek	
	Moore and Brogden property.	319	7
	Owens prospect	259	7
	Piedmont (Newton) prospect.	304 (?)	7
	Richland Creek placers	Richland Creek	
	Roberts property*	253	7
	Shelly property	290	7
	Suwanee (Percy, Simmons, Level Creek) prospect.	289 (?)	7
Habersham	Bean property*	In Clarkeville town limit	
	Black kyanite placer	24	12
	Bowen placer	60	10
	Crow Heirs placer	55, 62	10
	Crow Heirs prospect No. 2	60, 61	10
	Crow prospect*	57 Not on map	10
	Edwards property	147	3
	Hood (Habersham, Holland) placer	22	13
	LaPrade placer	35	11
	M. F. Wilson placer	19–21	13
	Nichols placer	92, 120	12
	Soque River placer	63	11
	Tailor Wood prospect	64	11
	U. S. Forest land—placers	27, 28	11
	Weikle Brothers prospect	30, 31	11
	Willbanks property*	Not on map	11
	Wilson placer	28	11
Hall	Banks property	3 miles northwest of Flowery Branch.	
	Big Joe prospect	61	11
	Black Hill prospect	1 mile northeast of White Sulphur.	
	Boggs prospect	35, 37	11
	Brenau College land	138. 1½ miles south of White Sulphur.	9
	Byrd prospect	156	9
	Cool Spring Church prospect.	31	10
	Currahee prospect	½ mile north of White Sulphur.	
	Dean prospect	138	9
	Elrod mine	100, 103, 104	10
	Glades prospect	100	12
	Gould prospect No. 1	86–87	10
	Gould prospect No. 2	5	8
	Ivy Mountain prospect	104	10
	Johnson property*	72	9
	Jones prospect	131, 139	9
	Longstreet prospect	130	9
	Mammoth prospect	2.3 miles south of White Sulphur.	
	Maynas prospect	1 mile south of White Sulphur.	
	McClesky prospect	5, 16	8
	Merck prospect	129	9
	Moore prospect	131 (?)	9
	Muddy Creek prospect	3½ miles west of Oakswood	
	Odom prospect	111	11
	O'Shields prospect*	127	9
	Parks prospect	31	11
	Pass property	133	10
	Potosi prospect	85	11
	Prater placer	123	10
	Rogers and Anderson prospect.	156	9
	Savage placer	122–123	12
	Smith prospect	82, 87	11
	W. P. Smith	127–128	
	Stockeneter Creek placer	116–117	12
	Stowe prospect	124	9
	University of Georgia land	116	12
		110	11
	Vickers prospect	½ mile northwest of Oakwood.	
Haralson	Dean placer	23	7
	Edwards placer	63–64	8
	Hollis prospect	134	8
	McBrayer property	1207, 1230	20
	Pole Branch placer	16–17	7
	Royal Gold Mine (Holland)	134	8
	Thomason property	127	7
Hart	Bowers prospect	1 mile southeast of Canon	
	Brown prospect	3½ miles southeast of Royston.	
	Hays placer	2½ miles east of Canon	
	Winter placer	2 miles east of Canon	
Henry	Walker property	68–69	7
Lincoln	Bussey prospect	2½ miles east of Double Branches.	
	Dill prospect	¼ mile northeast of Clay Hill Post Office.	
	Edmunds prospect	1¼ miles south of Amity	
	Julia (Phelps, S. K. Dill) property.	½ mile north of Little River.	
	Paschal prospect	¼ mile south of Clay Hill Post Office.	
	Ramsey place	1 mile east of Raysville	
	Rivers property	¼ mile east of Raysville	
	Sales (Lamar) property	2½ miles west of Goshen	
	Samuels place	1½ miles northeast of Double Branches.	
	Seminole mine	2¼ miles east of Metasville	
Lumpkin	Baggs Branch placer	207, 266	13
	Barlow mine (Pigeon Roost)	741, 743–748, 789, 793–795, 797–798.	12
	Barsheba Woody	725	12
	Bast mine	1035	12
	Battle Branch mine	456, 523, 524	12
	Beers property	South side Chestatee River across from Boley Field property.	
	Belle prospect	89	13
	Benning prospect	1031–1053	12
	Betz mine (Wing)	453–454, 459	12
	Bluffington prospect	Near or on 512	15
	Boly Field property	1182	12
	Bowen lot	931	12
	Boyd	½ mile northeast of McDonald prospect.	
	Briar patch placer	169, 170	11
		1191–1194, 740, 801–803, 808–809, 878–880, 871–873.	12
	Bunker Hill	1 mile east of Barlow mine	
	Calhoun mine	164–165	11
	Capps prospect	8[illegible]0	12
	Cavender Creek property	360–361, 373, 376–377, 386, 388–391, 400, 424–425, 432, 454–455, 458, 311, 323–324, 333–334, 344, 346–348.	15
	Chestatee placer	144–146, 167	11
		1041–1042, 1092, 1186–1187	12
	Cleveland property	208	13
	Columbia propsect	988	12
	Consolidated mine	999, 1032	
	Conway lot *	435	13
	Cora Lee property	433	15
	Crescent prospect	953–955	12
	Crown Mountain mine	947–948, 986, 987, 989	12
	Danae prospect *	West side Etowah River, below Topabri property.	
	Dry Hollow prosepct *	126	11
	Duncan Branch placer	108 (?)	13
	Early	Long Branch ¾ mile southwest of Skyrme prospect.	
	Etowah property	116–120 141–142, 155, 178–179	13
	Findley mine	1047–1048, 1087	12
	Fish trap prospect	932–934, 944–946, 964	12
	Free Jim property	988	12
	Garnet prospect	330–331, 350–359, 378–379, 403–404, 439, 450–451.	15
	Gold Hill prospect	15, 51, 52, 79	13
	Gordon property	609, 679, 680, 720–721, 750–751, 791–792.	12
	Greenfield prospect	386	12
	Griscom prospect	996	12
	Hedwig property (Chicago and Georgia).	527–529, 530, 591–594, 599–601, 660–663, 669, 670.	12
	Hightower prospect *	Near or on 1213	12
	Horner prospect	855	12
	Ivey mine	819, 820–821, 860, 861	12
	Jones prospect	512	12
	Jumbo prospect	374–375	15
	Keystone prosepct	Cane Creek, below old Barlow mill.	
	Lawrence (Street) prospect	951	12
	Liberty Bell property	20–22, 44–46, 85–88, 108–110	13
	Lockhart prospect	1050, 1085–1086	12
	Long Branch property	Long Branch	11
	Mary Henry prospect	1030	12
	McAfee-Lynn (Rutherford) prospect.	Northwest of Briar Patch property.	
	McDonald prospect	2 miles northeast of Dahlonega.	12
	McIntosh prospect	386	12
	Miller placer	253	13
	Norrell-Stewart prospect	736, 805	12

Georgia gold localities—Continued

County	Name	Location (lot No.)	District
Lumpkin	Old Columbia	¾ mile south of Findley mine.	------
	Parker lot	77–78	13
	Preacher mine	995	12
	Ralston property	726, 728, 731	12
	Reliance Mining Co. property.	527–529, 592–594, 599, 662–663, 669.	12
	Rider prospect	1058	12
	Rufus E. Wood property	312, 325–326, 466–467, 484–487, 495, 497, 510–511, 335.	15
	Saltonstall	659 (?) (at Auraria)	12
	Saprolite prospect	50–51, 80–81	13
	Shockley lot	891	12
	Singleton (Standard) property.	1083–1084, 1051	12
	Skyrme prospect	On Long Branch, 3 miles southeast of Dahlonega.	------
	Smith prospect	1¾ miles east of Auraria	------
	Stegall placer*	Near Saltonstall mine	------
	Tahloneka Branch placer*	Tahloneka Branch	------
	Tanyard Branch placer	986, 997, 1034, 1086	------
	Teal prospect	122	1
	Todd lot	930	12
	Topabri (Josephine) property.	526, 595, 1215	12
		17, 18, 48–49, 82	13
	Turkey Hill prospect	163–164	11
	Wells prospect	1213	12
	Whim Hill property	670	12
	White Rabbit	¼ mile north of Ivy mine	------
	Woods prospect*	Near Auraria	------
	Woodward prospect*	West of Briarpatch property	------
	Yahoola prospect	1052	12
Madison	Carrington place (placer)	4 miles north of Pooli	------
	C. M. Smith placer	2 miles north of Pooli	------
	Parham, Ridgeway property	3¼ miles north of Pooli	------
	Webb-Threlkeld-Oliver property.	2½ miles north of Pooli	------
McDuffie	Columbia (includes Hamilton and Motes properties) mine.	13 miles southeast of Washington.	------
	Edwards, Balbach, and Gerald prospect.	Southwest McDuffie County	------
	Griffin prospect	3½ miles northeast of Columbia mine.	------
	Henrick prospect	Just east of Columbia mine	------
	Landers prospect	¼ mile north of Parks property.	------
	Parks property	¾ mile east of Columbia mine.	------
	Porter prospect	¾ mile north of Parks property.	------
	Raysville Bridge	200 feet west of bridge across Little River at Raysville.	------
	Tatham property	2 miles northeast of Columbia mine.	------
	Woodall prospect	½ mile north of Tatham property at Flint Hill Church.	------
Meriwether	Lone Oak prospect	These properties are about 3 miles west of Luthersville. Property lines unknown.	------
	Post prospect		
	Wilkes prospect		
Morgan	Parker prospect	2 miles east of Rutledge	------
Murry	Cohutta prospect	257	26
	Gold Mine Creek and Chicken Creek placers.	Near Cohutta prospect	------
Newton	Middlebrook's placer	5 miles south of Covington and west of Yellow River.	------
Oglethorpe	Arnold propsect	4½ miles west of Triplett	------
	Briscoe prospect	3½ miles northeast of Bairdstown.	------
	Buffalo (Howard)	5 miles southeast of Lexington.	------
	Carl Thaxton prospect	8 miles east of Stephens	------
	Drake prospect	4 miles northeast of Bairdstown.	------
	Fluker-Story prospect	Adjoins Guarantee prospect.	------
	Guarantee prospect	6½ miles southeast of Lexington.	------
	Morgan prospect	do	------
Paulding	Austin prospect	984	2
	Barton prospect	334–369	19
	Dunnaway prospect	375, 418	3
	Greenfield property	444–445, 467	19
	Hobbs prospect*	713; not on map	3
	Hodges prospect*	655	3
	H. W. Brown prospect	932	3
	Mathews prospect*	108	3
	Nelson Dockery prospect (placer).	713–4	3
	Placer*	2 miles southwest of Huntsville on a small tributary of Raccoon Creek.	------
	Schofield prospect	1118	18
	Sheffield (Heidt) property	786	3
	Twillery (Dockery) placer	713–714	3
	Yorkville prospect	331	19
Rabun	Barclay prospect*	Persimmon Creek about 8 miles from Clayton.	------
	Blalock placer*	Tallulah river near Burton	------
	Bowers placer	44	3
	Bright Evans prospect	82	13
Rabun	Dillard placer	189	1
	Hamby placer	31, 43	3
	Hedden placer	101, 109	3
	H. W. Bentley prospect	44	1
	Lamar placer	30	3
	Ledford placer	176	1
	Ledford prospect	32	3
	Moore Girl prospect	58–59	1
	Page property	44–45	3
	Powell prospect	102	5
	Reeves prospect	108	5
	Rocky Bottom Smith placer	Flooded by Burton Lake	------
	Screamer Mountain placer	6	2
	Smith prospect	103	5
	Stone Sypher prospect	105	5
Towns	Brown prospect	19	9
	Chastain branch placer	136	18
	Eller prospect	102	18
	E. R. Brown	93	17
	Hooper and Berong prospect	61	18
	Horse vein	1	17
	Kerby prospect	65	17
	Malden prospect	99	17
	Murdock (Hiawassee Mng. Co.)	33, 42	17
	Nancy Brown	34	17
	Newton placer	131	18
	Old field prospect	3	17
	Pittsburg prospect	38	9
	Skeet Hooper placer	102	18
	Smith placer	94	18
	Struby prospect	67	17
	Willis Creek placer*	102	18
Union	Brown prospect	109	9
	Butt prospect	272	9
	Coosa Creek placer and lode	88–87, 93–95, 124–125, 192, 130	9
	Crumly Creek placer	Northeast of Owl Town Gap	------
	Gum Log prospect	52	9
	Hunt (Princeton) prospect	55	9
	J. H. Brown prospect	57	9
	Killian prospect	214	17
	Killian and Rhodes prospect	213	17
	Lot 20	20	9
	Legal tender prospect	304	9
	Martin prospect	½ mile south of Chapman Ford.	------
	Mauney prospect	174	9
	Old diggings	184	17
	Rogers and Stevens property.	About 2 miles northeast of Butt prospect.	------
	Ross prospect	2¼ miles northeast of Blairsville.	------
	Stannick prospect	110	9
	Teague prospect	107	9
	Wellborn Hill prospect	18	9
	Wellborn prospect	228	9
	Wellborn-Robinson prospect.*	2 miles northeast of Blairsville.	------
Walton	Conner placer (includes Malcome placer (Knox place).	9/10 mile north of Browning shoals.	------
	Smith placer	4/10 mile northwest of Monroe on Beaverdam Creek.	------
	Thompson placer	2 miles northwest of Compton.	------
Warren	Warren prospect	5 miles northeast of Raytown.	------
White	Ashbury prospect*	57	1
	Atkinson (Nix) prospect	48	4
	Baker placer	162	3
	Bell Creek placer	Bell Creek	------
	Bell Creek prospect	40	3
	Bell property	132	3
	Blake prospect (Sprague)	47	4
	Butts prospect	70	3
	Castleberry property	131–32	3
	Childs (Jarret) placer	10, 23–24 (Bean Creek)	3
	Conley prospect	39	3
	Courtney placer	33	1
	Cox Bottoms placer	4 miles north of Cleveland	------
	Damforth (Longstreet)	162	3
	Dean (St. George) mine	37–38, 59	3
	Dukes Creek placer	Dukes Creek	------
	Dunbar placer	4 miles north of Cleveland	------
	Eaton-Shostmile-Boston-Mercer properties.	60–62, 67–69, 92. Properties cannot be divided.	3
	Etries prospect (placer)*	62	1
	Flennigen prospect	24	4
	Franco-American property	37, north half of lot	3
	Franklin and Glenn prospect.	41	3
	Gayton placer	38	3
	Glover placer	161	4
	Hardeman property	Chattahoochee River east of Nacoochee.	------
	Henderson placer	34	1
	Hudson cut (Whitner)	60	3
	Hudson placer	Dukes Creek	------
	Jo Creek placer	22, 27	3
	Jones mine (Craig)	10	3
	Lewis prospect	27	4
	Long Hungary prospect	57–58 (?)	3

Georgia gold localities—Continued

County	Name	Location (lot No.)	District
White	Long Hungry prospect No. 2	South fork Long Hungry Creek.	------
	Lot 10	10–11, 21–23, 44	3
	Loud prospect	39, 40–41	1
	Lunsden placer	44 (Bean Creek)	3
	Martin property (Hamby)	59, 60, 62	3
	McAfee placer	25	4
	Merritt prospect*	124	3
	Mingo placer	¾ mile northeast of Flennigen prospect.	------
	Monroe Lowlands (Candler and Thompson).	12	3
	Nicks property	3 miles west of Cleveland	------
	Old Childs placer (Stevensons).	10; 3 miles east of Robstown	3
	Old Matthews prospect	49	4
	Old Office cut	60	3
	Old Thomas Leadford prospect.	99	3
	Park (McMillian property)	93	3
	Plattsburg (Old English)	40	3
	Poland prospect	47	4
	Reaves property*	37	1
	Reynolds(Hamby)prospect.	70–71	3
	Roberts prospect	26	3
	S. J. Cox placer	Little Tesnatee Creek south of lot 132.	3
White	Sprague prospect (Blake)	26	4
	Stovall placer	11, 21, 44	3
	Thurman prospect	102, 124	3
	Twiner property	2 miles northwest of Cleveland.	------
	White County (Thompson) mine.	102	3
	White-McGee (Oliver) prospect.	126	3
	Will Hood prospect	129	3
	York (Herd) property	2¼ miles north of Lynch	------
Wilkes	G. W. Booker property	10 miles northeast of Washington on French Mill road.	------
	Hilly prospect	Southeast corner of county	------
	Jasper Wolf property	½ mile northeast of Booker property.	------
	Keeter prospect	2 miles northeast of Metasville.	------
	Kendall prospect	4 miles southeast of Danburg	------
	Latimer (Fairy Ridge) prospect.	2½ miles northwest of Triplett.	------
	Stone Ridge (Orr) prospect	5 miles southwest of Washington.	------

BARTOW COUNTY

The Allatoona (Tudor) prospect, near Allatoona, was cleaned out and sampled in 1932,[94] but the workings were inaccessible when visited by the writers in 1935.

CHEROKEE COUNTY

CHEROKEE

The Cherokee mine is in southwestern Cherokee County, about 4 miles west of Holly Springs and 7 miles south of Canton. Most of the workings are on lot 428 in the fifteenth district (see pl. 39), but 11 forty-acre sections are included in the property, which is owned by W. H. Slack of Gainesville, Ga., and leased by C. M. Wacaster. The mine was idle when it was visited in 1935, but during 1932–33 part of the mine was cleaned out and sampled by the Southern Mineral Development Co., which was operating the Battle Branch mine in 1934.

The underground workings, with the exception of a few shallow tunnels, were all inaccessible in 1935. According to old mine reports [95] and R. A. Newton,[96] who was in charge of the recent work, the property was developed by four shafts, a long crosscut tunnel nearly through the hill, and several other levels and drifts. The two principal shafts are the Mill shaft, reported to be 425 feet deep, and the Black shaft, 260 feet deep. Recent sampling was confined entirely to the lode developed by the Black shaft, which descends vertically for 45 feet, and then follows the dip of the lode, about 40° SE. During the early period of mining, considerable surface work and sluicing were done. The largest hydraulic cut is about 300 feet long. There are many smaller depressions that appear to have been formed by the caving of shallow tunnels and other underground workings.

The country rock is a banded series of schists and gneisses, whose foliation planes strike N. 20° to 40° E. and dip 50° to 80° SE. Mica schist, mostly light colored, but in small part black, predominates on the whole, but the northwestern part of the area is underlain by amphibole gneiss, in part light colored and feldspathic. Thin layers of amphibole gneiss are common in the mica schist, and interfingering of the two rocks is common, especially near the contact of the larger masses. A few bands of micaceous quartzite are present. The surface exposures are entirely of saprolite, but comparatively fresh rock can be seen in several places on the old mine dumps.

The ore deposits are of the stringer-lode type; in one of the open cuts 12 stringers, each about an inch or less in thickness, are spread through a width of 4 feet (see pl. 9, *C*). The entire width of the mineralized zone is probably between 700 and 800 feet, and according to the old reports it contains 10 lodes of possible economic importance. Of these the Black lode and the Mill lode, near the two borders of the zone, have been most extensively developed. Both are in mica schist at or near a contact between the schist and amphibole gneiss. Garnets are generally present near the quartz stringers, and, to judge from poor exposures, they appear to decrease in quantity away from the lodes. Some sericite is developed in the walls near the lode. According to Atwater [97] a shoot has been developed in the Black shaft and possibly one or two others were mined in the past. The ore shoots are short; the known shoot in the Black Shaft workings is reported to be not over 60 feet long.

[94] Anderson, D. C., Gold mining in Georgia: Am. Inst. Min. Met. Eng., Contr. 57, 8 pp., 1933.

[95] Atwater, R. M., Jr., Cherokee gold mine, Private report, February 1933. Dolan, T. A., Private report to Mr. Cole Saunders, May 10, 1899. Whitehead, Cabell, Undated report on the Cherokee mine, probably written about 1890.

[96] Newton, R. A., Personal communication, 1935.

[97] Atwater, R. M., private report, February 1933.

The ore is soft and oxidized down to a few feet below the 85-foot level. Below the zone of oxidation the lode is persistent, strong, and regular. It dips about 40° E. and averages 2 to 6 feet in width. The ore in the shoot is said to contain, on the average, about 0.75 ounce of gold to the ton; most of the gold is believed to be closely associated with pyrite, as only about 30 percent could be recovered by amalgamation.

The dip of the Black shaft lode is 10° to 30° flatter than the reported dips of the other lodes. Dolan [98] states that the shoots do not extend straight down the lode, but pitch to the northeast. This statement is partly verified by the pitch of the stopes and the deflection of the shaft shown on plate 39.

Both R. A. Newton and R. M. Atwater independently sampled the Black shaft workings and reported a small tonnage of good sulfide ore, but additional development was not done because of difficulty in meeting the expense of an adequate development program and the cost of an efficient plant for handling sulfide ores.

CREIGHTON (FRANKLIN)

The Creighton (Franklin) mine is on the Etowah River, about 7 miles southeast of Ball Ground, in the eastern part of Cherokee County. The principal workings are in lots 398, 465, 466, and 473 of the Third district. The property is owned by Mrs. M. W. Southwell of Atlanta, and in 1935 was leased to J. B. Sitton of Atlanta.

During the early part of the present century the Creighton mine was the most important in Georgia and was one of the small but steady producers in the South. It is known to have yielded between $750,000 and $1,000,000. Becker visited the mine in 1894 and states [99] that at that time the mine was yielding about $100 a day. When the property was visited in 1935 it was idle, and no underground workings were accessible. The only information obtained was from a few old dumps and open cuts. Jones [1] gives a fairly complete description of the workings as they were in 1909. The following brief notes are taken mostly from his report, and from a private report by McCallie,[2] and a description in an earlier bulletin of his.[3] In 1909, shortly after the publication of Jones' bulletin, the mine was flooded by a cave-in beneath the dammed Etowah River. A large part of the workings had been abandoned, however, before the cave-in.

The mine was worked through five shafts spaced at irregular intervals for three-quarters of a mile along the strike of the lode. The deepest workings extend from shaft No. 1, which was sunk between 900 and 1,000 feet on the plane of the lode (see pl. 40). Several small pits and one large one along the outcrop of the lode are reported to have been dug before the War Between the States.

The country rock is mica schist with layers of amphibole gneiss. Zoisite is reportedly common in these rocks, and a few small garnets are present. Some of the rock on the dumps shows schist and gneiss in alternating bands, and a few amphibole nodules in the mica schist. No clear relationship between the ore deposits and the country rock has been recognized. In the large, open cut, however, the amphibole gneiss forms one wall and the mica schist the other, the lode material having been mined along or near the contact. Nothing is known concerning the detailed structure of the rock, but in general the foliation planes of the schist and gneiss strike about N. 50° to 60° E. and dip 40° to 50° SE. McCallie mentions two small dikes of olivine diabase, and Jones [4] says that these dikes cut the older quartz lodes.

Two lodes, the Franklin and the McDonald, were mined, but the Franklin is by far the better developed. The lodes strike and dip nearly parallel to the foliation. They consist of innumerable quartz stringers, and, to quote Becker: [5] "each [stringer] is a flat lens or pipe petering to a feather edge, but replaced by other similar bodies. * * * A fresh stringer is as likely to appear in the foot as in the hanging." As shown in McCallie's diagrams, several ore shoots were found, all of them pitching toward the northeast. The ore shoots were from 50 to 120 feet in length and about 3 feet in average thickness. They were connected by quartz stringers. According to Becker the walls are grooved, and individual grooves make an angle of about 56° with the strike of the walls and pitch to the northeast, at an angle about 27° less than the ore pipes. Nitze and Wilkens [6] noted the presence of soft gouge on both the hanging wall and the footwall of the Franklin lode. The ore is said to have averaged about 0.3 ounce a ton; the gold was generally in pyrite, some of which was in the quartz and some in the wall rock. A little calcite, muscovite, and chalcopyrite were usually present.

OTHER PROPERTIES

The Sixes prospect, near Holly Springs southwest of Canton, was idle when visited. The old workings had recently been cleaned out and sampled, but no additional development work had been done.

[98] Dolan, T. A., private report, May 10, 1899.

[99] Becker, G. F., A reconnaissance of the gold fields of the southern Appalachians: U. S. Geol. Survey 16th Ann. Rept., p. 3, p. 293, 1895.

[1] Jones, S. P., Second report on the gold deposits of Georgia: Georgia Geol. Survey Bull. 19, pp. 159–166, 1909.

[2] McCallie, S. W., private report on the Franklin gold mine, 1907.

[3] McCallie, S. W., in Yeates, W. S., McCallie, S. W., and King, F. P., A preliminary report on a part of the gold deposits of Georgia: Georgia Geol. Survey Bull 4A, pp. 175–183, 1896.

[4] Jones, S. P., op. cit., p. 162.

[5] Becker, G. F., op. cit., pp. 293–295.

[6] Nitze, H. B. C., and Wilkens, H. A. J., Gold mining in North Carolina and adjacent south Appalachian regions: North Carolina Geol. Survey, Bull. 10, p. 24, 1897.

The 301 (Doctor's, Kolb, Farrar) mine, on lot 301 in the fifteenth district, near Holly Springs, is controlled by a group of Atlanta businessmen. When visited it was being worked under the supervision of W. H. Fluker. The mine is opened by a shaft about 143 feet deep, from which two levels have been driven at depths at 80 and 140 feet. A short tunnel, several old stopes, and some other old workings were partly accessible.

The country rock near the lode is a mica schist (see pl. 41). About 100 feet southeast of the main workings is a few feet of interlayered mica schist and dark-green amphibole gneiss, and lighter-colored feldspathic amphibole gneiss crops out farther to the southeast. The foliation planes in the schist and gneiss strike N. 40° to 50° E. and dip 65° to 75° SE. Few exposures of solid rock are to be found except in the mine workings and in some road cuts, the surface being nearly everywhere covered with soil and saprolite.

The lode consists of numerous quartz layers and stringers, generally parallel to the foliation of the country rock. Near the collar of the shaft 15 quartz layers, each less than an inch thick, occur within a width of 28 inches. The number of quartz layers changes abruptly, and in places they are nearly absent. The rock adjoining them and forming part of the lode consists mainly of fine-grained quartz and sericite. A little pyrite and chalcopyrite are usually present; the gold is said to be in the pyrite. The sulfides are almost completely oxidized on the 80-foot level, but the rock in the lower (140-foot) level appears fresh.

Only a little exploration work had been done in depth up to the time of the visit, 1934–35, and the results were not encouraging. The property is said to have been core drilled, but the results were not available.

DAWSON COUNTY

KIN MORI

The Kin Mori (Harris Branch) property, about 4 miles south of Dawsonville, comprises lots 861, 862, 908, 909, 910, 911, 926, 927, 928, 929, 976, 977, 978, and 979, all in the 4th district. It is owned by J. C. Short and his brother, of Gainesville, Ga. According to Yeates[7] and Hall,[8] hydraulic mining was attempted for a period of 5 years, from 1883 to 1888, but the venture was unsuccessful. When visited in 1935, the property had been idle for many years and the pits were slumped and overgrown; the exposures were sufficiently good, however, to yield some information. No records of the past production are available.

Most of the work at this property was done by hydraulic methods. Three large pits and several smaller ones were opened. The largest, on what is known as the Quarles zone, is about 1,200 feet long, 100 to 200 feet wide, and 50 to 100 feet deep. An adit 137 feet long was the only accessible underground opening, although other underground work has been done.

The country rock throughout the area (see pl. 42) is saprolitic; no unaltered rock was seen. Most of the saprolite is of the kind formed by the weathering of mica schist; it is reddish or grayish and contains many residual flakes of bronzy mica, generally less than one-quarter of an inch but rarely as much as half an inch in diameter. The mica schist is all garnetiferous. The strike of the foliation is persistently about N. 45° E., and the dip is 45° to 65° SE. Layers of yellow saprolite, typical of weathered amphibole gneiss, cross the property near the northern and southern borders of the mapped area. The layer at the south, mapped as light-colored amphibole gneiss, is more siliceous than that to the north. The few observed contacts of light-colored amphibole gneiss and mica schist suggest that the northern, or lower, contact is more sharply defined than the southern, along which narrow layers of the two rocks alternate in a zone about 10 to 20 feet wide. One thin layer of ferruginous micaceous quartzie has been mapped.

FIGURE 35.—Detailed sketch of quartz veinlet crosscutting foliation planes of the mica schist, Kin Mori mine, Dawson County, Ga.

The lodes consist of numerous layers and stringers of quartz, few of them over 3 inches thick. Those in the mica schist are usually parallel to the foliation, though some of the stringers cut across it (see fig. 35). As many as 28 layers of quartz, each about an inch or less in thickness, were counted in a width of 5 feet of the mica schist near its northern contact with the amphibole gneiss. In the Quarles cut, 68 quartz stringers, none more than 3 inches thick and most of them less than 1 inch thick, were counted within a width of 230 feet. Five chip samples taken from the Quarles cut and those farther north all contained traces of gold, but none assayed more than 0.01 ounce per ton.

[7] Yeates, W. S., McCallie, S. W., and King, F. T., A preliminary report on a part of the gold deposits of Georgia: Georgia Geol. Survey, Bull. 2–A, pp. 164–169, 1896.

[8] Hall, B. M., letter to C. W. Short dated August 22, 1904.

The Sulphuret lode is in mica schist near the lower or northern boundary of the southern band of amphibole gneiss. Comparatively little work has been done on this lode, but it appears to contain larger quartz bodies than the Quarles and other lodes. The Sulphuret lode contains up to 10 or 15 feet of quartz. It is well exposed in an adit driven N. 46° W. from near the southeastern corner of the mapped area, to intersect the lode, which it entered 124.5 feet and left 135 feet from the portal. In the adit about half of the lode consists of sericitized schist, the remainder being quartz, part of which is dark bluish-gray and spotted and banded with sulfides, mainly pyrite and arsenopyrite. Although the country rock around the Sulphuret lode is altered to saprolite, fragments of hard bluish-gray quartz in the outcrop of the lode contain unaltered pyrite and arsenopyrite.

Seven chip samples from the Sulphuret lode, taken at various places along the outcrop and in the adit, gave only traces of gold. Yeates[9] recorded five assays of samples from the Sulphuret lode, taken by B. M. Hall, which gave 0.05, 0.05, 0.06, 0.19, and 0.56 ounce of gold to the ton, but he gave no details concerning the samples.

LINCOLN COUNTY

SEMINOLE (MAGRUDER)

The Seminole (Magruder) mine is in the western part of Lincoln County, about 12 miles northeast of Washington. The mine was described by Watson[10] and later by Weed,[11] and was at one time among the main sources of copper and gold in the region. According to Watson the property was developed by a 200-foot shaft, with levels turned at 90, 125, 145, and 185 feet. The total extent of the underground workings is not known but must amount to several thousand feet. When visited in 1935 the property had been abandoned and was owned by the county, the workings were entirely inaccessible and overgrown. It is reported, however, by R. W. Smith, State Geologist of Georgia, that the mine has been reopened since 1935.

The rocks on the dumps are mainly quartz-sericite schist with a large percentage of altered basic intrusive material. Three nearly parallel, well-defined veins were explored: the Wardlow, Finley, and the Magruder; the country rock between the veins was found to be fractured and silicified. The veins trend N. 25° to 40° E. and dip steeply west. Weed stated that the Magruder vein is the strongest, and he described several ore shoots. He described the quartz in the veins as laminated and sugary, with ore distributed in stringers, irregular bunches, and disseminated particles. Gold, chalcopyrite, galena, sphalerite, and pyrite were the main ore minerals, and a little native copper, tenorite, and malchite were found. Gold and chalcopyrite were most abundant where silicification had been most intense. The galena and chalcopyrite are said to have been argentiferous.

Both Watson and Weed described numerous basic dikes, ranging in width from a few feet to several hundred feet. These intrusive masses are postmineral, and commonly follow faults that offset the ore bodies. Weed noted one dike on the 125-foot level that contained a torn-off fragment of the vein.

The Magruder ore is reported to have contained about 3 percent copper and about 0.1 ounce of gold. The ore shoots in the other veins are said to have been of higher grade but smaller; one shoot in the Wardlow vein averaged 3 feet in width.

LUMPKIN COUNTY

BARLOW

The Barlow (Pigeon Roost) mine is east of Cane Creek, about 3 miles southeast of Dahlonega. The property comprises 13 lots, all in the twelfth district; mining and prospecting have been done on most of the lots. The main workings are on lots 726, 727, and 728. During 1934 the mine was operated by R. A. Brett under the ownership of Charles Cary. In 1935 work was suspended and the property abandoned. No estimate of past production is available.

The Barlow is one of a group of similar mines, which includes the Gordon, Ralston, Whim Hill, Hedwig, Topabri, and Saprolite. All are hydraulicked excavations in saprolite, on the south-southwest continuation of the same zone of amphibole gneiss that passes through the Ivy cut and Findley Ridge. Activity at the Barlow mine has been confined largely to hydraulic mining of the saprolite. The largest cut excavated in this manner is about 3,200 feet long by 200 to 300 feet wide, and variable in depth (see pl. 43). Many smaller openings have been made, but in 1935 all of them were overgrown and in many places slumped. The Bainbridge shaft, in the bottom of the large cut, had been sunk about 50 feet to intersect a series of narrow quartz layers known as the Brackett vein, which are distinct from the main lode and west of it. At a depth of 45 feet, a drift extended southward from the shaft for about 160 feet, and from this drift a crosscut had been driven about 70 feet eastward toward the main lode, which, however, it had not reached (see fig. 36). A stope, in part recently (1935) opened, on the Brackett lode extended upward from this level and could be reached through an adit driven from the bottom of the open cut. Several inclined raises had been put up for exploratory purposes, but they were not accessible in 1935.

The country rock is amphibole gneiss intruded by irregular masses of granitoid gneiss. The foliation in

[9] Yeates, W. S., McCallie, S. W., and King, F. P., A preliminary report on a part of the gold deposits of Georgia: Georgia Geol. Survey Bull. 4-A, p. 168, 1896.

[10] Watson, T. L., The Seminole copper deposit of Georgia: U. S. Geol. Survey Bull. 225, pp. 182-186, 1904.

[11] Weed, W. H., Magruder or Seminole mine, Georgia: U. S. Geol. Survey Bull. 455, pp. 145-149, 1911.

the rocks generally strikes N. 10° to 20° E. and dips 20° to 40° SE. The granitoid gneiss locally crosscuts the schistosity developed in the amphibole gneiss (see pl. 3, *C*).

The rocks exposed in the hydraulic cuts are all typical saprolites, and the pits afford excellent opportunities for study of saprolite. Some fresh granitoid gneiss was found on a few dumps and in the underground workings, which are all in that rock. No fresh amphibole gneiss was seen, though a few residual fragments of the rock in a partly weathered condition were found.

The structure of the Barlow area appears to be simple; the foliation is monoclinal, with only minor and local variations of strike and dip. It is difficult to distinguish between the regional gneissic structure and a later shearing or sheeting that is more local, for the individual shear planes produced by this later movement are in general nearly parallel to the foliation planes in

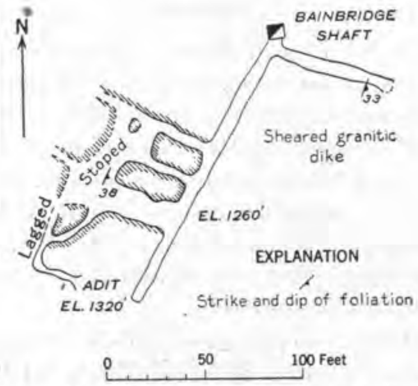

FIGURE 36.—Plan of workings from Bainbridge shaft, Barlow mine, Lumpkin County, Ga.

the gneisses. A sheeted zone parallel to the main axis of the large pit is particularly well exposed in the north end, where it is about 20 feet wide and consists of clean-cut cracks spaced at intervals of 1 to 6 inches. Quartz layers and lenses are generally associated with the sheeted zone and locally are brecçiated by the cracks.

The mineral deposit consists of many stringers and lenses of quartz, generally parallel to the foliation, but in a few places cross-cutting it. Quartz bodies are numerous in the granitic gneiss, but rare or absent in most of the saprolite derived from amphibole-bearing rocks. The Brackett lode consists of two or three quartz layers, each about 3 inches in average width, separated by 2 or 3 feet of granitic gneiss. These quartz layers persist throughout the extent of the underground workings. The country rock between them is weakly mineralized and is said to contain some gold.

The Barlow property is one of the few in Georgia on which a core-drilling campaign has been conducted. Sylvanite Gold Mines, Ltd., had the property examined during the fall and winter of 1933-34, and under their supervision diamond drilling was done by the Sullivan Machinery Co. Simplified core records are reproduced in the table below. The locations of holes 1 to 4 are shown on plate 43; hole 5 is not plotted because it was drilled near the Ogle shaft, north of the area mapped. Although too much confidence must not be placed in cores from a spotty and erratic lode of this type, the records show the interlamination of the granite and amphibole gneisses. A remarkable fact brought out by the assays of the cores is the exceptionally widespread distribution of small quantities of gold. The "traces" reported by the assayer are interpreted to mean less than 30 cents to the ton at the 1935 price of gold. Only parts of the cores were assayed and recorded. The drill records are, in the main, self-explanatory, although it should be noted that some of the samples consisted of chips distributed through several feet of core. Some check samples also are shown.

Record of diamond drilling at Barlow cut, Dahlonega, Ga.

Hole 1

Collar: 160 feet east of east rim of Barlow cut.
Length: 379 feet.
Dip: At collar, 50° W.; at 150 feet, 60° W.; at 350 feet, 63° W.
Assays by: Sylvanite Gold Mines, Ltd.

SLUDGE ASSAYS

Depth (feet)	Assay (ounce per ton)	Rock
20.0-30.0	Trace	Decomposed hornblende schist.
30.0-40.0	0.02	Do.
40.0-50.0	.02	Do.
50.0-60.0	----------	Hornblende schist.
60.0-70.0	Trace	Do.
70.0-80.0	.02	Do.
80.0-90.0	Trace	Do.
90.0-100.0	Trace	Do.
100.0-110.0	Trace	Hornblende schist and sheared granite porphyry.
110.0-117.0	Trace	Sheared granite porphyry.
117.0-125.0	----------	
125.0-135.0	Trace	Sheared granite porphyry.
135.0-145.0	Trace	Do.
145.0-155.0	Trace	Do.
155.0-165.0	Trace	Do.
165.0-175.0	Trace	Do.
175.0-184.0	Trace	Do.
178.0-184.0	.02	Do.
184.0-194.0	Trace	Do.
194.0-204.0	Trace	Do.
204.0-214.0	Trace	Do.
214.0-223.0	Trace	Do.
223.0-235.5	[a].02	Do.
235.5-243.0	.02	Do.
243.0-253.0	Trace	Do.
253.0-263.5	Trace	Do.
263.5-274.0	Trace	Hornblende schist.
274.0-284.0	Trace	Do.
284.0-294.0	.02	Do.
294.0-304.0	Trace	Do.
304.0-310.0	Trace	Do.
310.0-320.0	Trace	Do.
320.0-330.0	Trace	Do.
330.0-340.0	Trace	Do.
340.0-350.0	Trace	Do.
350.0-360.0	Trace	Do.
360.0-370.0	Trace	Do.
370.0-379.0	Trace	Do.

Record of diamond drilling at Barlow cut, Dahlonega, Ga.—Continued

Hole 1—Continued

CORE ASSAYS

Depth (feet)	Length (feet)	Assay (ounces per ton)	Depth (feet)	Length (feet)	Assay (ounces per ton)
115.0–120.0	5.0	0.01	255.5–258.0	2.5	0.01
125.0–128.5	3.5	Trace	258.0–259.0	1.0	.02
131.5–134.5	3.0	Trace	259.0–263.0	4.0	.01
134.5–138.0	3.5	Trace	263.0–266.3	3.3	Trace
138.0–139.5	1.5	.02	266.3–269.3	3.0	Trace
141.0–143.0	2.0	.01	269.3–270.3	1.0	Trace
150.5–152.0	1.5	Trace	270.3–271.3	1.0	Trace
158.5–159.0	.5	.06	271.3–275.3	4.0	Trace
164.0–168.0	4.0	.02	275.3–279.0	3.7	Trace
170.0–174.0	4.0	.03	279.0–280.5	1.5	.02
184.0–185.0	1.5	.04	283.0–284.0	1.0	.01
185.0–187.5	2.0	.01	284.0–287.5	2.0	Trace
189.5–192.5	3.0	.02	291.0–294.0	3.0	Trace
192.5–194.0	1.5	.05	302.0–310.0	2.7	Trace
211.0–212.0	1.0	.08	314.0–316.0	2.0	Trace
216.0–219.0	3.0	.04	316.0–323.0	2.0	Trace
221.0–222.5	1.5	.05	325.0–327.5	2.5	Trace
225.0–235.5	2.0	.27	329.0–332.0	3.0	Trace
235.0–235.5	.5	.04	337.0–341.0	4.0	Trace
235.5–240.5	5.0	.02	345.0–348.0	3.0	Trace
240.5–242.0	1.5	.04	348.0–355.0	5.0	Trace
242.0–246.0	4.0	.03	355.0–359.0	2.5	Trace
246.0–249.0	3.0	.01	363.0–366.0	3.0	.01
249.0–251.5	2.5	Trace	369.0–372.0	3.0	Trace
251.5–255.5	4.0	.02	375.0–378.0	3.0	Trace

[a] Between 223.0 and 235.5 feet only 4 feet of core was recovered. The last 2 feet o this core was assayed.

Hole 2

Collar: 300 feet east of east rim of Barlow cut.
Length: 368.5 feet.
Dip: At collar, 50° W.; at 150 feet, 60° W.; at 200 feet, 60° W.
Assays by: Sylvanite Gold Mines, Ltd.

SLUDGE ASSAYS

Depth (feet)	Assay ounces per ton	Rock
0–6	....	Red clay, overburden.
6–15	0.04	Decomposed hornblende schist.
15–25	Trace	Do.
25–31	Trace	Do.
31–40	.02	Hornblende schist.
40–50	.04	Do.
50–60	Trace	Do.
60–70	Trace	Do.
70–80	Trace	Do.
80–85	Trace	Do.
85–91	....	Do.
91–97	Trace	Do.
97–132.5	....	
132.5–140	Trace	Do.
140–150	Trace	Do.
150–160	Trace	Sheared granite porphyry.
160–170	Trace	Do.
170–180	Trace	Do.
180–190	Trace	Do.
190–200	Trace	Do.
200–210	Trace	Do.
210–220	Trace	Do.
220–230	.02	Do.
230–240	Trace	Do.
240–250	Trace	Do.
250–260	Trace	Do.
260–270	Trace	Do.
270–280	.04	Do.
280–290	Trace	Do.
290–300	Trace	Mixed hornblende schist and sheared granite porphyry.
300–310	.02	Do.
310–320	Trace	Do.
320–330	.02	Hornblende schist.
330–340	Trace	Do.
340–350	Trace	Do.
350–360	Trace	Do.
360–368.5	Trace	Do.

Hole 2—Continued

CORE ASSAYS

Depth (feet)	Length (feet)	Assay ounces per ton	Depth (feet)	Length (feet)	Assay ounces per ton
50.0–56.0	1.0	Trace	226.0–229.0	3.0	0.04
58.3–60.0	1.7	0.01	229.0–233.0	4.0	.06
60.0–64.0	4.0	Trace	233.0–236.0	3.0	.02
64.0–65.0	1.0	Trace	236.0–239.0	3.0	Trace
81.0–85.0	3.0	Trace	241.0–247.5	4.0	.01
88.4–89.0	.6	Trace	247.5–254.5	4.0	.05
89.0–94.0	2.8	Trace	(Core loss 3.0).		
102.0–106.5	4.0	Trace	254.5–258.5	4.0	.12
106.5–111.5	5.0	.01	258.5–260.0	1.5	Trace
111.5–116.0	4.5	Trace	260.0–264.0	4.0	Trace
116.0–121.0	5.0	Trace	264.0–267.0	3.0	Trace
121.0–126.0	5.0	Trace	267.0–276.5	2.7	.02
127.5–132.5	5.0	Trace	(Core loss 6.8).		
135.0–140.0	5.0	Trace	276.5–278.0	1.3	.07
142.0–146.0	4.0	Trace	(Core loss 5.0).		
146.0–151.0	5.0	Trace	283.5–287.5	4.0	.01
152.0–157.0	5.0	Trace	(Core loss 5.5).		
158.0–162.0	4.0	Trace	287.5–292.5	3.5	.01
163.0–165.5	2.5	Trace	(Core loss 1.5).		
168.0–171.0	3.0	Trace	292.5–297.0	4.5	.02
171.0–173.0	2.0	Trace	297.0–301.0	4.0	.03
176.0–180.0	4.0	Trace	306.0–310.0	4.0	Trace
180.0–184.0	4.0	Trace	316.5–320.5	4.0	Trace
187.0–190.0	3.0	Trace	323.0–326.0	3.0	Trace
192.0–195.0	3.0	Trace	328.0–331.0	3.0	.01
197.0–201.0	4.0	Trace	337.0–342.0	5.0	Trace
203.0–212.0	2.5	Trace	345.5–348.5	3.0	.01
(Core loss 6.0)			351.3–354.0	3.0	Trace
216.0–219.0	3.0	Trace	357.0–361.0	4.0	.01
222.0–226.0	4.0	.02	365.0–367.0	2.0	Trace

Hole 3

Collar: 300 inches east of east rim of cut.
Length: 446.5 feet.
Dip: At collar, 50° W.; at 150 feet, 59° W.; at 300 feet, 62° W.; at 440 feet, 61° W.
Assays by: Sylvanite Gold Mines, Ltd.

SLUDGE ASSAYS

Depth (feet)	Assay (ounces per ton)	Rock
0–8	Trace	Red clay overburden.
8–18	Trace	Decomposed hornblende schist.
18–28	Trace	Do.
28–40	Trace	Do.
40–50	Trace	Do.
50–60	Trace	Do.
60–70	Trace	Do.
70–80	Trace	Do.
80–90	Trace	Hornblende schist.
90–100	Trace	Do.
100–110	Trace	Do.
110–120	Trace	Do.
120–130	Trace	Do.
130–140	Trace	Do.
140–150	Trace	Sheared granitic porphyry.
150–160	.02	Do.
160–170	.02	Do.
170–180	.04	Do.
180–190	.02	Do.
190–200	Trace	Do.
200–210	Trace	Do.
210–220	Trace	Do.
220–230	Trace	Hornblende schist.
230–240	Trace	Sheared granitic porphyry.
240–250	.02	Do.
250–260	.02	Do.
260–270	Trace	Do.
270–280	.04	Do.
280–290	.02	Do.
390–300	Trace	Do.
300–310	.02	Do.
313–315.5	Trace	Do.
310–320	.02	Do.
320–330	Trace	Do.
330–340	Trace	Do.
340–350	Trace	Hornblende schist.
350–360	Trace	Do.
360–370	Trace	Do.
370–380	Trace	Do.
380–390	Trace	Do.
390–400	Trace	Do.
400–410	Trace	Do.
410–420	Trace	Do.
420–430	Trace	Do.
430–440	Trace	Do.
440–446.5	Trace	Do.

Record of diamond drilling at Barlow cut, Dahlonega, Ga.—Continued

Hole 3—Continued

CORE ASSAYS

Depth (feet)	Length (feet)	Assay (ounces per ton)	Depth (feet)	Length (feet)	Assay (ounces per ton)
40.0–50.0	2.7	Trace	273.5–277.0	3.5	0.09
(Core loss 7.3).			277.5–280.5	3.0	Trace
72.0–74.5	2.5	Trace	281.5–285.0	4.0	Trace
(6.5 core loss 65–74).			285.0–290.5	4.0	Trace
74.5–80.5	4.0	Trace	(Core loss 1.5).		
(74–80 core loss 2).			310.0–313.0	3.0	Trace
83.0–88.0	5.0	Trace	318.0–322.0	4.0	.02
89.5–93.0	3.5	Trace	327.5–331.5	4.0	Trace
93.0–96.5	3.5	Trace	335.0–339.0	4.0	Trace
100.0–102.5	2.7	Trace	339.0–343.0	4.0	.01
102.8–106.8	4.0	Trace	343.0–347.0	4.0	Trace
125.0–129.0	4.0	Trace	347.0–351.0	4.0	Trace
129.0–133.0	4.0	.01	351.0–356.0	5.0	Trace
139.0–142.5	3.5	.01	359.0–363.0	4.0	Trace
142.5–146.5	4.0	Trace	366.0–370.0	3.0	Trace
149.5–153.5	4.0	Trace	370.5–375.0	3.0	Trace
158.0–161.0	3.0	Trace	(Core loss 2.0).		
164.0–168.0	4.0	Trace	386.0–390.0	4.0	Trace
171.8–175.8	4.0	Trace	390.0–393.0	3.0	.01
179.0–183.0	4.0	Trace	394.0–398.0	4.0	Trace
184.5–188.5	4.0	Trace	398.0–402.0	3.5	.01
190.5–194.5	4.0	Trace	(Core loss 0.5).		
194.5–198.5	4.0	Trace	402.0–408.8	4.0	Trace
198.5–201.9	3.4	.01	(Core loss 2.8).		
203.4–206.9	3.5	Trace	409.0–412.0	3.0	.01
206.9–213.0	3.0	.03	415.0–419.0	3.7	Trace
(Core loss 3.1).			(Core loss 0.3).		
229.0–240.0	2¾	.01	423.0–427.0	4.0	Trace
(Core loss 7¼).			429.0–437.5	3.7	Trace
240¼–244¼	4.0	.01	(Core loss 4.8).		
247½–251½	4.0	.02	444.5–446.5	2.0	Trace
255–259.5	4.5	.04	(Core loss 437.5–446.5,7.0).		
259.5–263.5	4.0	.02			
268.5–272.0	3.5	.01			
272.0–273.5	1.5	Trace			

Hole 4

Collar: 310 feet east of east rim of Barlow cut.
Length: 350 feet.
Dip: At collar, 50° W.; at 170 feet, 57° W.; at 340 feet, 60° W.
Assays by: Sylvanite Gold Mines, Ltd.

SLUDGE ASSAYS

Depth (feet)	Assay (ounces per ton)	Rock
0–8	Trace	Sheared granitic porphyry.
8–18	Trace	Do.
18–22	Trace	Do.
22–30	Trace	Do.
30–40	Trace	Hornblende schist.
40–50	Trace	Do.
50–60	Trace	Do.
60–70	Trace	Do.
70–80	Trace	Do.
80–90	Trace	Do.
90–100	Trace	Do.
100–110	Trace	Do.
110–120	Trace	Hornblende schist and sheared granitic porphyry.
120–130	Trace	Do.
130–140	Trace	Sheared granitic porphyry.
140–150	Trace	Hornblende schist and sheared granitic porphyry.
150–160	Trace	Sheared granitic porphyry.
160–170	Trace	Hornblende schist and sheared granitic porphyry.
170–180	Trace	Biotite schist and sheared granitic porphyry.
180–190	Trace	Sheared granitic porphyry.
190–200	Trace	Do.
200–210	Trace	Do.
210–220	Trace	Do.
220–230	Trace	Do.
230–240	Trace	Do.
240–250	Trace	Do.
250–260	Trace	Hornblende schist and sheared granitic porphyry.
260–270	Trace	Hornblende schist.
270–280	Trace	Do.
280–290	Trace	Do.
290–300	Trace	Do.
300–310	Trace	Do.
310–320	Trace	Do.
320–330	Trace	Do.
330–340	Trace	Do.
340–350	Trace	Do.

Hole 4—Continued

CORE ASSAYS

Depth (feet)	Length (feet)	Assay (ounces per ton)	Depth (feet)	Length (feet)	Assay (ounces per ton)
50.0–58.0 (5.5 core loss).	2.5	0.01	210.0–217.0	3.5	Trace
			217.0–219.0	2.0	0.01
74.0–77.0	3.0	.01	219.0–223.0	4.0	.03
97.5–101.5	4.0	Trace	Mica schist with quartz stringers Slightly mineralized.		
105.5–108.5	4.0	.01			
115.5–120.0	4.5	Trace			
126.0.130.0	4.0	Trace			
130.0–133.0	3.0	.01	223.0–228.0	5.0	Trace
135.0–138.0	3.0	Trace	228.0–232.0	4.0	.02
140.5–145.0	4.5	.01	Mica schist with quartz stringers. Slightly mineralized.		
149.0–152.0	3.0	.01			
161.0–165.0	4.0	Trace			
176.5–180.5	4.0	Trace			
184.5–188.5	4.0	Trace	238.0–242.0	4.0	.02
195.0–199.0	4.0	Trace	260.0–263.5	3.5	Trace
202.5–206.5	4.0	.04	263.5–267.5	4.0	Trace
Sheared porphyry with quartz and pyrite.			290.0–294.0	4.0	Trace
			330.5–334.5	4.0	.01
			341.5–345.5	4.0	Trace
206.5–210.0	3.5	.02			

Hole 5

Collar: 360 feet east of east rim.
Length: 459 feet.
Dip: At surface 45° W.; at 200 feet, 58° W.; at 450 feet, 60° W.
Assays by: Sylvanite Gold Mines, Ltd.

SLUDGE ASSAYS

Depth (feet)	Assay (ounces per ton)	Rock
0–8	Nil	Decomposed hornblende schist.
8–18	Trace	Do.
18–28	Trace	Do.
28–38	Trace	Do.
38–48.5	Trace	Do.
48.5–60	Trace	Hornblende schist.
60–70	Trace	Do.
70–80	Trace	Do.
(From 70–160 Sludge probably contaminated owing to continuous caving of ground.)		
80–90	Trace	Sheared granitic porphyry.
90–100	Trace	Do.
100–110	Trace	Do.
110–120	Trace	Do.
120–130	Trace	Do.
130–140	Trace	Do.
140–150	Trace	Do.
150–160	Trace	Do.
160–170	Trace	Do.
170–180	Trace	Do.
180–190	Trace	Hornblende schist.
190–200	Trace	Do.
200–210	Trace	Do.
210–220	Trace	Do.
220–230	Trace	Do.
230–240	Trace	Do.
240–250	Trace	Do.
250–260	Trace	Do.
260–270	Trace	Do.
270–280	Trace	Hornblende schist and sheared granitic porphyry.
280–290	Trace	Sheared granitic porphyry.
290–300	.02	Do.
300–310	Trace	Hornblende schist.
310–320	Trace	Sheared granitic porphyry.
320–330	Trace	Hornblende schist.
330–340	Trace	Do.
340–350	Trace	Do.
350–360	Trace	Do.
360–370	Trace	Do.
370–380	Trace	Do.
380–390	Trace	Do.
390–400	Trace	Do.
400–410	Trace	Do.
410–420	.02	Do.
420–430	Trace	Do.
430–440	Trace	Do.
440–450	Trace	Hornblende schist and sheared granitic porphyry.
450–459	Trace	Sheared granitic porphyry.

Record of diamond drilling at Barlow cut, Dahlonega, Ga.—Con.

Hole 5—Continued

CORE ASSAYS

Depth (feet)	Length (feet)	Assay (ounces per ton)	Depth (feet)	Length (feet)	Assay (ounces per ton)
28. 5–59. 5	3. 0	Trace	300. 0–304. 0		
(Core loss 8.0.)			304. 0–310. 0	4. 0	0. 01
108. 0–111. 0	3. 0	Trace	(Core loss 3.0).	3. 0	Trace
129. 0-132. 0	3. 0	Trace	313. 0–317. 5		
146. 0–149. 0	3. 0	0. 01	322. 0–326. 0	4. 5	Trace
175. 0–179. 0	4. 0	Trace	332. 5–336. 5	4. 0	Trace
186. 0–190. 0	4. 0	Trace	345. 0–349. 0	4. 0	Trace
190. 0–194. 0	3. 0	Trace	352. 0–356. 0	4. 0	Trace
203. 5–207. 5	4. 0	Trace	367. 5–371. 5	4. 0	Trace
209. 5–213. 5	4. 0	Trace	405. 5–409. 5	4. 0	Trace
243. 0–247. 5	3. 0	Trace	410. 0–414. 0	4. 0	Trace
(Core loss 1.5.)			419. 0–423. 0	4. 0	Trace
259. 0–265. 0	4. 0	Trace	435. 0–439. 0	4. 0	0. 01
(Core loss 2.0.)			444. 0–448. 0	4. 0	Trace
222. 0–226. 0	4. 0	Trace		4. 0	0. 02
(Core loss 216.0–226.)					

BATTLE BRANCH

The Battle Branch mine is on the west bank of the Etowah River, about 1 mile west of Auraria, Lumpkin County. In 1935 the property, consisting of lots 523, 524, and 456 in the 12th district, was owned by the Southern Mineral Development Co., and supervised by R. A. Newton.

According to Yeates, [12] who has presented a fairly complete historical sketch of the mine up to 1896, gold was found on what is now the Battle Branch property in 1831, and since that time the property had been worked at irregular intervals. The mine was idle from 1917 until January 1934, when it was reopened by the Southern Mineral Development Co.; operations were continuous from that time to 1936. No records of the production of the mine are available, but from May 24, 1934, to May 20, 1935, 781.97 ounces of bullion, with an average fineness of about 850, were shipped to the mint.

The mine workings, accessible in 1935, included the Main or Rogers shaft, sunk about 195 feet below the present surface on the plane of the lode. The dip of the lode, and hence the inclination of the shaft, flattens from 35° in the upper part to about 30° between the 85-foot level and the bottom of the shaft. Two levels have been driven from the shaft at 85 feet and 173 feet on the incline below the collar. The 85-foot level contains about 280 feet of drifting, the 173-foot level about 300 feet (see pl. 44). An adit 253 feet long extends from the old hydraulic pit south of the shaft. The Blackwell shaft and the Pollard tunnel, southwest of the main workings, have been connected, and the country both north and south of the Blackwell shaft has been explored. In addition to these workings, many abandoned and partly filled inclines and drifts have been found, and in places they have been reopened.

There are no natural outcrops near the mine except in the nearby valley of the Etowah River. Surface exposures commonly consist of light-red or yellowish clay soil that contains minute flakes of brownish, partly decomposed mica and small discs of garnet. At a depth of a few feet there is a layer of saprolite, which consists mainly of clay, but contains residual grains of such resistant minerals as garnet and staurolite. At a depth of 80 feet in the mine the saprolite passes rather abruptly into unweathered mica schist.

The mica schist has the regional trend, striking N. 30° to 45° E., and dips 20° to 43° SE. (see pl. 45). Where least affected by the mineralization, it is grayish brown and breaks in smooth thin plates, which contain numerous flattened nodules of red garnet about an eighth of an inch in diameter. Biotite is one of the most conspicuous constituents, though it is less abundant than the fine-grained quartz, which it largely covers on cleavage faces. Muscovite is more abundant in some places than biotite, and nearly every fresh specimen of the rock contains some white mica. A little pyrite is usually visible, and kyanite, staurolite, and iron oxides can be recognized under the microscope.

As the lode is approached the schist changes character. The grains of garnet become larger, and alongside the lode they form discoidal nodules as much as an inch in diameter. Biotite and muscovite become coarser-grained and quartz more conspicuous. The rock near the lode is in general more quartzose than that of most surrounding areas; it usually contains veinlets of quartz, thin seams of which cut the garnet in the nodules. Green hornblende occurs in nodules and in layers that are generally less than half an inch thick; in places there are isolated crystals of greenish-black hornblende, some of them as much as 2 inches long and half an inch thick. Both pyrite and pyrrhotite are widespread and conspicuous, the pyrite in well-formed cubes less than one-quarter of an inch on a side, and the pyrrhotite in irregular veinlets and masses. Where the rock is broken the many nodules of garnet and quartz project abruptly from the surface. Locally the schist contains lenses of dark-gray massive quartzite; these are particularly common at the crests of rolls, and they form the footwall of the lode. A narrow layer of white, fine-grained muscovitic marble may be seen in most of the underground workings (see pl. 2, *B*). This layer has a maximum thickness of about 4 inches, but is usually between 1 and 3 inches thick. In places two or more even thinner layers can be recognized. Some of this marble is so dense it resembles chert spotted with small mica flakes. The marble layer is approximately parallel to the foliation planes in the schist, but whether it represents an original recrystallized bed or material introduced later is unknown.

The foliation in the schist forms broad sweeping curves in both horizontal and vertical sections. The 85- and 175-foot levels in the mine have been driven approximately parallel to the schistosity. Near the mine the schist is conspicuously jointed. The joints are very ir-

[12] Yeates, W. S., McCallie, S. W., and King, F. P., A preliminary report on a part of the gold deposits of Georgia: Georgia Geol. Survey Bull. 4A, pp. 475–478, 1896.

regular in both strike and dip; the most persistent ones strike nearly east-west and dip north. Grooving is well developed on the walls of the east-west joints; it generally strikes 5° to 10° more toward the east than the joints, and pitches 25° to 35° W. Fractures are found, also, that strike approximately parallel to the foliation of the schist but dip northwest. In places these fractures are open and serve as water channels. Both the water-bearing fractures and the joints contain a little gouge and breccia, and in some places they offset the quartz in the lode from a few inches to a few feet; the hanging wall in each case has moved upward relative to the footwall.

The lode is a zone of silicified and mineralized schist with numerous lenses and stringers of quartz. It is nowhere exposed across its entire width, which is estimated to be a maximum 30 feet. The lenses and stringers are mostly parallel to the schistosity, though in some places they cut the foliation planes. Eldridge,[13] who visited the property in 1879, gives a good description of the lode. He says:

> The gold occurs in * * * layers of quartz which are not uniformly separated from each other. * * * They (quartz bands) vary in width, at places being not more than 2 or 3 inches in thickness, while at others widening out and taking upon themselves lenticular forms called pockets, which are an average dimension of 4 feet in length, though varying from 2 to 10 feet, a width of 6 to 8 feet, and a thickness of from 2 to 5 feet, at times there being a mere trace of the quartz from one pocket to the next.

The lode, where exposed in the underground workings, consists of three main streaks or "veins," together with many smaller stringers and lenses, in silicified schist. The three main streaks persist throughout the underground workings, but they pinch and swell abruptly, varying in width from a few inches to 2 feet or more. In places two of the streaks merge and form quartz bodies 4 or 5 feet wide. The country rock between the streaks has a maximum width of 6 to 8 feet.

The joints are grouped along the crests of broad rolls in the schistosity. They appear to be tension cracks, caused by the bending of the brittle rock in the lode around the massive quartzite lenses.

The larger pockets of quartz and ore are concentrated along seams and breaks, which must have been formed prior to ore deposition. Some postore movement has occurred, however, for in places the ore is shattered and broken, and specimens containing gold and galena smeared along the fracture planes have been shown to the writers by the mine operators.

The ore shoots are localized at intersections of joints or fractures with the main lode—the more numerous the fractures the better the ore. Fractures developed more readily on the crests of the rolls than on the flanks and, to judge from the few exposures visible in the workings, the better ore appears to be near the sharper bends in the formation. The lode quartz between the ore shoots contains but little gold and in 1935 it could not be milled at a profit.

[13] Eldridge, G. H., field notes on file, U. S. Geol. Survey, 1879.

Premineral joints and cracks have caused noteworthy irregularities in the outline of the shoots, in some places terminating an ore body abruptly, in other places deflecting it into a new channel. Generally, but not everywhere, the shoots coincide with the quartz pods or cylinders. The shoots as well as the veins pinch and swell both along the strike and down the dip. They are generally less than 5 or 6 feet in stope length by 2 feet in width, though a few of them are larger. At least one of the shoots is known to be about 100 feet long, but in the longer shoots the ore forms a series of pockets connected by narrow gold-bearing streaks. The ore in the shoots consists predominantly of quartz, galena, ankerite, and gold, but it contains other minerals, generally in small quantity. Red almandite garnet is generally present near the borders of the ore, and some shoots have thin tubelike sheaths of garnet. In many places gold and galena form thin layers in parting cracks in garnet, and gold has been seen between cleavage plates of muscovite.

Several shoots have been mined out and one, in the middle streak of the three main quartz streaks previously described, was studied in considerable detail by the writers while it was being mined. The ore in this body was followed from the 85-foot level upward along the intersections of the lode with several joint planes trending northeast. The richest pocket found during the recent operations was where this shoot intersected a fracture striking N. 40° E. and dipping 45° to 60° NW. Sixty ounces of gold were obtained by hand in 1 day from this pocket. The quartz at this place was stepped down about a foot to the south, along the intersecting fracture, but was not much broken. In stoping upward to where the ore went into the hanging wall, it was found that former miners had worked downward on the upper streak of quartz. The mass of quartz rich in gold and galena dipped at a slightly steeper angle than the streak as a whole. Where followed downward, the shoot cut out about 15 feet below the 85-foot level along a tight crack that strikes N. 80° E. and dips 58° N. Here the gold was concentrated near the footwall of the middle quartz streak. No exploration had been done on the lower streak up to 1935. The ore in this shoot was bordered on either side by a sheet of red garnet; it crossed from side to side between these sheets, but nowhere did it cut them.

ETOWAH

The Etowah property is on the Etowah River, along the Dawson-Lumpkin County line. It comprises 15 lots, numbers 116, 117, 118, 119, 120, 141, 142, 155, 178, 179, 203, 204, 205, 234, and 235, all in the 15th district.

In 1935 the placer part of the property was being worked under the direction of C. V. Rechsteiner, but no underground workings were accessible. A number of small open cuts had been made, and an inclined shaft said to be 45 feet deep had been sunk.

The country rock consist of alternating layers of mica schist and amphibole gneiss. A considerable thickness of rock near the center of the area mapped (see pl. 46) is made up of thin layers of mica schist and amphibole gneiss, too intimately mixed to map as separate units. The individual layers strike N. 10° to 30° E. and dip 30° to 50° SE., conforming with the regional trend.

The mineral deposit is a lode made up of many small stringers and lenses of quartz. Considerable arsenopyrite and pyrite were seen on the dump, and also a little chalcopyrite and marcasite. The arsenopyrite is well crystallized, forming crystals up to 1½ inches in length. In a specimen given to the Geological Survey field party by Mr. Rechsteiner and reported to have come from the inclined shaft, considerable free gold occurs in a streak of spongy quartz about a quarter to half an inch thick. Quartz stringers are especially numerous along contacts of amphibole gneiss and mica schist; most of them are in the schist. A few samples were taken on the surface at the collar of the inclined shaft. Assays of these samples, recorded below, indicate that there is but little gold in the cross-section of the lode at the shaft.

Assays of samples from collar of inclined shaft, Etowah mine, Lumpkin County, Ga.

[Assays by E. T. Erickson, U. S. Geological Survey]

Sample No.	Ounces		Remarks
	Au	Ag	
E–1	Trace	None	Chip sample, 26 inches, across upper part of mineralized zone at inclined shaft.
E–2	do	do	Chip sample, 4 inches, of footwall below E–1.
E–3	do	do	Chip sample, 9 inches, in footwall, same location as E–1; includes mica and hornblende gneiss, quartz, and sulfide.
E–4	None	do	Chip sample, 9 inches, of white sugary quartz in hanging wall near main shaft.

The adjacent Etowah River has been diverted from its channel through a tunnel 770 feet long, and the drained channel is being washed and the placer gold recovered. The average value of the stream gravel is not known, but a considerable amount of gold recovered from it was seen by the Geological Survey parties.

MINES ON FINDLEY RIDGE

Findley Ridge, south of Dahlonega, Lumpkin County, rises a few hundred feet above the surrounding country and is a prominent landmark. It trends about N. 80° E. from the Ivy cut to the Findley mine, where it assumes a trend of N. 10° E. for a short distance. It is cut off on the north and east by the entrenched and meandering Yahoola Creek, and on the southwest by Cane Creek. Findley Ridge contains many large hydraulic cuts, notably the Ivy, Capps, Bowen, Fish Trap, Crown Mountain, Columbia, Preacher, Griscom, Bast, and Findley cuts, but all the properties on the ridge were inactive when visited. Plate 47 is a detailed map of Findley Ridge and of the valley of Yahoola Creek for a short distance north of the ridge.

The country rock is micaceous schist (Carolina gneiss) intruded by amphibole gneiss (Roan gneiss), which is probably a metamorphosed diorite; both rocks have been folded and faulted. As shown on the map, the crest of the ridge coincides more or less closely with a contact between the gneiss and the schist. A few small decomposed bodies of granitic gneiss locally known as "sand veins" are exposed in the cuts. Their prevailing trend is N. 10° to 20° E.

In the surface exposures, which are all saprolitic, the textures and smaller structures of the rocks have been largely destroyed. The weathered rocks differ conspicuously in color, as is well known to local miners; the amphibole gneiss weathers to a lemon-yellow soil, locally termed "yellow belt," whereas the mica schist forms a grayish or reddish soil with an abundance of bronze-colored mica flakes. The contact between these two rocks is of a special interest because of its relation to the ore deposits. The contact material is highly resistant to erosion, as shown by the fact that it forms the crest of Findley Ridge. In the saprolite zone it is about 100 to 300 feet wide. It is a sandy rock, locally resembling quartzite, and, being generally blackened with manganese and iron oxide, it is locally called the "black belt." The freshest contact rock seen by the writers was on a few old mine dumps. Its dominant constituent is quartz, which on weathering becomes granular, but it contains numerous nodules of red garnet and a few well-formed garnet crystals. The contact rock is sharply divided from the amphibole gneiss, but it grades into typical mica schist and appears to have been wholly derived from that rock. It probably was formed at the same period as the intrusion of the amphibole gneiss, and perhaps as a direct result of the intrusion.

Schistosity is not well developed in any of these rocks. The mica schist tends to break in elongate pencil-shaped fragments and the amphibole gneiss into angular blacks, generally 6 to 8 inches on an edge. It is usually difficult to distinguish between schistosity and joint or shear planes parallel to the contact; in many places these features probably coincide. There is also a confusing similarity between the foliation planes and shear planes parallel to the contact. On the western part of Findley Ridge the strike of the schistosity appears to be in general parallel to the ridge, and its dip about 65° N.; at the

Findley cut, where the trend of the hill becomes more northerly, the strike of the schistosity swings with it, and the dip reverses, becoming southeasterly. The most persistent feature is a linear structure that strikes N. 40° to 70° E. and pitches 20° to 40° NE. This structure persists with little variation throughout the area mapped.

Considerable movement along the contact has undoubtedly taken place, as shown by breccia in a few places and by closely spaced shear planes in others. Jointing is common and is best developed in the amphibole gneiss. Two small faults that appear to strike northwest can be seen in the Preacher cut, but cannot be followed. The identification of faults is greatly complicated by weathering and by near-surface fractures caused by slumping. In general, the fault contacts are not sharp lines but they are usually marked by zones of interfingering mica schist and hornblende gneiss which vary considerably in width.

The ore deposits on Findley Ridge consist of irregularly distributed quartz stringers and veins, chiefly confined to the contact rock and the "sand veins" of granite gneiss, probably because the latter as well as the former was harder and more brittle than the adjoining rocks; locally, however, the ore extends into the mica schist. Ore is rare or absent in the amphibole gneiss. No evidence has been found to indicate that the ores were deposited before the regional deformation. The quartz does not appear to be deformed, for it locally crosses foliation planes. No direct genetic relation is known to exist between the ores and the intrusive amphibole gneiss. Deposition of individual quartz bodies was largely controlled by the well-developed linear structure. Some of the quartz forms typical saddle reefs, ellipsoidal or roughly oval in cross section; some individual bodies of quartz resemble huge tapering pencils, dipping toward the contact and getting smaller, or splitting, away from the contact.

FINDLEY

The Findley property, controlled in 1935 by Cornelius O'Kane and associates, is on the northeast end of Findley Ridge, about 1½ miles east of Dahlonega. The main workings are on lots 1047, 1048, and 1087 in the twelfth district. The mine had been idle for years; a power line was installed in 1934, but plans for resuming work at that time did not materialize. In the past, however, the mine was worked extensively, and it was selected for detailed study because of the numerous exposures afforded by the old surface openings and natural outcrops, which reveal interesting and well-defined structures.

Much hydraulic mining has been done on the property, and also, to judge from old dumps and former descriptions,[14] considerable underground work. All the underground workings however, except a few short tunnels, were inaccessible in 1935, and practically no information was obtained from them. Most of the following data were obtained from two large hydraulic pits (see pl. 48).

The work at the mine appears to have been done mainly on two ore bodies. One of them lies east of and parallel to the contact between the Roan gnèiss and the Carolina gneiss, near the east center of the mapped area; the other—the Dead Horse vein—forms the western border of the large western hydraulic pit. One exceptionally rich shoot is said to have been worked to a depth of 350 feet on the incline, but the old workings on this shoot were not identified, and published statements regarding their location are vague.[15] According to Yeates, about $300,000 had been produced from the Findley mine up to 1896, mostly from this rich shoot. The shoot is described as being about 4 to 6 inches wide and only 1½ to 2 inches thick, but extremely rich in coarse gold.

Near the western border of the mapped area (see pl. 48) the contact, and also the shear planes, dip about 45° N. Along the eastern part of the contact, however, the dip is to the southeast. The rocks apparently form a recumbent fold that plunges north-northeast at the southeastern end of the contact. Other smaller folds occur, and locally the rocks are closely folded or crumpled.

LOCKHART

Northeast of the Findley mine the amphibole gneiss appears to plunge to the northeast under the schist exposed at the Lockhart mine. The Lockhart workings are in the black contact rock southwest of Yahoola Creek, near the northeasternmost exposure of the hornblende gneiss.[16] In 1934 the Lockhart shaft was cleaned out and reopened to a depth of about 148 feet, and some drifting was done in an attempt to develop enough ore to support a large mill, but the work was discontinued early in 1935.

PROPERTIES NORTH AND EAST OF DAHLONEGA

North and east of Dahlonega there are many prospects and mines, including the Singleton, Consolidated, Yahoola, McDonald, Hand, Mary Henry, Benning, and Free Jim (see pl. 47). Work on these properties has largely been confined to washing saprolite, derived mainly from granitic gneiss but locally from the Carolina and Roan gneisses. The granitic gneiss occurs in dikes, which in most places are near contacts between mica schist and thin sheets of amphibole gneiss.

The Betz mine, west of the Battle Branch mine, on lots 453, 454, and 459, is one of the most extensively de-

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[14] Yeates, W. S., McCallie, S. W., and King, F. P., op. cit., pp. 371–383.

[15] Eldridge, G. H., Notes on file in U. S. Geological Survey, 1879. Yeates, W. S., McCallie, S. W., and King, F. P., op. cit., p. 373.

[16] Lindgren, W., Gold deposits of Dahlonega, Georgia: In U. S. Geol. Survey Bull. 293, pp. 126–127, 1906.

veloped properties in the region. Several open cuts have been made and, judging from the surface and from local report, considerable underground work has been done. The lode, as exposed in the cuts, consists of a series of quartz stringers and nodules in silicified Carolina gneiss. Considerable interest in this property has been manifested from time to time, and several unsuccessful attempts to reopen it were made in the 1930's. The ore in the pit is said to have contained 0.1 to 0.15 ounce to the ton.

During 1935 a shallow shaft on the B. J. Boyd property, 1¾ miles northeast of Dahlonega, was cleaned out and sampled. The gold, as in the nearby McDonald property, is in a sheared granitic dike. The workings are entirely in saprolite.

The Calhoun mine is about 2½ miles south of Dahlonega, on lots 164 and 165 of the eleventh district, adjoining the Briar Patch placer on the Chestatee River. The property is of historical interest, because it is the reputed site of the discovery of gold in Georgia.[17] It was idle when visited, and but little can be added to published descriptions. A shallow shaft had been sunk on a quartz vein 1 foot thick, which in general conforms to the foliation of the Carolina gneiss. The old workings consisted of several caved and inaccessible pits and tunnels, apparently confined to the saprolite zone. Several rich ore shoots are said to have been found in these workings. The lode appears to have been a zone of quartz stringers en echelon, in silicified Carolina gneiss.

At the Consolidated mine (see fig. 37), which had just reopened at the time it was visited, in 1934, amphibole gneiss crops out just east of the portal of the main tunnel that gives access to the Knight lode. This lode is a zone of interlayered quartz and silicified schist striking N. 80° W. and dipping about 60° SE, and has been stoped from the tunnel level to the surface. The open stope is 6 to 10 feet wide, and the mica schist in the walls displays the rolls in the foliation exceptionally well. These rolls are, on the average, about 15 feet from crest to crest, and have an amplitude of about 6 feet; their axes plunge about 20° NE.

At the McDonald property, 2 miles northeast of Dahlonega, the saprolite of a poorly exposed sheared granitic dike was being worked in a small way during the early 1930's. The gold is mostly in small quartz stringers in the dike. The stringers are approximately parallel to the schistosity, which has a strike of N. 50° E.

The Topabri (Josephine, Auraria) mine is about 1 mile southwest of Auraria, Lumpkin County, on the McClusky branch of the Etowah River. Mining on this property has been mainly confined to lots 595, 596, 1213, and 1214 in the twelfth district. The property was worked in 1934, with B. F. Johnson of Baltimore, Md., in charge, but the mine was idle when visited in 1935. The work done in 1934 consisted entirely of hydraulic mining of saprolite. Several fairly large cuts had been made, and they furnished good exposures of the country rock. The relative positions and sizes of the cuts are shown in figure 38.

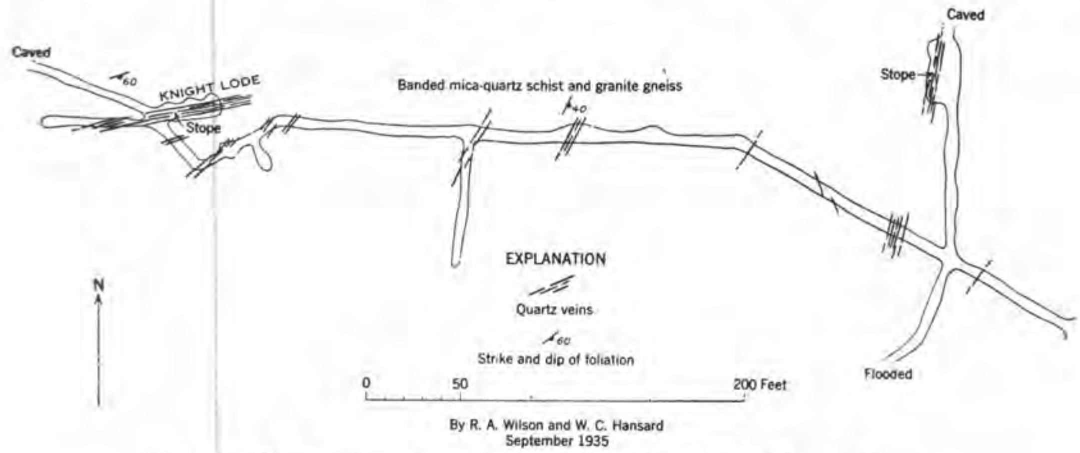

FIGURE 37.—Plan of main tunnel, Consolidated mine, Lumpkin County, Ga.

The country rock is made up of thin layers and lenses of amphibolitic gneiss, amphibole-feldspar gneiss, and mica and chlorite schist, intruded by many small masses of a granitoid rock and by a few narrow stringers of aplite, all of which are deeply weathered. Much of the weathered schist is coarse grained, and locally it contains dull-bronze flakes of altered biotite half an inch in diameter. The mine workings are entirely in saprolite, large quantities of which are reported to contain about 0.02 to 0.05 ounce of gold to the ton. Most of the gold is intimately associated with quartz stringers, and the granitoid dikes and the schist contain more gold than the amphibole gneiss.

At the Whim Hill property, about three-quarters of a mile north of Auraria, a diamond-drill rig was installed in 1934 or 1935. One hole was drilled about 300 feet, through alternating layers of amphibole gneiss and

[17] Yeates, W. S., McCallie, S. W., and King, F. P., op. cit., pp. 495–501.

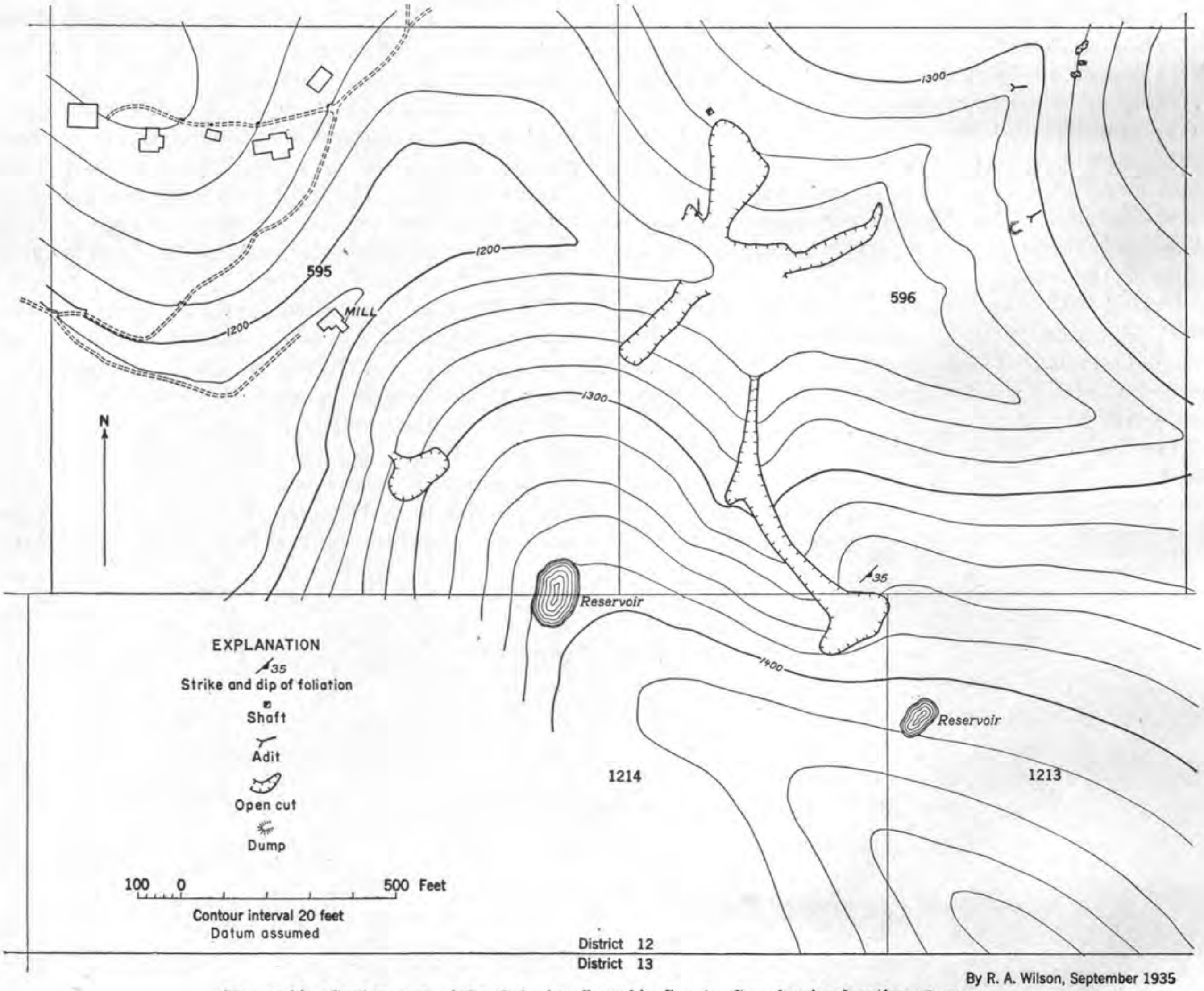

FIGURE 38.—Surface map of Topabri mine, Lumpkin County, Ga., showing location of cuts.

sheared and mineralized granite, but the work was discontinued early in the summer of 1935.

McDUFFIE COUNTY

COLUMBIA

The Columbia mine, controlled by W. H. Fluker, is on a tract of land known as the Forty-acre Lot, about 11 miles northwest of Thomson, the county seat. A paved highway passes just south of the mine, and Little River lies about 2 miles to the north. The mine was last worked in 1922, and was idle and inaccessible when visited in 1935.

In the past, this was one of the most extensively worked mines in northeastern Georgia. The Columbia shaft was sunk on an incline of about 45° to a depth of about 450 feet; at least four levels were driven from the shaft. Figure 39 shows the location and plan of the more recent workings; no map is available of the older, near-surface workings. The fourth level is the most extensive, having been driven nearly 950 feet to connect with the Hamilton shaft, west of the property.

The country rock, as in most of the mines in eastern Georgia, is composed of tuffs, mica schists, gray slates, and phyllites; these rocks are in part volcanic and in part sedimentary in origin, but they are all classed as members of the volcanic series. Intrusive granitic gneisses are exposed in places. The strike of the foliation in the schists and slates is generally N. 50° E. and the dip about 60° NW.

Many lodes and veins are known to occur in the area. The better-defined veins, such as the Columbia, strike a little north of west and dip northeast. The Columbia vein has been traced on the surface for nearly three-quarters of a mile. It has a maximum width of about 8 feet, but it pinches and swells, and locally it is made up of alternating ribbons of quartz and country rock.[18] An ore shoot near the inclined shaft has been followed

[18] Fluker, W. H., Deep veins in the Appalachian belt: Eng. and Min. Jour., vol. 114, pp. 93–94, 1922.

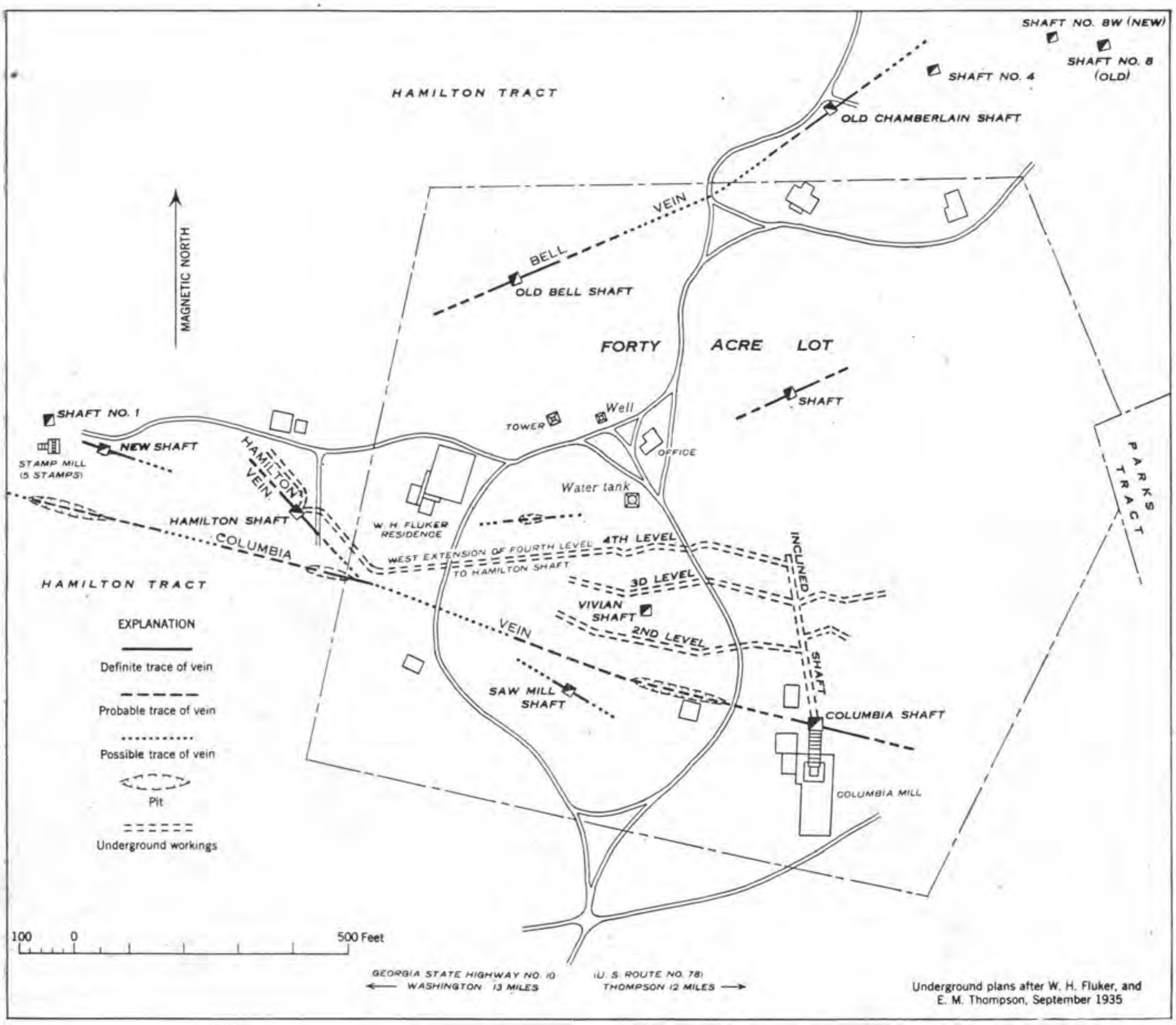

FIGURE 39.—Plan of the Columbia mine and adjacent properties, McDuffie County, Ga.

to the deepest level. This ore shoot pitches about 60° E., and according to Mr. Fluker it has a maximum length of 300 feet, is 1½ to 4 feet in average thickness, and assays about 0.5 ounce of gold to the ton. Several veins and lodes strike north-south, and at least one strikes northeast with the trend of the country rock; all of them are nearly vertical. These north-south veins and lodes are not as strongly developed as those that strike east-west. Mr. Fluker says that faulting is not rare in this area.

The best ores are reported to contain considerable galena. Pyrite is said to be widely distributed and to be independent of the gold. Chalcopyrite is rarely found.

An article published in 1934 gives the results of a geophysical survey of the property.[19]

[19] Kelly, S. F., Zuschlag, Theador, and Low, Bela., Discovering gold-quartz veins electrically: Mining and Metallurgy, vol. 15, pp. 250–256, 1934.

PAULDING COUNTY

At the Yorkville prospect, near Yorkville, the workings had been cleaned out and a little exploration work was being done in 1935. This property was in charge of J. S. Colbert. The lode consists of a few quartz lenses and stringers in altered mica schist.

At Burnt Hickory Ridge, north of Dallas, some prospecting was being done in 1935.

WHITE COUNTY

WHITE COUNTY (THOMPSON) MINE

The White County (Thompson) mine, on lot 102 of the 3d district, about 1½ miles southeast of Nacoochee, is owned by Messrs. Henry and Humphries of Habersham Mills, Ga. It was idle when visited in 1934 but had been operated for a short time in 1932 by Messrs. Fleming and Scott. The workings include a large number of shallow shafts, and many adits, drifts, and open cuts. About 700 feet of the adits was accessible in 1934. Many of the small open cuts are old stopes worked upward from shallow adits.

Surface exposures in the area around the workings are better than those elsewhere in this part of the gold-bearing region (see pl. 49). Most of the exposed rock is saprolitic, but comparatively fresh rock is found in the adjacent stream valleys and in some of the open cuts. The country rock is banded amphibole gneiss and mica gneiss, both of which are cut by intrusive masses of a coarse-grained light-colored granitic rock. The amphibole gneiss is generally similar to that throughout north Georgia, but it includes a dense, fine-grained, greenish-black phase that is conspicuous because of its resistance to weathering. The mica gneiss is medium-grained, and not nearly as schistose as most of that exposed near other gold deposits in Georgia. In many hand specimens it exhibits textures and structures resembling those of a sheared intrusive or coarse flow. In both the amphibole gneiss and the mica gneiss the foliation strikes about N. 50° E. and dips steeply either northwest or southeast. The granitic rock forms irregular masses cutting across the foliation in the gneiss and is not itself noticeably gneissic. Locally a pegmatitic phase is common. The relations of the various rock types are well exposed both on the surface and underground (see fig. 40).

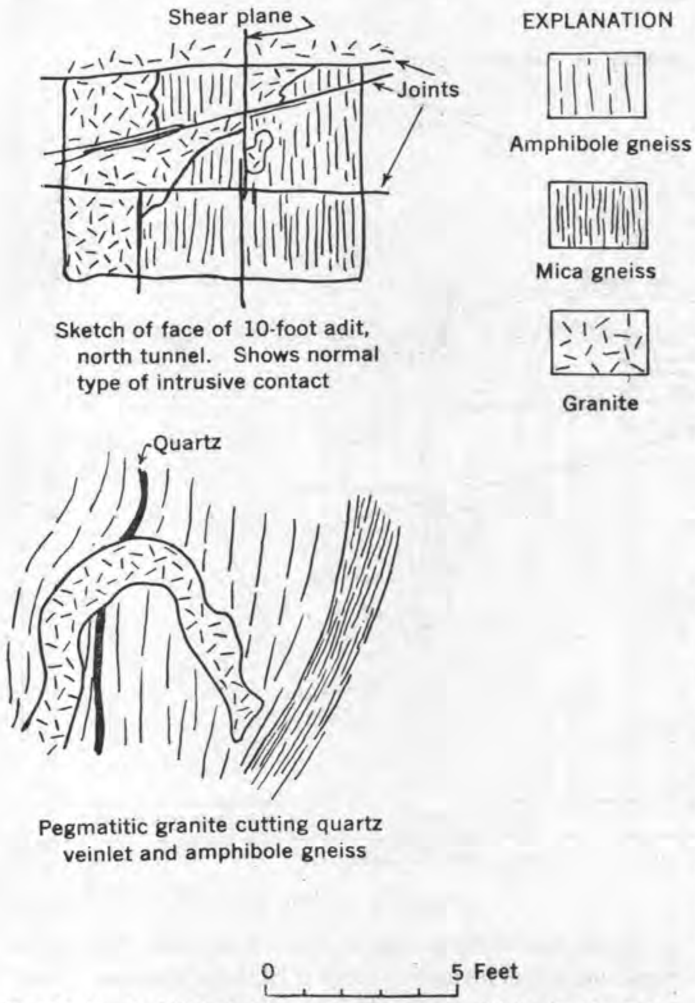

FIGURE 40.—Detailed sketches in north tunnel, White County mine, Georgia.

Assays of samples from White County mine, White County, Ga.

[Assays by E. T. Erickson, U. S. Geological Survey]

Sample No.	Ounces		Remarks
	Au	Ag	
W-1	0.03	None	Chip sample; 2 feet of quartz and wall rock.
W-2	None	do	Chip sample; 9-inch vein of quartz, carbonate and pyrite, 40 feet from portal of north adit.
W-3	do	do	Grab sample; granite and quartz stringers 40 feet from portal of north tunnel.
W-4	.01	do	Grab sample; quartz and granite parallel to drift. Same location as W-3.
W-5	Trace	do	Chip sample; 3.5 feet of quartz stringers in country rock; east drift, 50 feet in from portal.
W-6	.02	.50	Chip sample; 2 feet of quartz and mica gneiss; west zone, just outside portal.
W-7	.01	.87	Chip sample; 2.5 feet of quartz and mica gneiss; east drift at crosscut.
W-8	.03	.43	Chip sample representing width of 4.0 feet. West drift at maximum width of mineralized zone.

The mineralized zone consists of numerous quartz stringers and layers, in places spaced closely enough to permit mining the lode as a whole. In general the quartz layers are nearly parallel to the foliation of the gneiss, but a few stringers cut across it. Yeates [20] gives a good description of the lode, which was being mined at the time of his visit. He states that the lode consisted of quartz stringers in a zone 6 to 10 feet wide. In the workings accessible in 1934 the quartz is generally confined to zones less than 20 inches wide; many of these zones are nearly solid quartz. In some places several of these zones lie side by side, or in steplike arrangement, separated by poorly mineralized country rock. Quartz veins up to 4 inches in thickness have a fairly uniform width although they gradually pinch and swell along the strike and dip. Ragged remnants, as well as more compact fragments, of country rock are abundant in the quartz. The rock adjacent to the quartz is generally platy and sericitic, and grades outward into the normal country rock. Mineralized lode quartz is mostly confined to the mica gneiss near amphibole gneiss bands, although a few streaks of quartz appear in the amphibole gneiss and the granite.

The writer took samples to determine the amount of gold in the lode between the old stopes. No attempt was made to sample the property thoroughly, and the assays

[20] Yeates, W. S., McCallie, S. W., and King, F. P., A preliminary report on a part of the gold deposits of Georgia: Georgia Geol. Survey Bull. 4-A, p. 72, 1896.

given below show only the gold content in the accessible unmined part of the lode (see pl. 49).

As shown by the above assays, the average gold content of the ordinary run-of-lode material between the mined shoots is low. In silver, however, samples W–6, W–7, and W–8 gave higher values than any other samples taken in Georgia. No silver mineral has been recognized in them, and it is not known in what form the silver occurs.

Some shearing has taken place along the lode. This shearing is much obscured by later mineralization, and in a few places there are small postore fractures.

OTHER PROPERTIES

At the Franco-American mine, near Helen, a crosscut adit had recently (1935) been driven about 350 feet in the Carolina gneiss. According to R. A. Brett, the operator, this adit had cut two veins, one at 227 feet and one at 335 feet from the portal. Both veins were said to contain gold in pyrite. Several pieces of the ore picked up on the dump show pyrite in quartz, a little ankerite, and curved plates of ilmenite.

In 1935 the Sprague (Blake) vein, a few miles northwest of Cleveland, had recently been developed by C. O. Poland; a 60-foot shaft had been sunk and an adit about 250 feet long had been driven. The vein as exposed in the shaft strikes about N. 68° E., dips about 60° NW, and varies from a few inches to a few feet in width. It consists mainly of quartz, but contains garnet, pyrite, chlorite, and black and white micas. One piece of quartz that showed free gold was picked up on the dump.

ALLUVIAL PLACERS

In 1935 two alluvial placer properties in White County had been working, except during a few shutdowns, for several years. T. J. Stevenson had installed a dragline excavator at the Childs mine, on Bean Creek, several miles north of Cleveland, on lots 23 and 24 of the third district. The gravel is reported to average 10 to 11 cents a cubic yard (gold $35 an ounce), and between 600 and 900 cubic yards a day were handled. The value and fineness of the gold were said to decrease toward the northwest, and in 1935 the work was being pushed southeastward. Much of this land is supposed to have been worked in the early days for the richer streaks of gravel. The country rock is hornblende gneiss with many lenses and bands of granite gneiss. Quartz seams are abundant.

W. C. Hudson had leased some bottomland on Dukes Creek, a few hundred yards west of the Cleveland-Helen highway, from Dr. L. G. Hardman, of Commerce, Ga. The ground was being washed in 1935 by means of a hydraulic giant, which was used with a pressure of 80 pounds from a 3-inch nozzle, and handled approximately 150 cubic yards of gravel a day. The work had been going on continuously since 1931, except for temporary shutdowns, usually late in the summers, caused by insufficient water. Water was brought to the mine in a flume from a point on Dukes Creek about 11 miles above the mine. The gravel was raised by a hydraulic elevator and the gold recovered in sluice boxes. The average gold content of the gravel is not known, but several nuggets weighing an ounce or more are said to have been found.

C. L. Dunbar had subleased from Mr. Hudson 17 acres of land downstream from the Hudson workings. When the mine was visited a steam shovel had been installed, with which a trench about 150 yards long had been excavated. The country rock at both properties is mainly hornblende-biotite gneiss but includes many lenses and layers of granitic gneiss. The valley fill consists of sandy alluvium mixed with coarse boulders of quartz and country rock, and the operations are almost wholly on previously worked ground. The stream alluvium that has been worked averages about 10 feet in thickness, and is a mixture of gravel, sand, clay, and boulders—mostly of quartz. Most of the gold recovered comes from sandy lenses next to the decomposed bedrock. These lenses were difficult to work by hand in the old days and the production then came chiefly from the coarser gravels.

A dragline excavator was installed in 1935 on what are known as the Cox Bottoms, on Little Tesnatee Creek, about 4 miles north of Cleveland. This property, which contains approximately 35 acres of bottomland, is owned by S. J. Cox and leased by H. L. Schwalbe. It is said to have been partly worked in the early days. No information as to the value of the gravel or the occurrence of the gold has been obtained.

The Baggs Branch (Cleveland) placer is on Baggs Branch, just above its junction with Etowah River, and near the Lumpkin-Dawson County line. It was worked in the early days, and for 8 years prior to 1935 it had been worked in a small way by the Dixie Gold Mining Co., under the direction of Wm. Loffler. Most of this work had been done on lot 266 of the Thirteenth district, but the company also controlled lots 207 and 233 of the same district, and had done some prospecting on them. Mining was done chiefly by hand, with some aid from a small hydraulic giant. A hydraulic lift raised the gravel to a sluice box, where the gold was recovered. A ditch took water from near the head of the branch, and power had been obtained in the past from a large water wheel. The recent work had been confined chiefly to a layer of coarse gravel against the east bank of the stream, next to bedrock. Three men were said to be recovering, on the average, a quarter of an ounce of gold a day. Some work had been done in saprolite near the top of an adjacent hill; the results of the work are not known. The dominant country rock is mica schist, mostly garnetiferous, but granite gneiss is exposed in the southeastern part of the property.

In 1935 a little work had recently been done, at the Boley Field property, about 2½ miles southeast of Dahlonega, Lumpkin County, along the west side of the Chestatee River, on lot 1182, twelfth district. Considerable work had also been done on Long Branch, about 4½ miles southeast of Dahlonega. The alluvium worked there is 15 to 20 feet deep, with gold in sandy layers near the bedrock. Many small stringers of quartz are found here in the Carolina gneiss, particularly near a band of amphibole gneiss on the northwest slope of the valley. J. S. Cowps had recently done a little prospecting on the old Cavender Creek placer, on lot 29 of the fifteenth district, about 4 miles northeast of Dahlonega. Many other alluvial areas scattered throughout northern Georgia were being rewashed and panned in a small way. Many attempts to placer the gravels in prospects on the Yahoola and Chestatee Rivers and on other streams have been made, but these prospects were idle when visited.

ALABAMA MINES

LODES AND RESIDUAL PLACERS

The distribution of the gold deposits of Alabama is shown on plate 50, and the localities from which gold has been reported are given by counties in the table below. The deposits are confined to a relatively small area in the east-central part of the State. About 100 properties are known to be gold-bearing, but pertinent information was obtained at only a few. The better-known and most fully developed mines and prospects are discussed below. The distinction between lode and placer deposits is not clear-cut, and most of the lodes were originally worked as residual placers.

In the following tabular summary the gold localities are listed alphabetically by counties:

Alabama gold localities

[Asterisks indicate properties not visited]

County	Name	Location	District
Chilton	B. T. Childers*	NW¼SE¼ sec. 15, T. 22 N., R. 13 E.	
	Franklin (Jemison)*	NW¼SW¼ sec. 8, T. 22 N., R. 13 E.	
	Mulberry Creek placer*	Sec. 17, T. 22 N., R. 13 E.	
	Rippatoe placer*	Sec. 17, T. 21 N., R. 16 E.	
	Rocky Creek placer*	Sec. 30, T. 21 N., R. 16 E.	
	Placer*	Sec. 31, T. 21 N., R. 16 E.	
Clay	Alabama Gold Mine & Mica Co.	SE¼SW¼ sec. 36, T. 19 S., R. 7 E.	Idaho.
	Ashland Mining Co.	1½ miles south of Haraldson property.	Do.
	Benjamin, near Cragford.		Cragford.
	Brown prospect	5 miles northwest of Ashland.	Idaho.
	California*	Sec. 15, T. 20 S., R. 7 E.	Do.
	Chinca Pina	Sec. 33, T. 19 S., R. 7 E.	Do.
	Dawkins*	SE¼ sec. 2, T. 21 S., R. 9 E.	Cragford.
	Eley	NW¼SE¼ sec. 27, T. 19 S., R. 7 E.	Idaho.
	Farrar	NW¼SW¼ sec. 36, T. 20 S., R. 9 E.	Cragford.
	Franklin (Idaho)	Sec. 3, T. 20 S., R. 7 E.	Idaho.
	Grizzel	Sec. 24, T. 20 S., R. 9 E.	Cragford.
	Haraldson	Sec. 33, T. 19 S., R. 7 E.	Idaho.
	Harall*	Sec. 34, T. 20 S., R. 6 E.	Do.
	Hobbs	Sec. 3, T. 20 S., R. 7 E.	Do.
	Horns Peak	Sec. 4, T. 20 S., R. 7 E.	Do.
	Lashley	Northeast of Cragford	Cragford.
	Laurel	Sec. 4, T. 20 S., R. 7 E.	Idaho.
	Manning placer	Secs. 25–36, T. 20 S., R. 9 E.	Cragford.
	Prospect*	Sec. 13, T. 22 S., R. 8 E.	
	Prospect tunnel*	SW¼ sec. 23, T. 21 S., R. 7 E.	
Cleburne	Anna Howe (Anna Howe Extension, Crutchfield).	Sec. 34, T. 16 S., R. 11 E.	Arbacoochee.
	Arbacoochee placer	Secs. 5, 6, T. 17 S., R. 11 E.	Do.
	Ayers*	SW¼SW¼ sec. 33, T. 17 S., R. 11 E.	
	Bennefield*	Sec. 27, T. 16 S., R. 12 E.	
	Carr Creek*	Sec. 23, T. 17 S., R. 9 E.	Chulafinnee.
	Chulafinnee	Secs. 14, 5, 6, T. 17 S., R. 9 E.	Do.
	Clear Creek	Sec. 7, T. 17 S., R. 11 E.	Arbacoochee.
	Crown Point*	Sec. 19, T. 17 S., R. 11 E.	
	Crumpton*	Sec. 7, T. 17 S., R. 12 E.	
	Eckles*	Sec. 23, T. 17 S., R. 10 E.	
	Golden Eagle (Prince)*	Sec. 17, T. 17 S., R. 11 E.	Do.
	Hicks-Wise	Sec. 2, T. 17 S., R. 11 E.	
	Higginbottom*	NE¼ sec. 22, T. 17 S., R. 9 E.	Chulafinnee.
	Jack Talley		Arbacoochee.
	Johnson. Near Chulafinnee cross roads.		Chulafinnee.
	King	Sec. 16, T. 17 S., R. 9 E.	Do.
	Rev. Mr. King*	E½NW¼ sec. 22, T. 17 S., R. 9 E.	Do.
	Lee	Sec. 2, T. 17 S., R. 11 E.	Arbacoochee.
	Lucky Joe*	Sec. 25, T. 17 S., R. 11 E.	
	Marion White*	Sec. 6, T. 16 S., R. 12 E.	
	Middlebrook*	Sec. 3, T. 17 S., R. 12 E.	
	Moss-back*	Sec. 35, T. 17 S., R. 11 E.	
	Pritchet	Sec. 36, T. 17 S., R. 11 E.	
	Prospect	Sec. 32, T. 16 S., R. 11 E.	
	do	Sec. 33, T. 16 S., R. 11 E.	
	do	Sec. 25, T. 17 S., R. 11 E.	
	Striplin	Sec. 22, T. 17 S., R. 9 E.	Chulafinnee.
	Sutherland*	Sec. 34, T. 16 S., R. 12 E.	
	Valdor	Sec. 3, T. 17 S., R. 11 E.	Arbacoochee.
Coosa	Alum Bluff	Sec. 35, T. 22 N., R. 16 E.	
	Flint Hill locality*	Sec. 17, T. 22 N., R. 16 E.	
	Gold Ridge prospect*	Sec. 1, 2, T. 21 N., R. 16 E.	
Coosa	Hatchett Creek placer*	Hatchett Creek	
	Rockford placer*	Near Rockford	
	Rockford prospect	Southeast limit of Rockford Town.	
	Stewart (Parsons) prospect.	Sec. 4, T. 23 N., R. 17 E.	
	Weogufka Creek placer*	Weogufka Creek	
Randolph	Bradford Ridge prospect.*	NW¼SE¼ sec. 30, T. 20 S., R. 10 E.	Cragford.
	Goldberg prospect*	SW¼ sec. 30, T. 20 S., R. 10 E.	Do.
	Gold Ridge property*	Sec. 4, T. 18 S., R. 12 E.	
	Morris property*	Sec. 21, T. 20 S., R. 10 E.	Do.
	Pine Hill prospect*	SE¼NE¼ sec. 30, T. 20 S., R. 10 E.	Do.
	Pinetucky mine	Sec. 12, T. 18 S., R. 10 E.	
	Teakle prospect	NW¼ sec. 29, T. 20 S., R. 10 E.	Do.
	Wild Cat Hollow*	Sec. 29, T. 20 S., R. 10 E.	Do.
Talladega	Gold Log (Story, Warwick and Cogburn).	SW¼SW¼ sec. 20, T. 19 S., R. 6 E.	Riddle's Hill.
	Riddles	Sec. 16, T. 19 S., R. 6 E.	Do.
	Woodward tract*	Sec. 16, T. 19 S., R. 6 E.	Do.
Tallapoosa	Alabama King prospect.	1½ mile southwest of Jackson's Gap.	Devils Backbone.
	Birdsong	W½ sec. 4, T. 24 N., R. 23 E.	Goldville.
	Blue Hill	Sec. 33, T. 21 N., R. 22 E.	Devils Backbone.
	Bonner Terrel prospect*	Sec. 19, T. 22 N., R. 23 E.	Do.
	Tine Burnett property*	Cowpens	Goldville.
	Chisolm prospect*	Sec. 9, T. 23 N., R. 22 E.	Do.
	Croft Pits*	Sec. 34, T. 24 N., R. 22 E.	Do.
	Dent Hill prospect*	½ mile northeast of Silver Hill.	Devils Backbone.
	Duncan property*	3 miles from Alexander City on Hillabee Bridge Road.	Goldville.
	Dutch Bend prospect (Ulrich, Romanoff)	Sec. 8, T. 23 N., R. 22 E.	Do.
	Early pits*	SW¼ sec. 26, T. 24 N., R. 22 E.	Do.
	Germany pits	Sec. 8, T. 24 N., R. 23 E.	Do.
	Goldville pits	Sec. 8, T. 24 N., R. 23 E.	Do.
	Greer prospect*	SE¼ sec. 24, T. 23 N., R. 23 E.	Eagle Creek.
	Gregory Hill	Sec. 33, T. 21 N., R. 22 E.	Devils Backbone.
	Hammock prospect*	SW¼ sec. 24 T. 23 N., R. 23 E.	Eagle Creek.
	Hawthorne prospect	¾ mile southwest from Lowe property.	Goldville.
	Hog Mountain (Hillabee) mine.	Secs. 10 and 15, T. 24 N., R. 22 E.	
	Holly prospect*	Sec. 10. T. 21 N., R. 22 E.	Devils Backbone.
	Houston pits*	Sec. 18, T. 24 N., R. 23 E.	Goldville.
	Jennings property	SW¼ sec. 26, T. 23 N., R 23 E.	Eagle Creek.
	Johnson prospect*	W½SW¼ sec. 17, T. 23 N., R. 24 E.	Do.
	Jones pits	Sec. 5, T. 24 N., R. 23 E.	Goldville.
	Log pits	Sec. 24, T. 24 N., R. 22 E.	Do.
	Lowe property	Sec. 9, T. 24 N., R. 23 E.	Do.
	Mahan pits	Sec. 4, T. 23 N., R. 22 E.	Do.
	Silver Hill property*	Secs. 16 and 17, T. 20 N., R 22 E.	Devils Backbone.
	Stone pits*	Sec. 34, T. 24 N., R. 22 E.	Goldville.
	Tallapoosa (Hood) prospect.	SW¼SW¼ sec. 26, T. 24 N., R. 22 E.	Do.
	Tapley prospect*	SE¼ sec. 27, T. 23 N., R. 23 E.	Eagle Creek.

CLAY COUNTY

ASHLAND MINING COMPANY

In August 1934 the Ashland Mining Co. was sinking two shafts just north of the Ashland-Talladega Highway and about 1 mile west of the Heflin Schoolhouse. One shaft had been sunk about 80 feet and the other about 40 feet. The development was reported to be still proceeding in February 1935, but the property was not visited at that time. The country rock is Ashland mica schist containing many crystals of iron-rich garnet about an eighth of an inch in diameter. A little quartz was seen and was said to contain some gold.

BROWN

The Brown prospect is about 5 miles northwest of Ashland and about half a mile east of the better known Franklin mine. The lode is exposed in a shaft more than 45 feet deep and in several trenches (see fig. 41).

The country rock is weathered almost beyond recognition, but on the State geologic map it is included in the Ashland mica schist. Fragments of an intrusive rock were seen on the dump from the shaft, and pegmatite stringers and lenses have been cut in the trenches. The pegmatite consists of quartz, muscovite books as much as 1½ inches in diameter, and small masses of kaolin presumably derived from feldspar. The soil and saprolite are speckled and have a texture suggesting that they are derived from granite. A schistose structure also can be recognized in places, and garnets were seen near the prospect. Several pieces of quartzite float enclosing considerable kyanite were found northwest of the workings.

The quartz exposed in the workings is similar in appearance to the quartz in the pegmatite stringers. It is grayish or white, coarsely sugary, and usually vitreous,

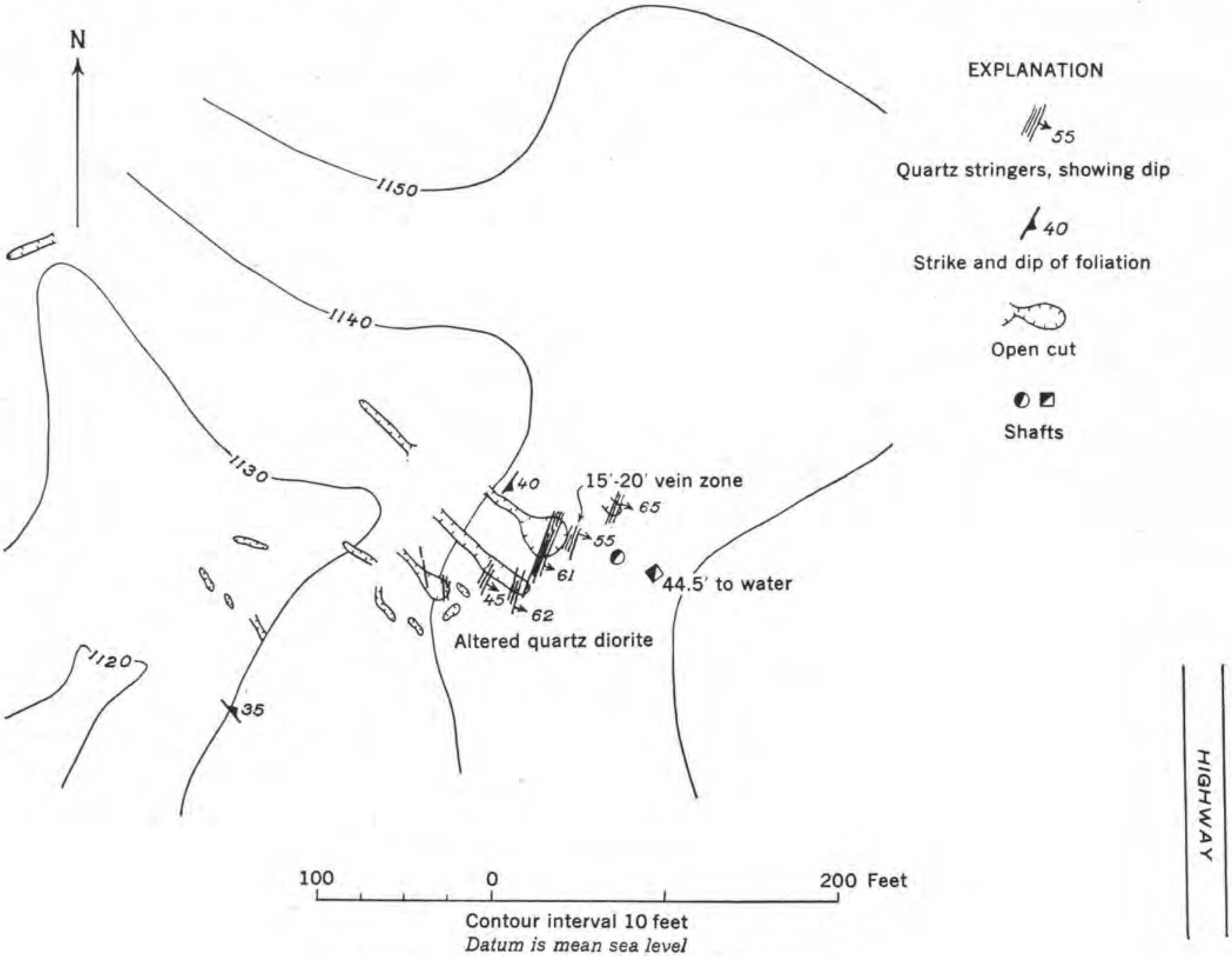

FIGURE 41.—Surface plan, Brown prospect, Clay County, Ala.

and it has a conspicuous platy structure. Much of the quartz contains spots of kaolin, probably formed by weathering of feldspar, and much of it is stained with oxides of iron and manganese. Some of it contains a little ilmenite.

Exposures in the workings indicate the presence of a considerable body of quartz. This body has not been followed, however, for more than 150 feet on the surface, where it is not well enough exposed to be outlined with any degree of assurance. From the distribution of the workings, it is inferred that the trend of the lode as a whole is northwest, although the individual quartz bodies within it apparently strike northeast.

FRANKLIN

The Franklin (Idaho) mine is in sec. 3, T. 20 S., R. 7 E., Huntsville meridian, about 5 miles northwest of Ashland (see pl. 51).

Two lodes, the Franklin and the Little Samson, have been worked in this mine. The Franklin lode, which is the larger, is exposed in two open cuts, each about 40 feet deep in 1935. It consists of numerous lenses and stringers of quartz. The ore body, which is said to have been about 50 feet wide, was opened by cuts for more than 300 feet along the strike and to a maximum depth of 60 feet. The ore is said to have contained about $2 to the ton in gold. During 1896 a plant designed to handle 30 tons in 24 hours was in operation.[21]

The workings on the Little Samson lode lie northeast of the two large pits. They were inaccessible when visited, but, judging from the quartz seen in place near the surface and material on the dumps, the Little Samson lode is similar to the more extensively developed Franklin lode.

Near the south end of the mapped area is an old open cut that contains a few pieces of quartz float but no rock in place. In the dry gully on the southwest border of the map is an old adit 160 feet long, which shows a few small quartz stringers in decomposed black garnetiferous schist.

The country rock is the Ashland mica schist, possibly derived in part from intrusive rock. Its nature is largely inferred from a study of the saprolite and soil for, although the accessible workings are 40 to 45 feet below the surface, they expose no fresh rock. Despite the generally decomposed condition of the rocks, much of the schist and quartzite contains comparatively fresh biotite. The schistosity strikes about N. 50° to 75° E., and dips southeastward at various angles. These rocks are cut by inconspicuous joints, which trend nearly north and dip either east or west, and by a few small stringers and lenses of pegmatite. The pegmatite contains biotite and muscovite, which form books about an inch in maximum diameter, quartz, and kaolin presumably derived from feldspar. In at least one place the mica and kaolin decrease in amount, and the pegmatite grades into a typical quartz stringer.

[21] Brewer, W. M., A preliminary report on the upper gold belt of Alabama: Alabama Geol. Survey Bull. 5, pp. 58–62, 1896. Nitze, H. B. C., and Wilkens, H. A. J., Gold Mining in North Carolina and adjacent south Appalachian States: North Carolina Geol. Survey Bull. 10, p. 89, 1897.

LASHLEY

On the Lashley property, near Cragford, a few shallow pits had recently (1935) been dug along the Fisher vein, which is a few inches to 2 feet wide where it was seen.

CLEBURNE COUNTY

KING

The King property, in sec. 16, T. 17 S., R. 9 E., Huntsville meridian, about 3 miles west of Chulafinee, was prospected during the summer of 1934 by the Southern Appalachian Development Co., but the work was suspended shortly thereafter.

The property is developed by many open-cuts and several shafts (see pl. 52). Two of the shafts were accessible when the project was visited. The deeper shaft had been sunk to a depth of 74 feet below the bottom of a large open hydraulic pit made by former operators, or about 95 feet below the original surface of the ground. It followed the intersection of two sets of quartz stringers, in which free gold was seen at the surface. The other shaft was about 20 feet deep. A pilot mill, consisting of a small jaw crusher, two stamps, and two 25-ton Gibson amalgamators, was operated at irregular intervals.

The country rock, as shown on the State geologic map and described by Adams,[22] is Hillabee chlorite schist. Fresh rock exposed in the bottom of a 74-foot shaft consisted of greenish-gray spotted schist, all of it silicified and containing many small nodules and minute grains of quartz and magnetite. Except in this shaft, all the rock seen was much decomposed. The altered schist usually breaks into pencil-shaped fragments. Most of it is brownish to yellowish, but some of it shows greenish and reddish colors which the local miners regard as favorable signs for gold.

The ground-water level is shallow, in most places 10 feet or less below the surface. The 74-foot shaft makes 75 to 90 gallons of water a minute. The saprolite zone extends below the water level, but the rock gradually increases in hardness downward and appears fresh in the bottom of the shaft.

The quartz is partly in lenses as much as 2 feet wide, but mostly in stringers, which are widely distributed but irregular in attitude. These stringers in many places have a platy structure, accentuated by layers of sericite. They contain many remnants of schist, a little tourmaline, and a few spots of kaolin, and they are

[22] Adams, G. I., Gold deposits of Alabama: Alabama Geol. Survey Bull. 40, p. 19, 1930.

stained with oxides of manganese and iron. Near the surface the quartz is sugary in texture. An assay by W. W. Simmons of a picked specimen of high-grade quartz from a veinlet gave 9.12 ounces of gold per ton. A specimen of the wall rock immediately adjacent to this veinlet gave 0.1 ounce of gold per ton.

RANDOLPH COUNTY

PINETUCKY

Unsuccessful efforts were made in the early 1930's to reopen the old Pinetucky mine, in sec. 12, T. 18 S., R. 10 E., Huntsville meridian. This mine is one of the most extensively developed in Alabama, but when it was visited in 1935 the workings were inaccessible, and no information was obtained from the badly disintegrated and overgrown dumps. The mine was described in 1896 by Brewer,[23] who says that the mine exploited a vein a fraction of an inch to 2 feet wide, striking about N. 10° E. and dipping 15° to 35° SE. The one ore shoot developed is reported to have contained high-grade quartz, some of which yielded more than $100 a ton.

TEAKLE

On the Teakle property, near Cragford, some work was being done in 1935 by D. H. Farmer of Lineville. A vertical shaft was being sunk to intersect, at a depth of about 100 feet, a vein that was exposed for about 50 feet in an abandoned inclined shaft, which in 1935 was inaccessible below that depth. In the incline this vein is 4 to 5 feet wide and consists of 3 to 4 feet of dark, greasy-looking quartz and about 1 foot of clay mixed with quartz fragments. The vein strikes about N. 55° E. and dips 50° to 60° SE. The country rock appears to be schist of the Wedowee formation, but it is so altered near the surface that its origin is uncertain. Some material on the dump resembles saprolite derived from an intrusive rock. A little arsenopyrite and pyrite are found in the quartz, and also some iron oxide and scorodite.

TALLADEGA COUNTY

GOLD LOG

The Gold Log mine is in the SW¼SW¼ sec. 20, T. 19 S., R. 6 E., Huntsville meridian, about 7½ miles southeast of Talladega, on the west bank of Talladega Creek (pl. 53). It was described by Bastin [24] in 1916. The property was idle at the time of visit in 1935. It is owned by Story, Warwick, and Cogburn, and is held under lease by T. R. Jones of Talladega, Ala.

The country rock is Talladega slate, which at this place is a fine-grained greenish-gray rock that readily breaks into thin flat or smoothly curved plates. It consists mostly of a quartz and sericite. A little chlorite and pyrite are usually present, though inconspicuous, and small red garnets, about an eighth of an inch in diameter, are found. The foliation strikes N. 60° to 70° E. and dips 30° to 50° SE.

The lode is a series of quartz stringers and lenses that lie approximately parallel to the schistosity. Locally the schist in the lode is silicified and is cut across by stringers of quartz, many of which contain a little calcite.

Bastin [25] reports that small quantities of chalcopyrite, enargite (?), and free gold occur in the quartz. He says also:

> The vein has been exploited by a drift tunnel about 250 feet long, from which an incline follows the vein for about 320 feet. * * * The stopes range in width from 5 to 8 feet, the average being about 6 feet. The richer parts of the ore are typified by an exposure at the bottom of the incline, where a number of subparallel lenses of quartz, calcite, and metallic minerals together constitute about two-thirds of the 5-foot face. The individual lenses, which range from a few inches to a foot in width, are separated by sericite schist and by quartzose and calcite schist formed by the partial replacement of the sericite schist. It is characteristic of the deposit that comparatively wide bodies of ore may decrease greatly in width or pinch out completely in very short distances parallel to the trend of the vein. For example, 6 feet along the strike of the vein from the 5-foot exposure just described, which was about two-thirds ore, practically all the vein quartz had pinched out, the entire face being sericite schist.

TALLAPOOSA COUNTY

ALABAMA KING

The Alabama King mine is about 1½ miles south of Jackson's Gap (pl. 54). In 1934 the workings were inaccessible, and the mine had apparently been idle for some time, but judging from the size of the dumps, considerable underground work has been done.

The country rock is the carbonaceous, garnetiferous schist of the Wedowee formation. The foliation planes and the bedding planes, which are marked by thin quartzitic layers and are approximately parallel, strike N. 30° E. and dip 35° to 45° E.

The lode dips at low angles, nearly parallel to the foliation. It is persistent for several hundred feet and contains small but well-defined quartz veins, which locally form lenses several feet wide. In places the schist adjacent to the stringers is somewhat silicified.

BLUE HILL AND GREGORY HILL

The Blue Hill and Gregory Hill mines are in sec. 33, T. 21 N., R. 22 E., St. Stephens Meridian, about 12 miles southwest of Dadeville, on the west slope of the prominent ridge known as the Devil's Backbone. The two properties, though under separate ownership, form a continuous mineralized belt and are described together (see pl. 55).

[23] Brewer, W. M., op. cit., pp. 50–56.

[24] Bastin, E. S., The Gold Log mine, Talladega County, Ala.: U. S. Geol. Survey Bull. 640, pt. 1, pp. 159–161, 1916.

[25] Bastin, E. S., op. cit., p. 160.

In 1934 the Gregory Hill mine was idle and most of the old workings were inaccessible. The Blue Hill mine was being developed by the Frye-Rhea Development Co. The old workings had been cleaned out, and some sampling and a little mining had been done from the inclined shaft on the plane of the lode, which trends N. 20° E. The water level in the Blue Hill mine is shallow and it was said that when pumping was stopped the inclined shaft would fill completely with water in about two weeks. A mill of 100-ton capacity was installed at Blue Hill late in 1934, and when the property was revisited in February 1935 this mill was in operation. Gold was being recovered in Gibson amalgamators and on tables. Operations were suspended in October 1935.

The country rock is dark-gray carbonaceous schist of the Wedowee formation, the foliation planes of which trend north to N. 20° E. and dip eastward at low angles. Jointing is noticeable but not conspicuous; it strikes northwest and dips either northeast or southwest. Along the crest of the ridge (Devils Backbone) east of the mines is a conspicuous resistant quartzite about 10 feet thick, which is apparently faulted off to the south. The depth of decomposition of the carbonaceous schist is surprisingly shallow; a few feet below the surface the rock has its original texture and black color, the only signs of alteration being that the rock is softer than in depth and that its pyrite is changed to brownish iron-oxide.

The deposit consists of many quartz stringers and lenses, generally alined with the schistosity but in a few places cutting across it. The width of the lode is somewhat indefinite but is probably 40 to 50 feet. The quartz stringers are commonly concentrated in zones a few feet wide, separated by zones of barren schist that are similar to them in width. Quartz veins 1 to 2 feet thick occur in a few places, and on Gregory Hill a vein 18 inches to 2 feet thick cuts the schistosity at a low angle. Near the surface the quartz has a sugary texture, but it becomes more massive in depth. A little pyrite is present, and marcasite is found in seams. Near the lode the schist is somewhat silicified and platy and in part sericitic.

BURNETT

At Tine Burnett's place, just northeast of Cowpens in the Goldville belt, a quartz lode was exposed in several shallow pits. Free gold could be panned from much of this quartz.

DUTCH BEND

The Dutch Bend property (also called the Ulrich or the Romanoff) is on the east bank of Hillabee Creek, in sec. 8, T. 23 N., R. 22 E., St. Stephens Meridian, about 9 miles from Alexander City. The property was operated during 1934 and 1935 by Robert Russell, but was closed in the fall of 1935. The mine marks the southern limit of mining on what is locally termed the Goldville belt, although some prospecting has been carried on farther south. Old workings can be traced northeast of Dutch Bend for more than 10 miles, with but few long intervals in which there is not a pit or an adit.

The country rock is carbonaceous schist of the Wedowee formation, intruded by a schistose quartz diorite dike which contains most of the quartz veins (see pl. 56). In both schist and diorite the foliation strikes a few degrees east of north. The contact between the two rocks is generally tight and shows no sign of movement. It locally cuts across the schistosity, but in general the dike is parallel to the trend of foliation. Contact metamorphism is not conspicuous, although in both the dike and schist muscovite is somewhat more common near the contact than elsewhere. Small reddish garnets are widely distributed through the schist.

An intrusive body of quartz diorite of unknown size is exposed northwest of the area shown on the surface map; its relation to the dike is not known.

The mine is developed by a shaft about 100 feet deep, from which two levels have been driven. The upper level, at a depth of about 40 feet, comprises about 700 feet of drifting and connects with an adit (see pl. 56). The lower level, which extends from the bottom of the shaft, contains about 500 feet. The Wolf Den adit, northeast of the main shaft, was apparently driven to intersect the dike. It is caved about 275 feet from the portal, and from there outward it cuts no well-defined vein. Numerous open-cuts have been made in the deep-red clayey soil overlying the quartz diorite dike. This soil grades downward into the saprolite zone, and the 100-foot level is mostly in hard rock, although even at this depth some of the rock is soft and decomposed. As a rule the schist is less deeply weathered than the sheared quartz diorite. The original depth of the water table is not known, as the water cannot now rise above the 40-foot adit.

The pits and the deeper workings at Dutch Bend expose numerous quartz veins. The veins in the quartz diorite dike, as viewed in either a horizontal or a vertical section, form a steplike, or echelon pattern. Structurally and mineralogically the deposit is similar to those at Hog Mountain (p. 9). The veins pinch and swell so markedly that each vein may be regarded as a series of lenses connected by stringers of quartz. On passing from the diorite into the schist, most of the veins pinch out within a few feet, but a few of them split, where they enter the schist, into two or more branches that soon become parallel to the foliation. Some lenses and small veins of quartz are found in the schist at a distance from the quartz diorite, and at least one vein follows the contact.

The veins consist mostly of quartz and sericite. Near the surface the quartz has a sugary texture and the ore readily breaks into thin sericite-coated slabs. On the 100-foot level the quartz is massive and dark bluish, with a platy or ribbonlike structure formed by alternating bands of quartz and sericite. In the freshest ore pyrrhotite, chalcopyrite, and a little arsenopyrite were recognized. Marcasite is present in seams that cut the veins and the country rock. Some gold is reported to occur in the rock near the veins.

The gold is usually fine grained and is associated with and enclosed in the sulfides. Small particles of gold can be seen in the oxidized ores, and colors are readily obtained by panning the surface debris on the slope below the outcrops of the vein.

Mining done in the years immediately preceding 1935 was largely confined to the area shown on plate 56. Veins outside that area but on the strike of the belt also had been worked and one mineralized vein of exceptional width (about 10 feet) is exposed in an open cut a short distance northeast of the area. Early in February 1935, 6 tons of concentrates were produced in a small flotation mill on the property and shipped to the Nichols Copper Co.'s smelter on Long Island.

HAWTHORNE

The Hawthorne prospect is near the north end of the Goldville belt and about three-quarters of a mile southwest from the Lowe mine (fig. 42). A little work was done on the property in 1932–33, but it was idle when visited in 1935.

Two nearly parallel, rather narrow, lodes have been found on the property. They consist of stringers and small lenses of quartz in carbonaceous schist of the Wedowee formation. The quartz in the exposures is sugary and contains cavities from which sulfides have been leached. Some of these cavities contain a little sulfur and oxides of manganese and iron. Locally the schist near the stringers is silicified and contains considerable sericite. Two directions of foliation in the schist can be recognized.

HOG MOUNTAIN

Hog Mountain is in the north-central part of Tallapoosa County, about 13 miles northeast of Alexander City. The Hog Mountain Gold Mining and Milling Co. controls 1,658 acres of land; its principal mine workings are in secs. 10 and 15, T. 24 N., R. 22 E., St. Stephens Meridian. The property has been briefly described in several papers,[26] and it was studied in considerable detail by the writers.[27]

[26] Phillips, W. B., The gold fields of Alabama: Alabama Geol. Survey Bull. 3, pp. 36–55, 1892. McCaskey, H. D., Mineral Resources U. S. 1908, pp. 650–652. Notes on some gold deposits of Alabama: U. S. Geol. Survey Bull. 340, pp. 36–52, 1908. Aldrich, T. H., Jr., The treatment of the gold ores of Hog Mountain, Ala.: Am. Inst. Min. Met. Eng. Trans. vol. 39, pp. 578–583, 1909. Adams, G. I., Gold deposits of Alabama: Alabama Geol. Survey Bull. 45, pp. 49–50, 1930.

[27] Park, C. F., Jr., Hog Mountain gold district, Alabama: Am. Inst. Min. Met. Eng., Tech. Pub. 598, 1935; Trans., vol. 115, pp. 209–228, 1935.

The mine was worked at irregular intervals from its discovery in 1839 until 1890 when it was acquired by Col. T. H. Aldrich. Before 1890 mining was almost confined to South Hill, near the south end of the intrusive mass (see pl. 57). About 1893 work was begun on the veins in the northern part of the intrusive body. The mine was operated continuously until 1915, when it was forced to close, probably because of economic conditions resulting from World War I and because of depletion of the amenable oxidized ores. During this period of 1893–1915 the reported production of gold amounted to about 12,500 ounces, valued at $250,000.[28] The mine was idle from 1916 to August 1933, when it was reopened by the Mountain Mining & Milling Co.

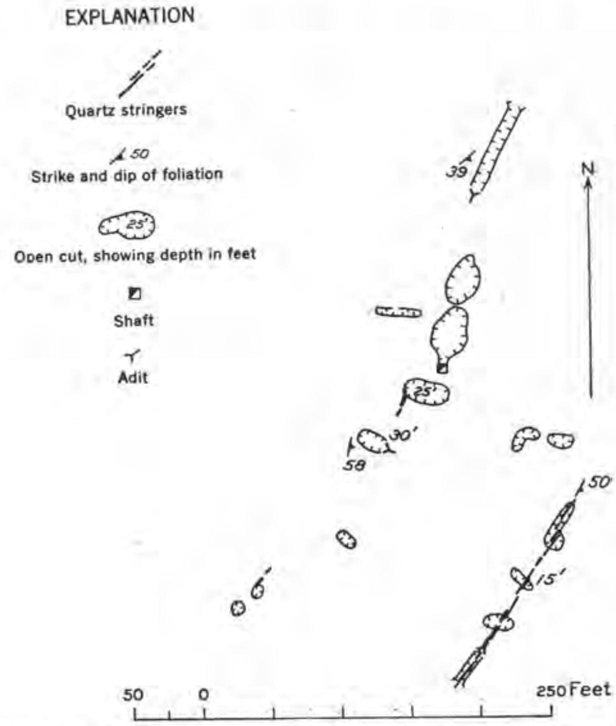

FIGURE 42.—Compass-and-pace sketch of Hawthorne prospect, Tallapoosa County, Ala.

During 1934 and 1935 this company produced about 4,800 ounces of gold, valued at about $168,000.[29] The mine was closed and the plant dismantled in May 1937. An exploratory drift driven southward on the 200-foot level disclosed only small, rather low-grade veins.

Hog Mountain is a conspicuous ridge rising about 400 to 500 feet above the adjacent country, or a little more than 1,000 feet above sea level (see pl. 57). It consists of quartz diorite and silicified schist, which are more resistant to erosion than the surrounding schist of the Wedowee formation. The quartz diorite occupies an area about 4,800 feet long and 800 to 1,300 feet wide. The long axis of this body extends about N. 10° E., ap-

[28] Adams, G. I., Gold deposits of Alabama: Alabama Geol. Survey Bull. 40, p. 50, 1930.

[29] Minerals yearbook, 1935, 1936.

proximately parallel to the strike of the surrounding schists. Veins of possible commercial value are almost wholly confined to the quartz diorite, whose boundaries mark, in general, the limits of the ore bodies. The form of the intrusive body is thus of direct economic importance.

The northern part of the quartz diorite is thought to be a sheet the bottom of which plunges southward at an angle of 20° to 25°. An east-west section along either the North or the Rat vein, both supposedly mined out, shows the contact between the schist and the quartz diorite to be saucer-shaped. The igneous mass is complex in shape and is not, as might be assumed from the sections, a simple pipe-shaped body which dips eastward parallel to the lines of schistosity and plunges southward. The schist found in the eastern end of the 200-foot level indicates either a roll in the lower contact of the intrusive or a large inclusion of schist. The former alternative appears to be supported by detailed study of the orientation of the crystals in the quartz diorite at this place. The west contact of the diorite dips 30° to 35° eastward near the main shaft but appears to steepen southward. The east contact apparently has a steeper eastward dip, as indicated by the schist in the east end of the 100-foot level and by old stope maps (see pl. 58). This inference has not been fully verified by first-hand observation, for the stopes are now inaccessible, and accurate measurements of the dip at the surface are impossible because of interfingering of quartz diorite and schist, contact-metamorphic effects, and poor exposures. When the contact is exposed underground it is tight, showing no evidence of movement, although a schistosity along the contact zone can be seen in places. Much more underground development, particularly to the south, would have to be done before the shape of the intrusive body could be fully determined.

At least 16 well-defined veins are developed by surface cuts and shallow workings. These veins are, from north to south: the North, Rat, Red, Tunnel, Pasley, Barren, Blue, Sugar Quartz, Big Pine, Triple, Little Pine, Champion, Thunderwood, Dogwood, Boundary, and Old Tunnel. Others, such as the Jumbo, Rawhide, Smith, and many unnamed veins farther south, have been less extensively developed (see pl. 58). Most of these veins persist for greater distances along the strike than appears on the geologic map, but owing to the deep weathering it is impossible to trace veins on the surface without considerable trenching. The veins differ widely in thickness. The thickest is the Blue vein, which attains a thickness of 20 feet, but judging from abandoned stoped and accessible exposures, veins from 3 to 8 feet thick are common. The Barren vein is somewhat narrower than the Blue vein, the stopes along it being about 4 feet wide (see pl. 6, *B*). It dips more steeply than the Blue vein—perhaps 70° N. on the average. Up to 1935, no work had been done on it below the 200-foot level.

The veins that were being worked at Hog Mountain are opened by a vertical shaft 215 feet deep, from which two levels have been driven (see pl. 59). The 100-foot level, which had about 2,380 feet of workings on January 1, 1936, developed the Blue vein, the Barren vein, and the Aldrich vein. The 200-foot level comprises about 1,200 feet of workings on the Blue and Barren veins and an unnamed vein. Most of the stoping done by the company operating in 1935 has been on these two levels. Shrinkage stoping has been used entirely and is generally satisfactory, although some difficulties are met where the veins are deflected along flat joints.

More work has been done on the Blue vein than on any other in the property (see pl. 58). The Blue vein ranges in width from 1 or 2 feet to a maximum of about 20 feet, which is attained on the 200-foot level and in the "shear-zone" stope on the 100-foot level. The average width of the stopes on it is 6 to 8 feet. On the surface, the old pits indicate a split in the vein, and underground this breaking up is commonly exhibited. The Blue vein dips 50° to 75° NW., its average dip being about 60°. The Red and Tunnel veins are opened by about 1,200 feet of workings comprising an adit and drifts on the veins (see pl. 59). The stoping and most of the other work on these veins was done before 1916.

Much of the mining south of the main shaft was carried on through the south drift, a shallow adit, caved and inaccessible in 1935. No maps of this old working level are available. There are more than 3 miles of surface cuts and many shallow tunnels, some of them several hundred feet long, but most of the old tunnels are caved. The work before 1916 was confined almost entirely to oxidized ores; the sulfide zone was pierced in only a few places.

The form and distribution of the vein fractures are thought to be best explained as due to cracking of the rigid mass of quartz diorite, in the midst of incompetent schist that yielded to stress by slipping along foliation planes. The persistence of the fractures and this pattern preclude the theory of tension cracks formed during the cooling of the quartz diorite, as suggested by Aldrich,[30] Park,[30a] and Adams.[31]

In a few places the veins widen near the contact to form pipe-shaped ore bodies. An example of this condition is seen at the west end of the Blue vein on the 200-foot level, where the vein expanded into a replacement body of quartz and mineralized quartz diorite, which was mined for a width of about 20 feet. At the east end of the Blue vein on the 200-foot level, quartz

[30] Aldrich, T. H., Jr., The treatment of the gold ores of Hog Mountain, Ala.: Am. Inst. Min. Met. Eng. Trans., vol. 39, p. 578, 1909.

[30a] Park, C. F., Jr., Hog Mountain gold district, Ala.: Am. Inst. Min. Met. Eng. Trans., vol. 115, pp. 226–227, 1935.

[31] Adams, G. I., op. cit., p. 40.

stringers are so numerous that an attempt has been made to mine them. In several places small veins of quartz are found along the contact.

Sheeted zones of closely spaced joint planes that strike nearly due east and dip uniformly to the north are conspicuously developed in the quartz diorite. They are present also in the schist but are less noticeable because the rock is poorly exposed. Many of the joint planes cross the veins; others bend so as to merge with the veins. They appear to be essentially contemporaneous with the vein fissures, but some are later than the vein fissures and offset them slightly. This relation is generally much obscured by late mineralization, but it is well shown in the "shear-zone stope" on the 100-foot level along the Blue vein. The sheeted zones are not as a rule persistent, although in some places they have been followed for as much as 200 feet and show little variation in character. Most of the larger stopes and pits show prominent sheeted zones that cross the veins at angles usually of less than 45°.

Postmineral movement, to judge from available evidence, was exceptional and relatively slight; the mineralizing solutions appear to have been introduced after practically all deformation had ceased. Not only did the solutions deposit their mineral constituents in such openings as existed, but in many places the quartz diorite was replaced, as is shown by the preservation of granitoid texture in rock that is largely composed of quartz. Some of the ore bodies, especially at places where the lode is crossed by sheeted zones, have poorly defined contacts, and near these contacts completely silicified quartz diorite grades into almost unaltered intrusive rock. Many of the small veinlets and stringers have irregular interlocking contacts with the adjacent quartz diorite. Many of the veins, however, have well-defined walls, thinly coated with chlorite and sericite. Some fissure filling may have taken place; but no ribbon structure, comb texture, or other indication of inward growth from the walls has been seen. Evidence now available indicates that replacement was the most important process in the formation of the veins.

Tension fissures, sheeted zones, and joint planes have apparently influenced silicification in many places. In some places one wall of a vein persists and the other wall is deflected along premineral fracture planes; elsewhere both walls are deflected along breaks and the attitude of the vein changes appreciably. Joints dipping less than 20° are prominent in the Blue vein stopes. Large blocks of country rock are enclosed in several of the veins, and these blocks are locally bounded by smooth walls coated with chlorite or sericite.

It is reported by the mine operators and shown on old stope assay maps that the ore in general contained between 0.1 and 0.2 ounce of gold to the ton. Some shoots are of higher grade.

LOWE

The Lowe property is near the north end of the mineralized zone known as the Goldville belt. The main workings are in sec. 9, T. 24 N., R. 23 E., St. Stephens meridian, about 1¼ miles northeast of Goldville (see pl. 60). The property was worked for nearly a year in 1932–33 by a Mr. Pasley, but when visited by the writers in 1934 it had been idle since February 1933.

The country rock is altered schist of the Wedowee formation that has been converted to saprolite not only on the surface but in all the accessible mine workings. Bedding planes in the mine are marked by distinct alternating bands of sandy and clayey saprolite, mostly less than 1 inch thick. The schistosity cuts the bedding at low angles wherever both can be recognized. Much of the saprolite contains small black spots that probably indicate the former presence of garnet.

Approximately 1,000 feet of underground work was accessible in 1934. Three tunnels had been driven (pl. 60) and several shafts were open; the deepest one measured was 42 feet deep. The quartz bodies exposed appear to form two systems, one striking a few degrees east of north and the other about N. 30° E. Some veins locally cut the schistosity. In places the quartz bodies are 10 or 15 feet thick, but they pinch and swell abruptly. The quartz mined is said to have averaged about 0.1 ounce of gold per ton.

The material mined was mostly quartz but included some decomposed schist. The quartz commonly has a sugary texture and contains numerous thin layers of sericite. Marcasite and sulfur, probably formed by the alteration of a sulfide, occur in vugs. Red and brown iron-oxides are abundant in the walls. Manganese stains and ilmenite are common in the ores and in the soil and saprolite.

The accessible workings were all dry, but in places they were probably not more than a few feet above the water level. A small stream that flows through the property was formerly used for milling.

A small cyanide plant was operated during the recent operations, but it has been mostly dismantled and removed.

PLACERS (ALLUVIAL)

Most of the known alluvial placer deposits in Alabama have been worked several times and are now of interest only as a matter of history. A few new placer deposits may remain to be discovered, but most future production is likely to come from lode mining in unoxidized ores.

During 1934 there was a little activity in two placer districts, the Chulafinnee and the Arbacoochee. In the Arbacoochee district, Mr. Jack Talley was sluicing a small amount of saprolite and gravel and recovering the gold in a log washer. The saprolite contains gold-bearing quartz stringers and is mantled with gold-bearing gravel, in places several feet thick, probably an old terrace deposit. A little panning was being done in several branches in this district, and a small amount of gold was being recovered.

In the Chulafinnee district, R. A. S. Johnson had opened a small pit in stream gravel and was attempting to recover the fine gold said to be present. Conspicuous in the gravels are small nodules of white clay, which when wet become soft, plastic mud. A small amount of fine gold said to have been obtained from the gravels was seen by the writers. Except for a few men panning the branches in other areas, no other work was known to be in progress on any placer deposits in the State.

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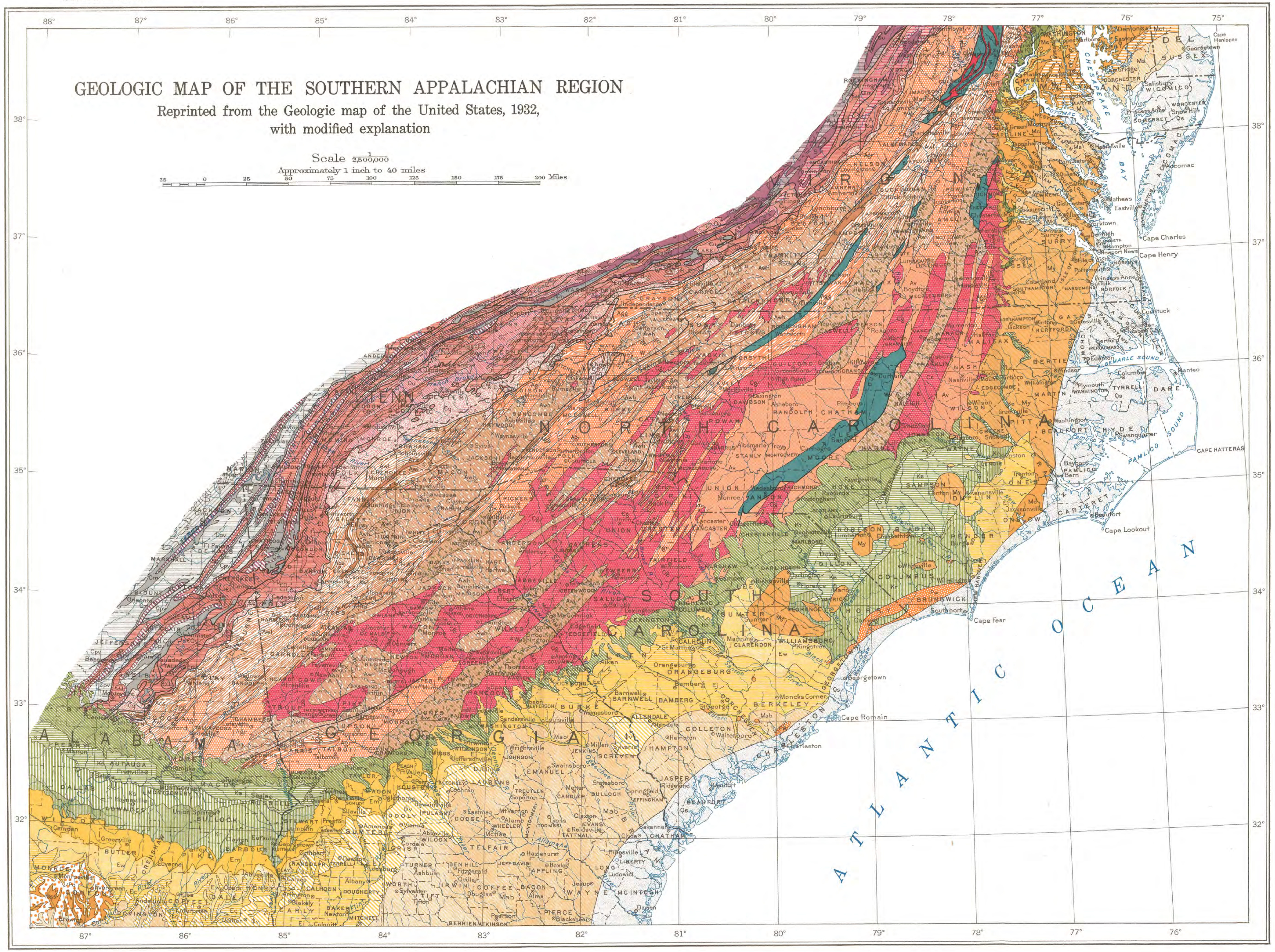


EXPLANATION

QUATERNARY

- Qs — Coastal and estuarine sand and gravel

TERTIARY

Pliocene

- Pc — Continental deposits *(River and estuarine terrace deposits)*
- Pw — Waccamaw marl

Miocene

- My — Yorktown formation *(Duplin marl in North and South Carolina)*
- Ms — St. Marys formation
- Mct — Choptank formation
- Mc — Calvert formation *(Trent marl in North Carolina)*
- Mss — Catahoula sandstone
- Mab — Alum Bluff group and younger beds

Oligocene

- Φv — Vicksburg group

Eocene

- Ej — Jackson group *(Barnwell formation in South Carolina and Georgia; Castle Hayne marl in North Carolina; Cooper marl and Santee limestone in South Carolina; Ocala limestone in Georgia and Alabama)*
- Ec — Claiborne group *(McBean formation in South Carolina and Georgia; Nanjemoy formation in Virginia and Maryland)*
- Ew — Wilcox group *(Black Mingo formation in South Carolina; Aquia formation in Virginia and Maryland)*
- Em — Midway group

CRETACEOUS

- Ks, Kr — Ripley formation and Selma chalk *(Peedee formation in North Carolina and South Carolina)*
- Ke — Eutaw formation *(Black Creek formation in North Carolina and South Carolina, in part of younger age)*
- Kt — Tuscaloosa formation *(Middendorf formation, South Carolina, and contemporaneous deposits in North Carolina)*
- Kl — Lower Cretaceous rocks *(Potomac group, including Patapsco, Arundel, and Patuxent formations)*

TRIASSIC

Upper Triassic

- TR — Newark group
- TRd — Intrusive diabase *(Includes basalt lava flows; mostly of late Triassic age)*

CARBONIFEROUS

Pennsylvanian

- Cpv — Pottsville group

Mississippian

- Cm — Mississippian rocks *(Devonian, Silurian, and Upper Ordovician rocks included in narrow areas)*
- Cmu — Rocks of Chester age

- Cg — Carboniferous (?) granite *(Unmetamorphosed granite intrusive in pre-Cambrian rocks)*

DEVONIAN

- Dmu — Rocks of Chemung to Onondaga age

SILURIAN

- S — Silurian rocks *(Oriskany sandstone and Helderberg limestone included locally in Virginia and West Virginia)*
- SO — Silurian and Ordovician rocks *(Devonian and Mississippian included in places)*

ORDOVICIAN

- Ou — Shale of Maysville and Eden age *(Some beds of Stones River age included in Tennessee)*
- Olm — Limestones of Trenton to Beekmantown age *(Some beds of Eden and Maysville age included in southern Virginia and east Tennessee, and Quantico and Arvonia slates in Virginia, Ordovician (?), included)*
- €O — Limestone of Upper Cambrian and Lower Ordovician age *(Beekmantown, Copper Ridge, and Conococheague limestones; some older Cambrian beds included in Georgia)*

CAMBRIAN

- €u — Limestone and shale of Upper and Middle Cambrian age *(Conococheague and Elbrook limestones; Honaker and Nolichucky limestones in Virginia and Tennessee; Conasauga shale in Georgia)*
- €l — Limestone and shale of Lower and Middle Cambrian age *(Waynesboro shale and Tomstown dolomite in north; Watauga and Rome shales and Shady dolomite in south; some younger Cambrian beds included south of Virginia)*
- €q — Lower Cambrian quartzites and slates

PRE-CAMBRIAN

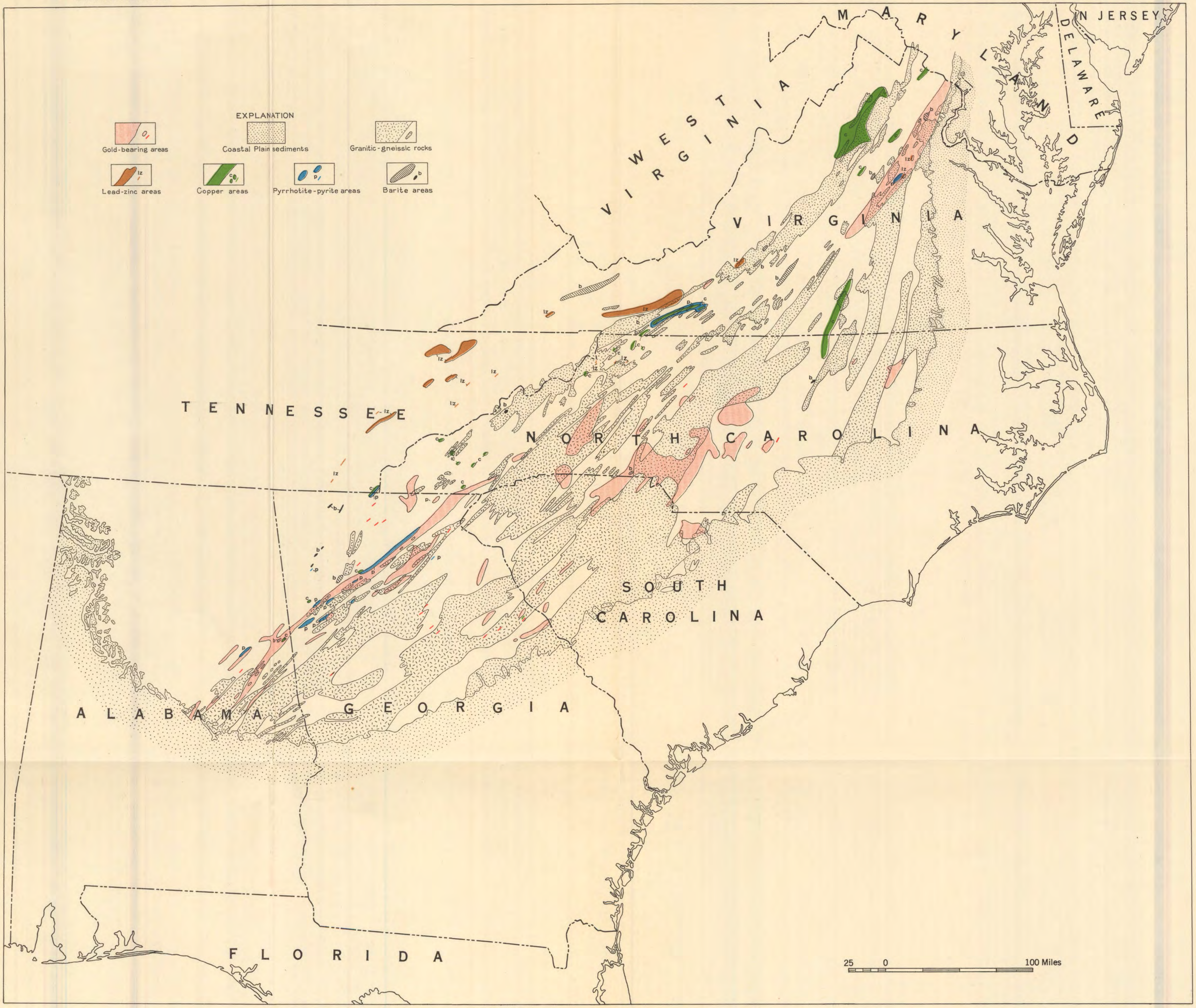
Algonkian ? (Glenarm series)

Wissahickon schist

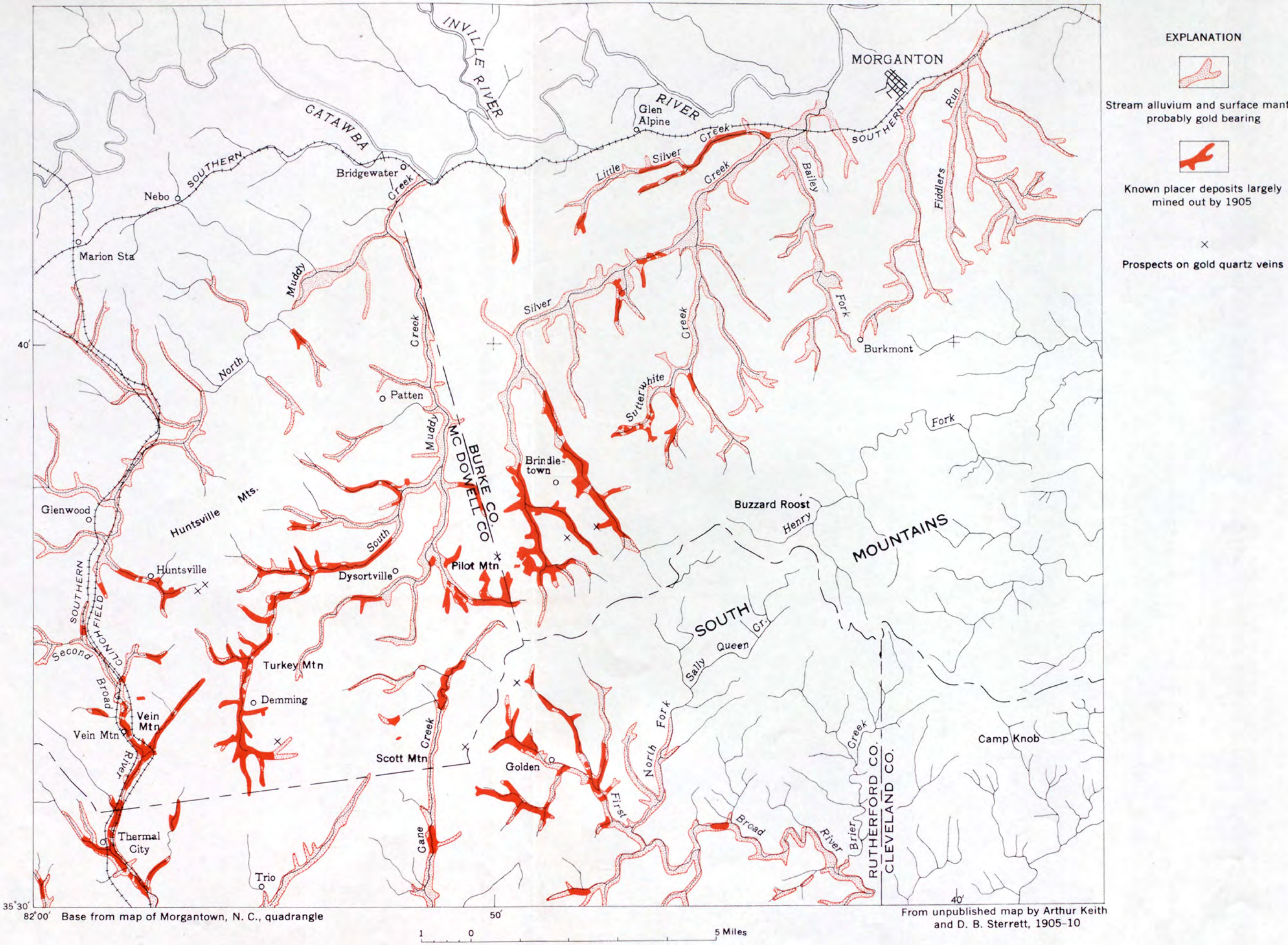
- Awh — Oligoclase-biotite schist *(Indicative of high-rank metamorphism)*
- Awl — Albite-chlorite schist and garnetiferous phyllonite *(Indicative of low-rank and retrogressive metamorphism)*

- Awi — Wissahickon schist with igneous injection
- Acs — Cockeysville marble, Setters formation, and associated volcanic rocks

- Agr — Granite, gabbro, and hornblende gneiss
- Agg — Mylonitized granite gneiss and hornblende gneiss *(Augen gneiss and granite mylonite; indicative of intensive differential deformation)*
- Av — Volcanic rocks *(Metabasalt or greenstone and aporhyolite)*



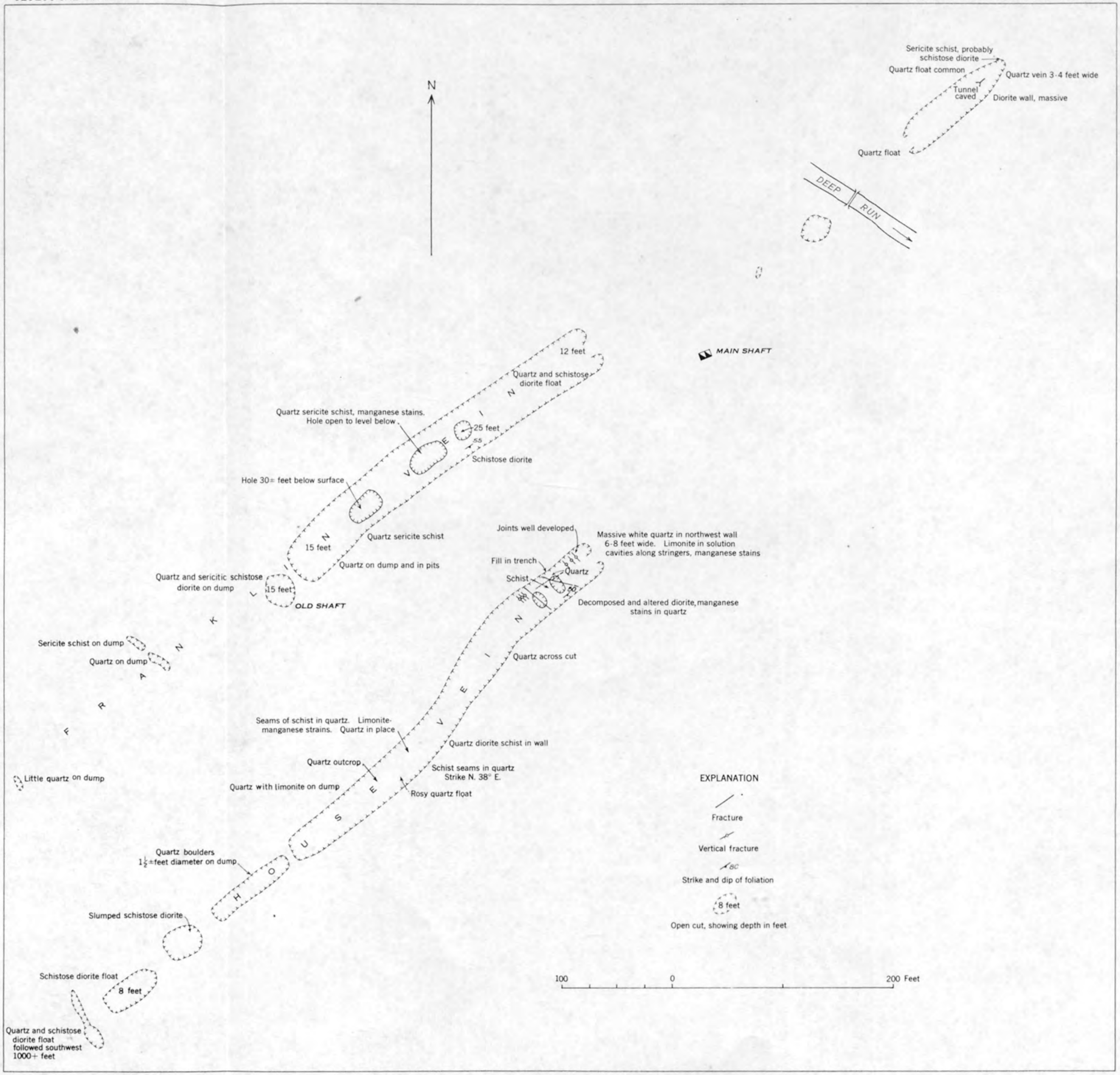
DISTRIBUTION OF METALLIFEROUS DEPOSITS AND BARITE IN THE SOUTHEASTERN STATES



Base from map of Morgantown, N. C., quadrangle

From unpublished map by Arthur Keith and D. B. Sterrett, 1905–10

GOLD PLACERS AND LODES IN THE SOUTHWEST PART OF THE MORGANTOWN QUADRANGLE, NORTH CAROLINA



MAP OF PART OF THE SURFACE WORKINGS, FRANKLIN MINE, FAUQUIER COUNTY, VIRGINIA

Modified after J. L. Darnell

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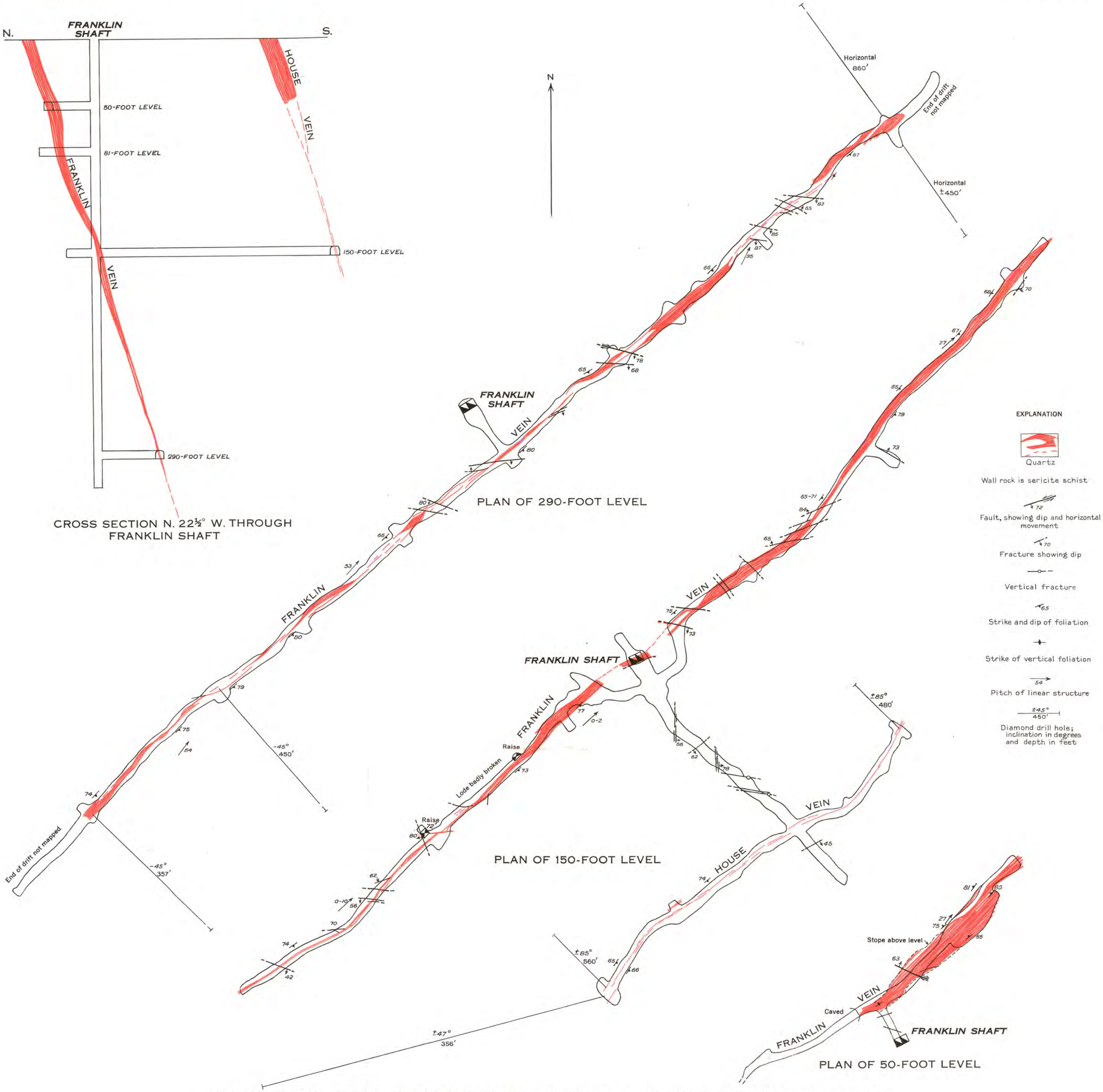
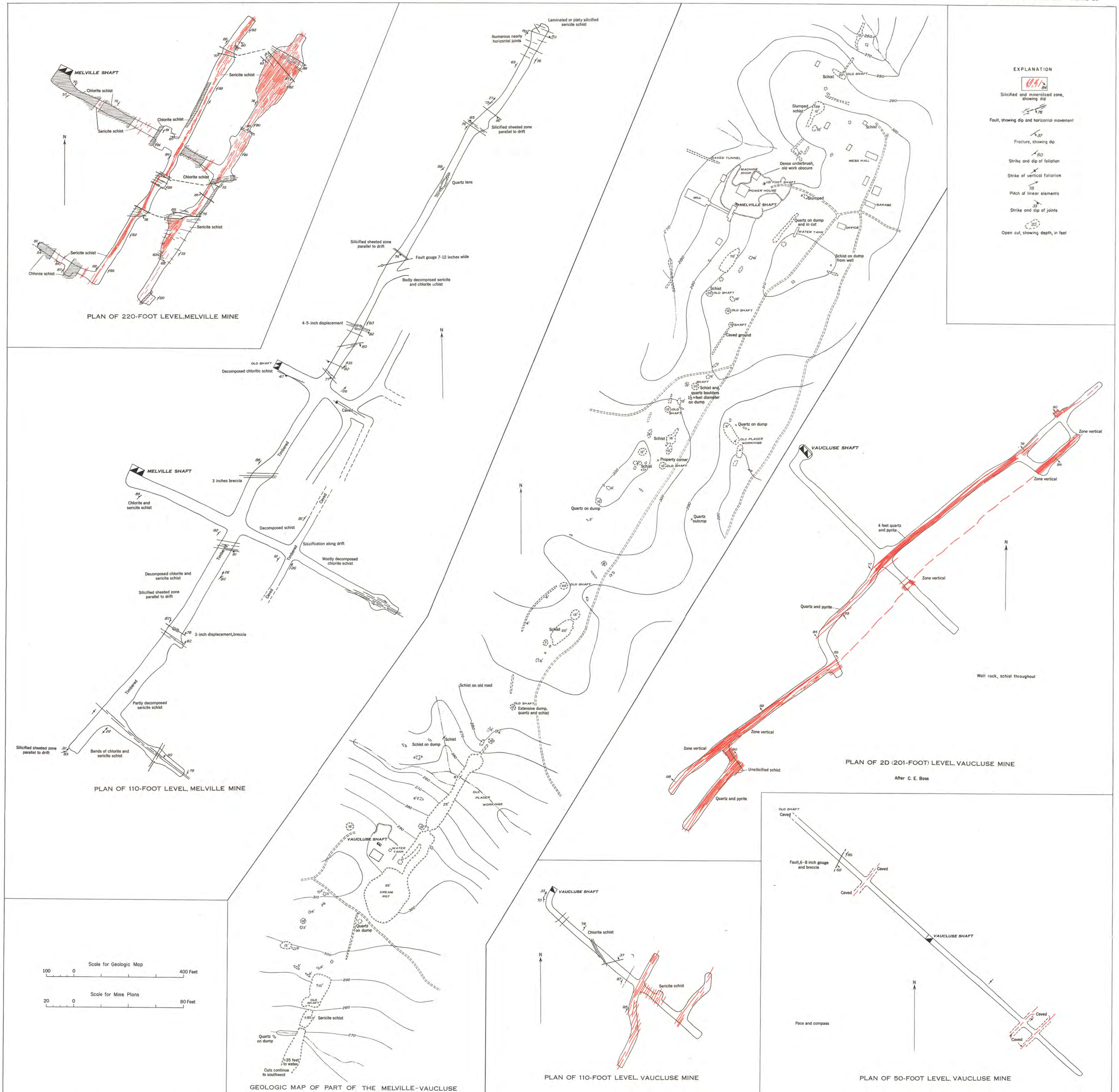
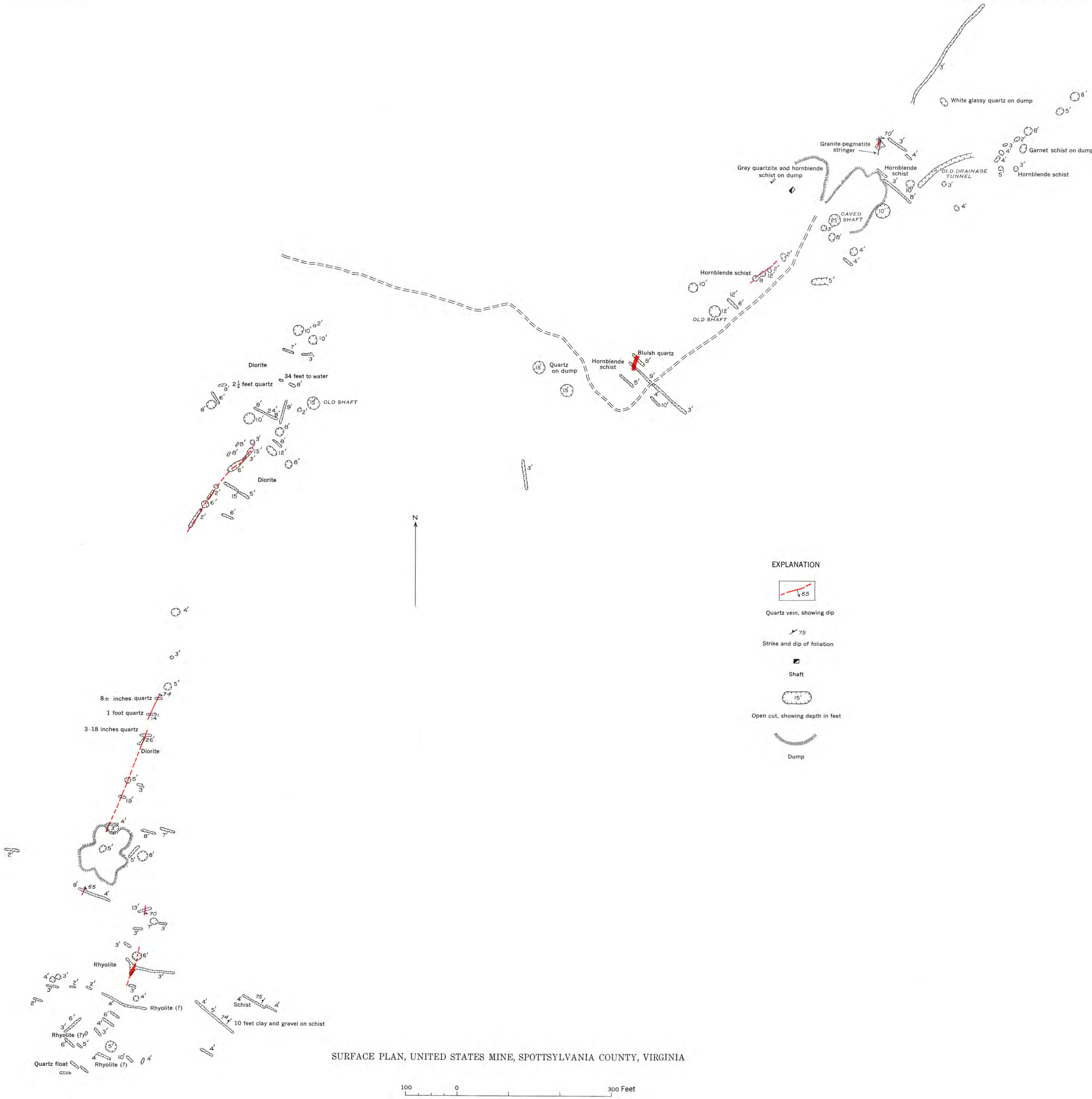


PLANS OF 50-FOOT, 150-FOOT, AND 290-FOOT LEVELS AND CROSS SECTION THROUGH FRANKLIN (MAIN) SHAFT, FRANKLIN MINE, FAUQUIER COUNTY, VIRGINIA

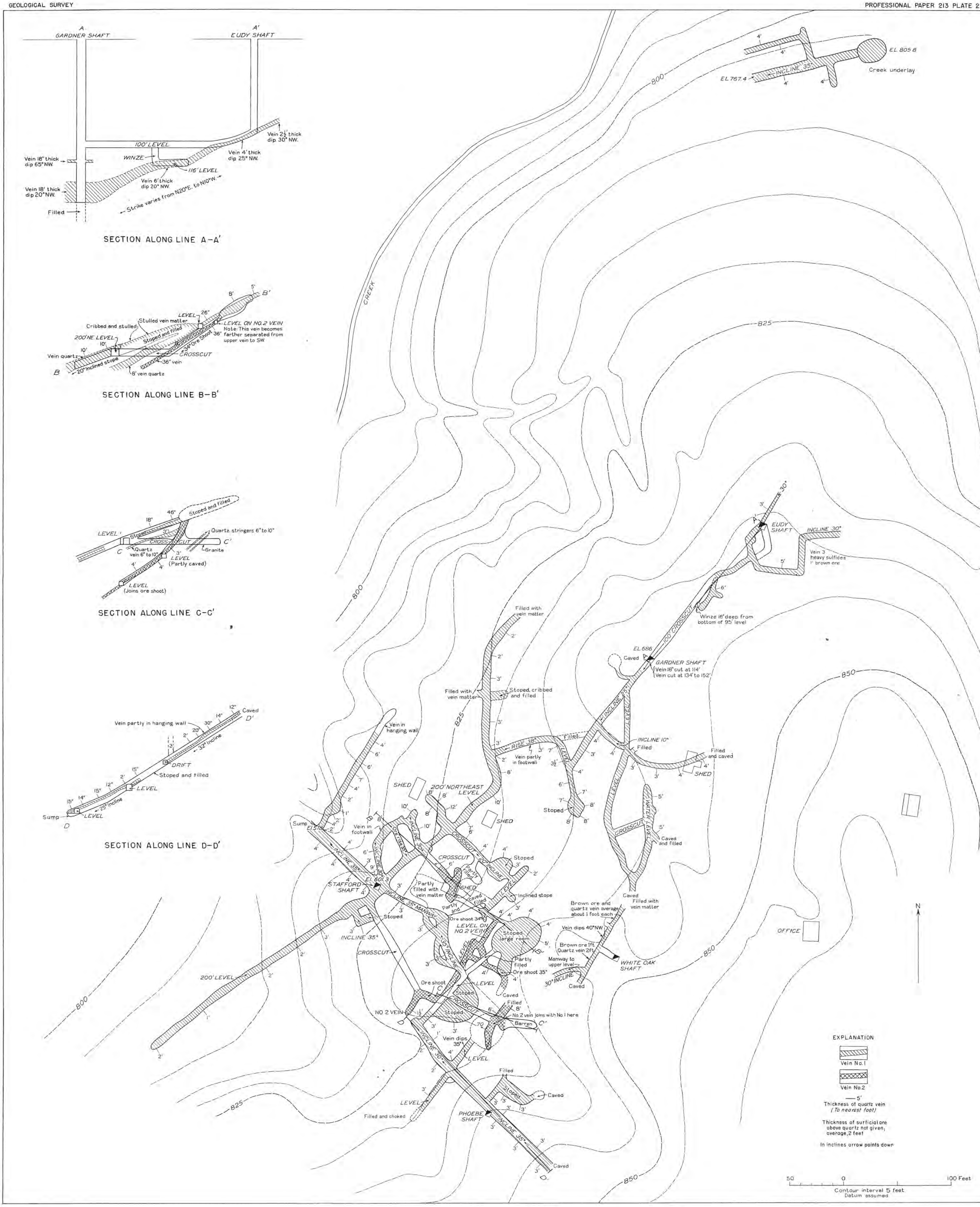
0 50 100 200 Feet



GEOLOGIC MAP OF PART OF THE MELVILLE-VAUCLUSE SHEAR ZONE, WITH PLANS OF MINE LEVELS, ORANGE COUNTY, VIRGINIA



SURFACE PLAN, UNITED STATES MINE, SPOTTSYLVANIA COUNTY, VIRGINIA



PLAN AND SECTIONS OF GARDNER HILL MINE, GUILFORD COUNTY, NORTH CAROLINA

PLAN OF SURFACE WORKINGS, CAPPS HILL–McGINN GROUP OF MINES, MECKLENBURG COUNTY, NORTH CAROLINA

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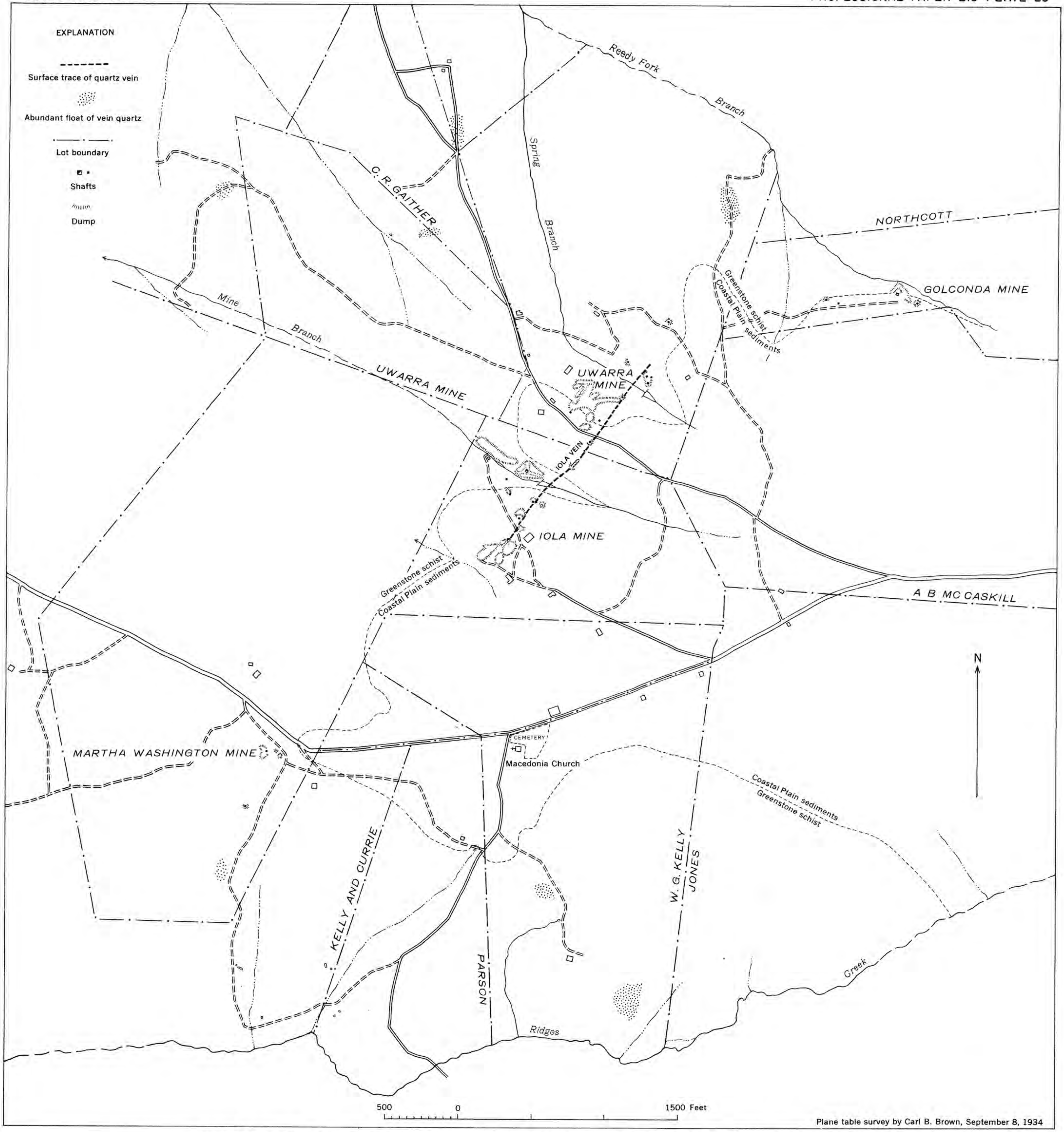

MAP OF THE VICINITY OF THE IOLA MINE, MONTGOMERY COUNTY, NORTH CAROLINA

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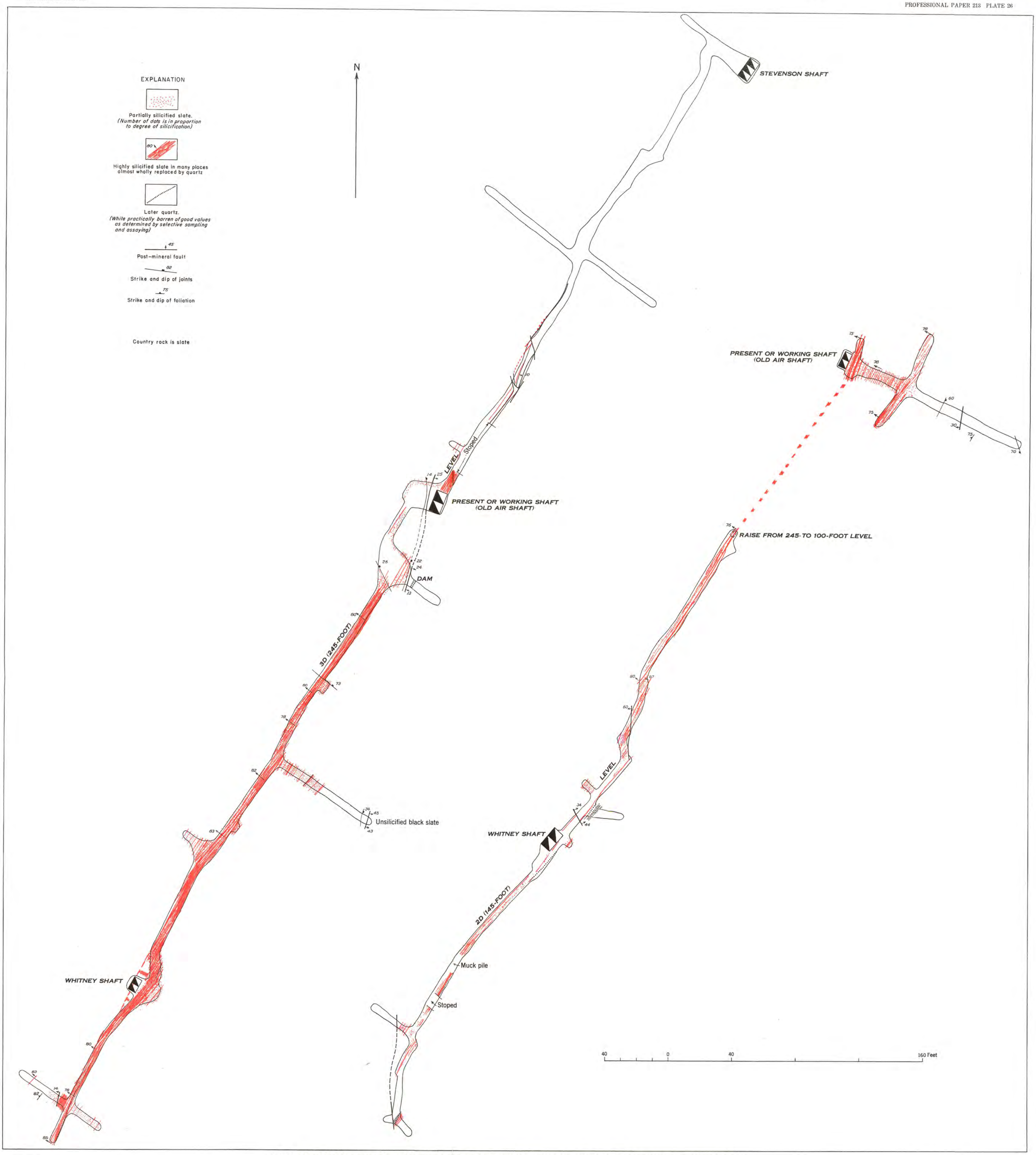
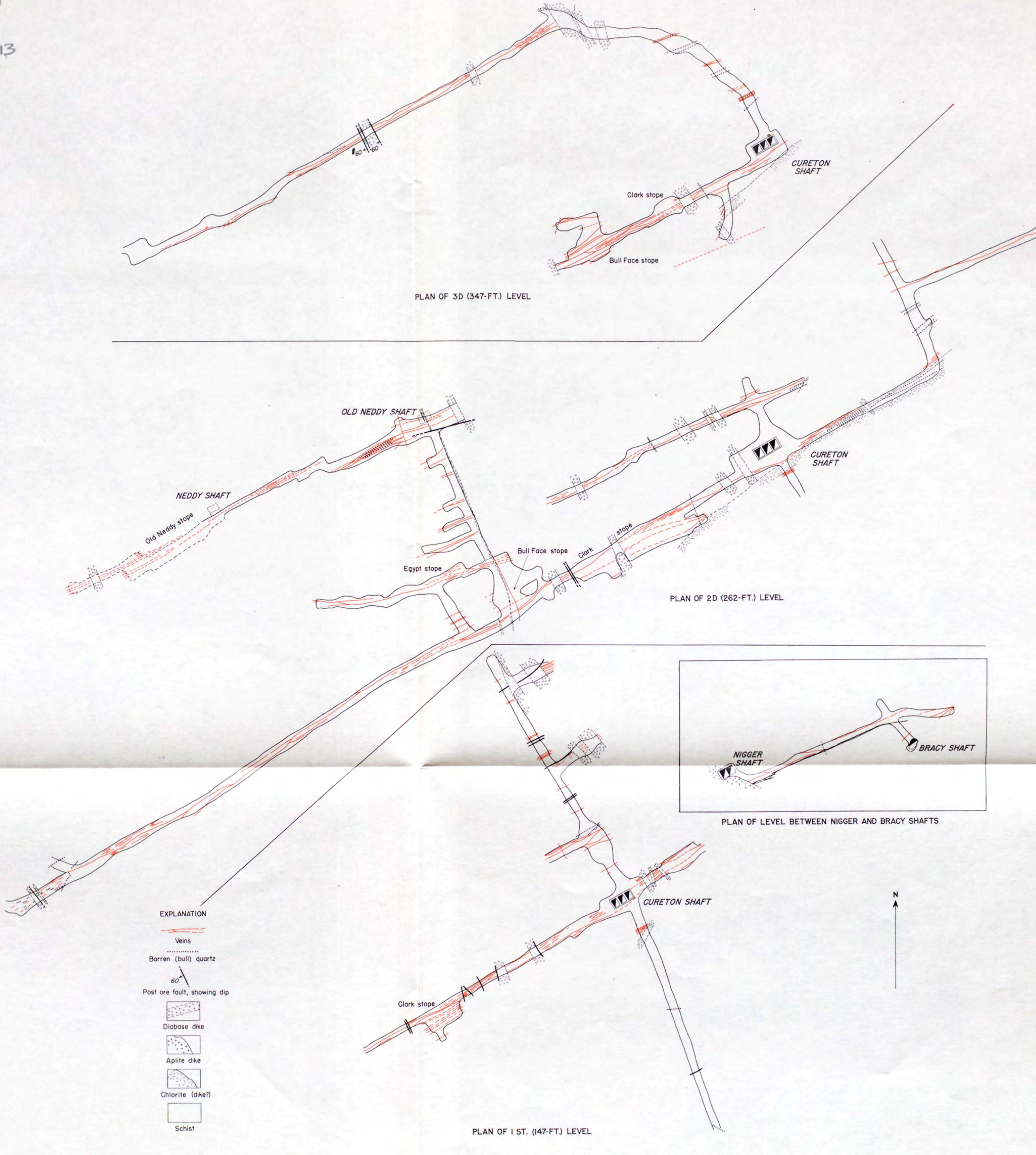


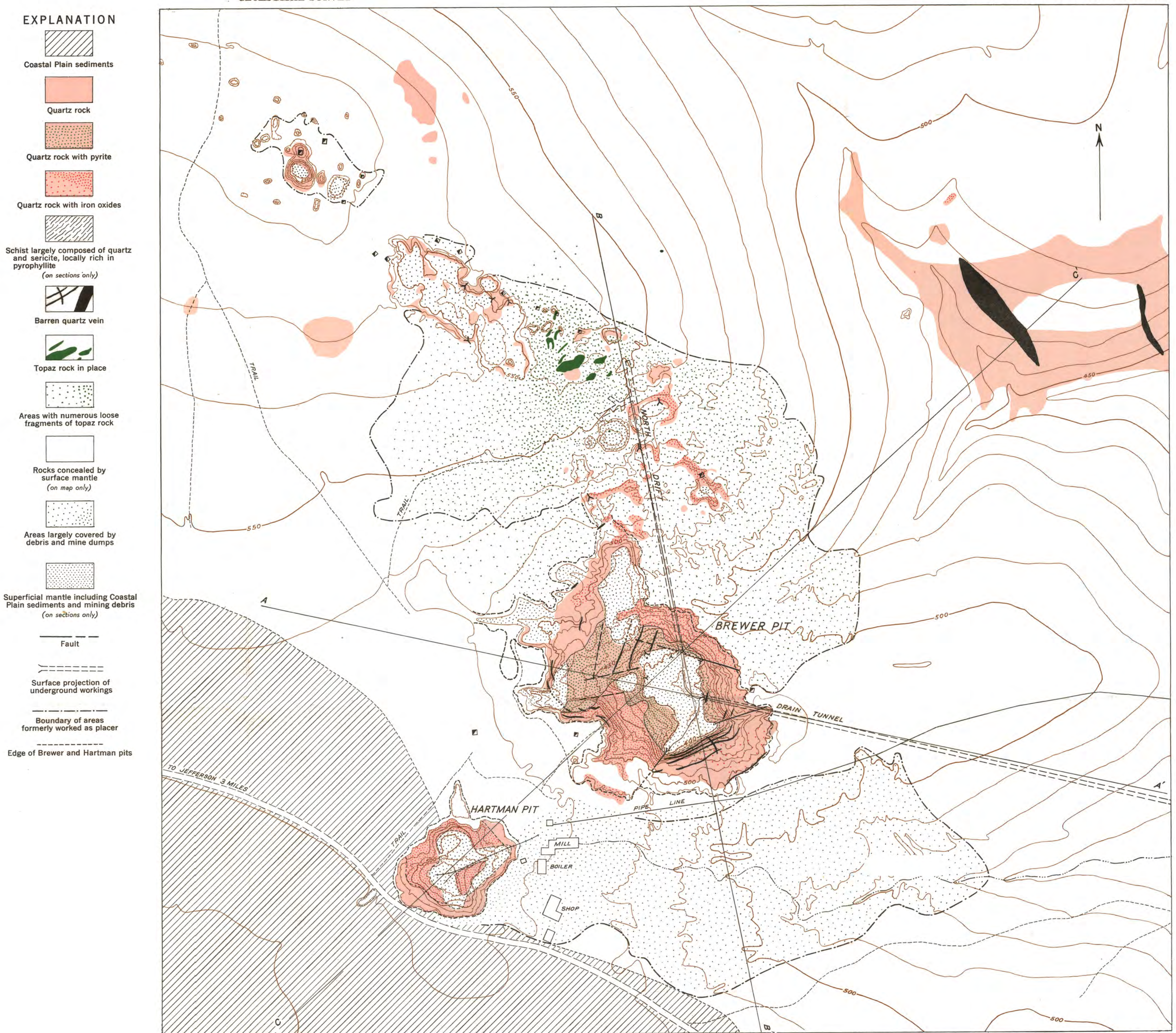
PLAN OF SECOND (145-FOOT) AND THIRD (245-FOOT) LEVELS, WHITNEY MINE, ROWAN COUNTY, NORTH CAROLINA

GEOLOGIC MAP OF THE SURFACE WORKINGS AND SECTION OF HOWIE MINE, UNION COUNTY, NORTH CAROLINA



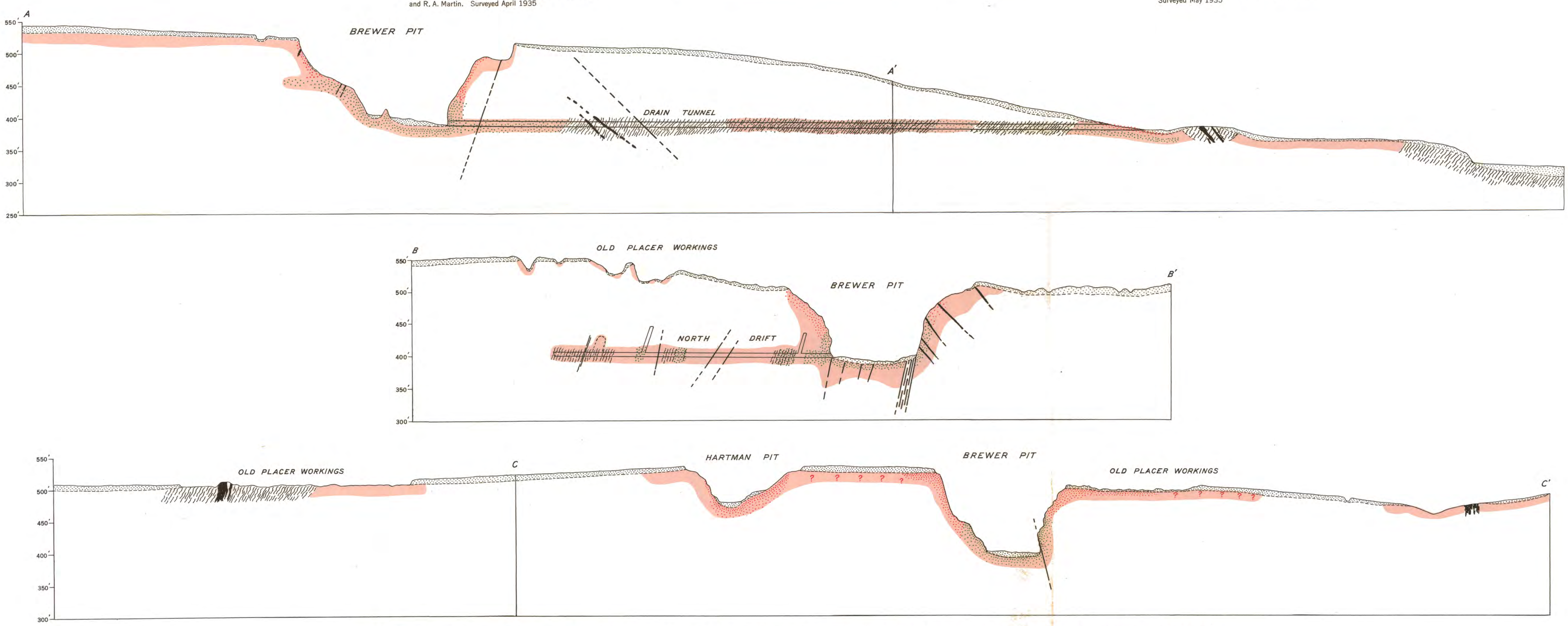
PLANS OF LEVELS OF HOWIE MINE, UNION COUNTY, NORTH CAROLINA

GEOLOGIC MAP AND SECTION OF BREWER MINE AND VICINITY, CHESTERFIELD COUNTY, SOUTH CAROLINA



Topography by C. G. Dickinson, assisted by L. O. Rowland, and R. A. Martin. Surveyed April 1935

Geology by C. E. Bass, W. T. Holland, and J. T. Pardee Surveyed May 1935



MAP AND SECTIONS SHOWING MINE WORKINGS AND GEOLOGY, BREWER MINE, CHESTERFIELD COUNTY, SOUTH CAROLINA

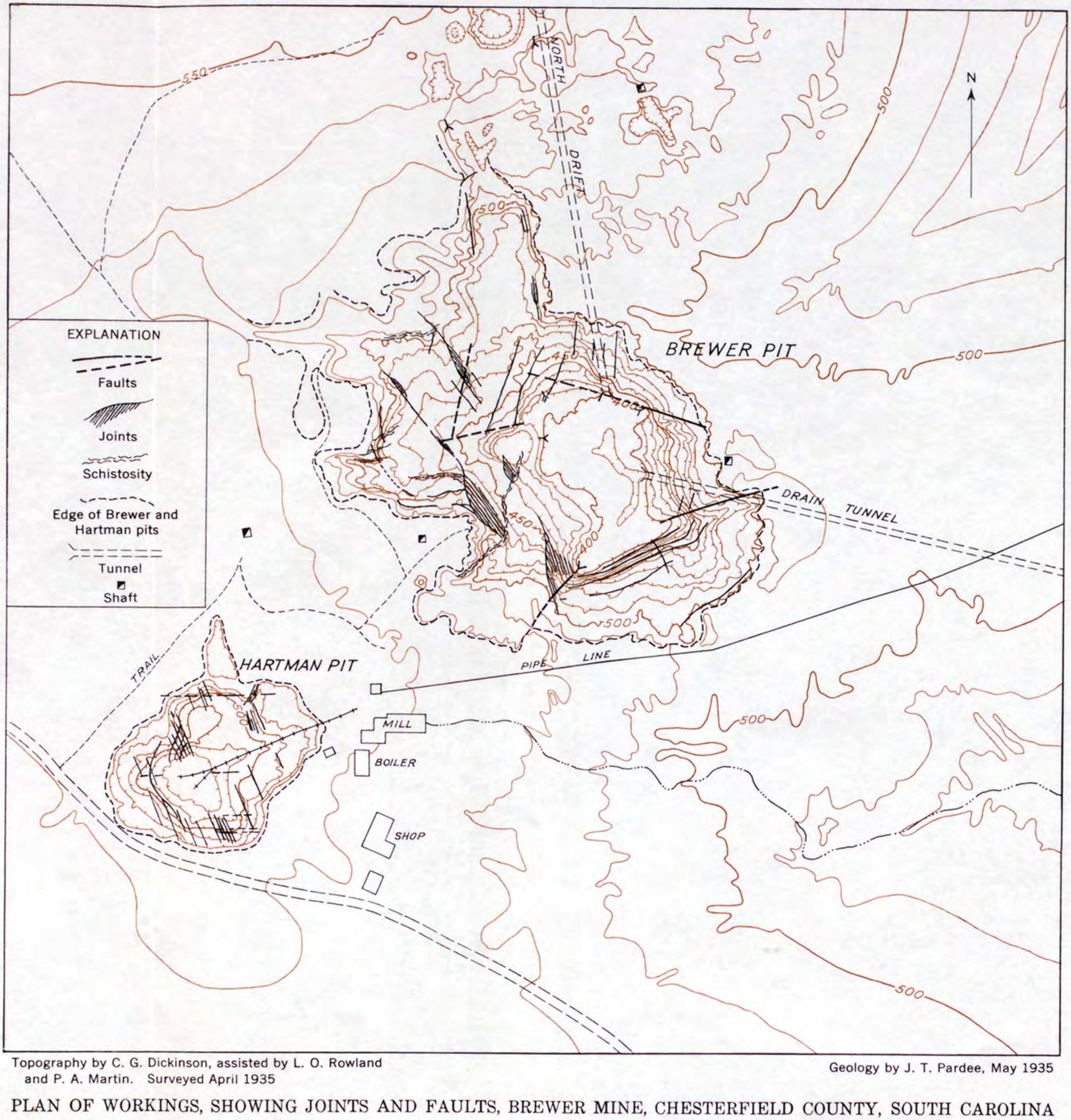
100 0 500 Feet

Contour interval 10 feet

Datum is mean sea level

RECONNAISSANCE GEOLOGIC MAP, BREWER-HAILE AREA, CHESTERFIELD COUNTY, SOUTH CAROLINA

(200)
QE
no. 213



Topography by C. G. Dickinson, assisted by L. O. Rowland and P. A. Martin. Surveyed April 1935

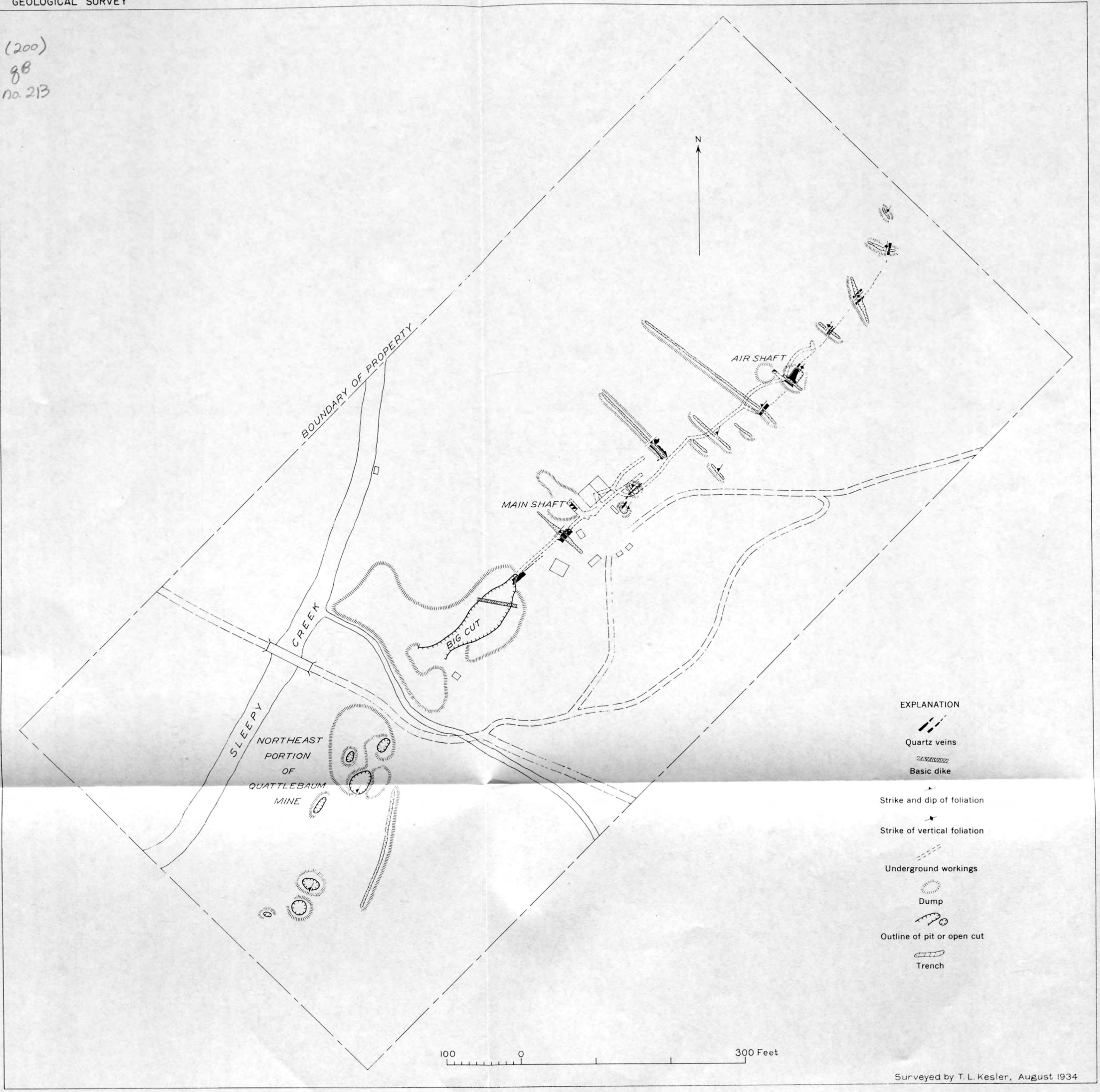
Geology by J. T. Pardee, May 1935

PLAN OF WORKINGS, SHOWING JOINTS AND FAULTS, BREWER MINE, CHESTERFIELD COUNTY, SOUTH CAROLINA

100 0 500 Feet

Contour interval 10 feet

Datum is mean sea level



Surveyed by T. L. Kesler, August 1934

PLAN OF WORKINGS, LANDRUM MINE, EDGEFIELD COUNTY, SOUTH CAROLINA

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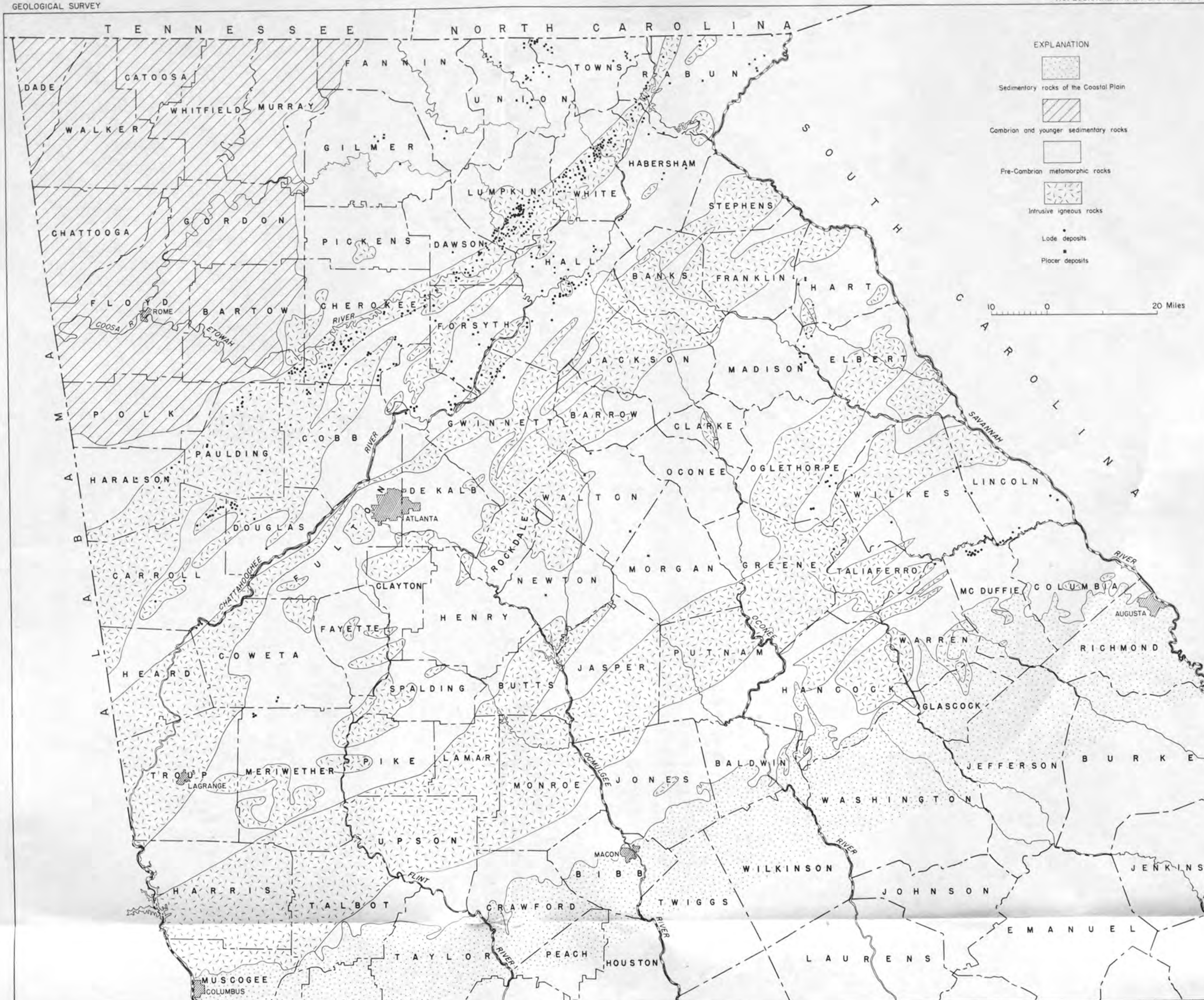
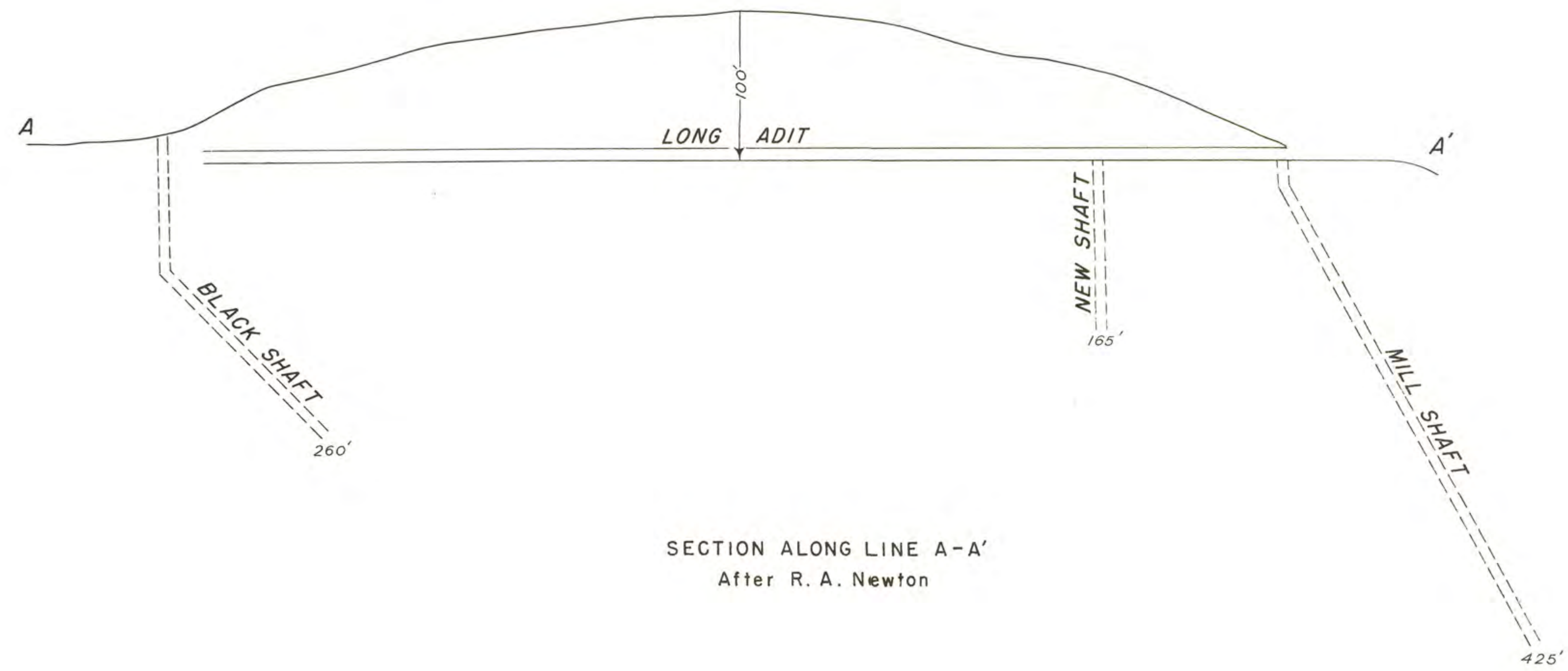
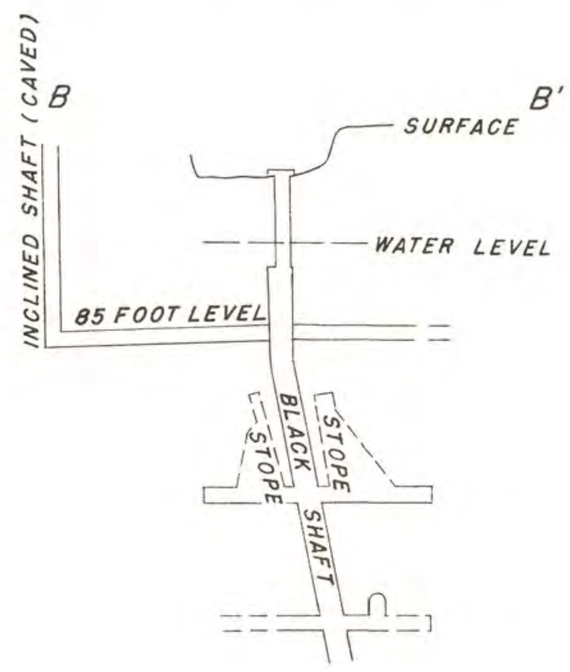
GEOLOGIC MAP OF HAILE MINE AND VICINITY, LANCASTER COUNTY, SOUTH CAROLINA



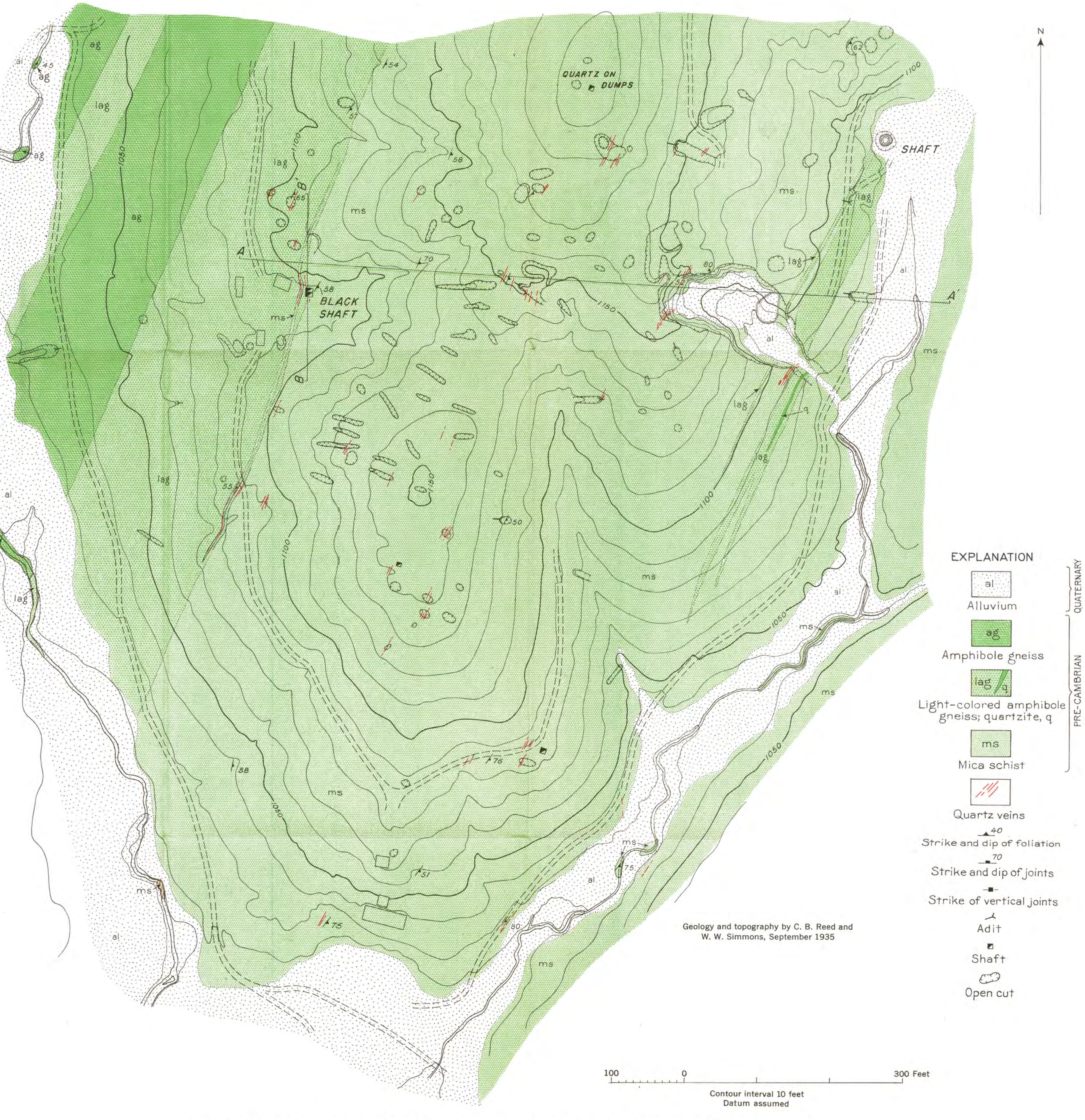
MAP OF GEORGIA, SHOWING LOCATION OF KNOWN GOLD DEPOSITS



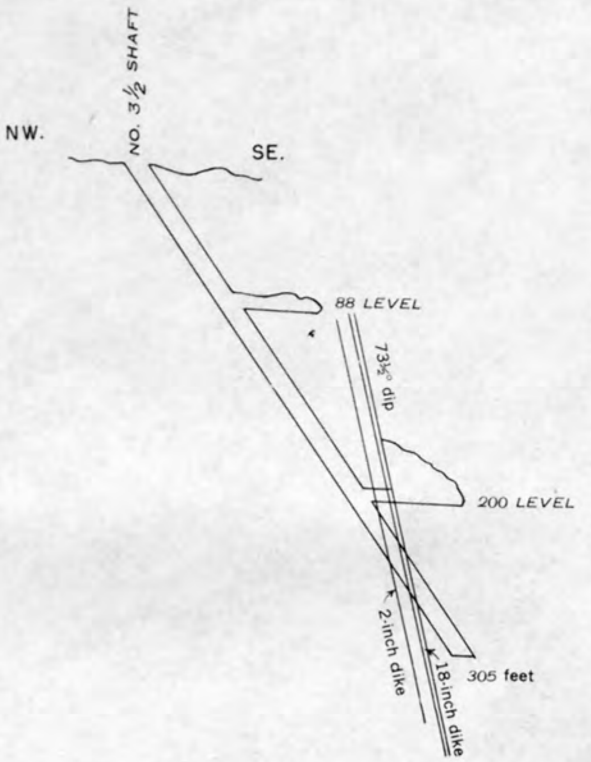
SECTION ALONG LINE A-A'
After R. A. Newton



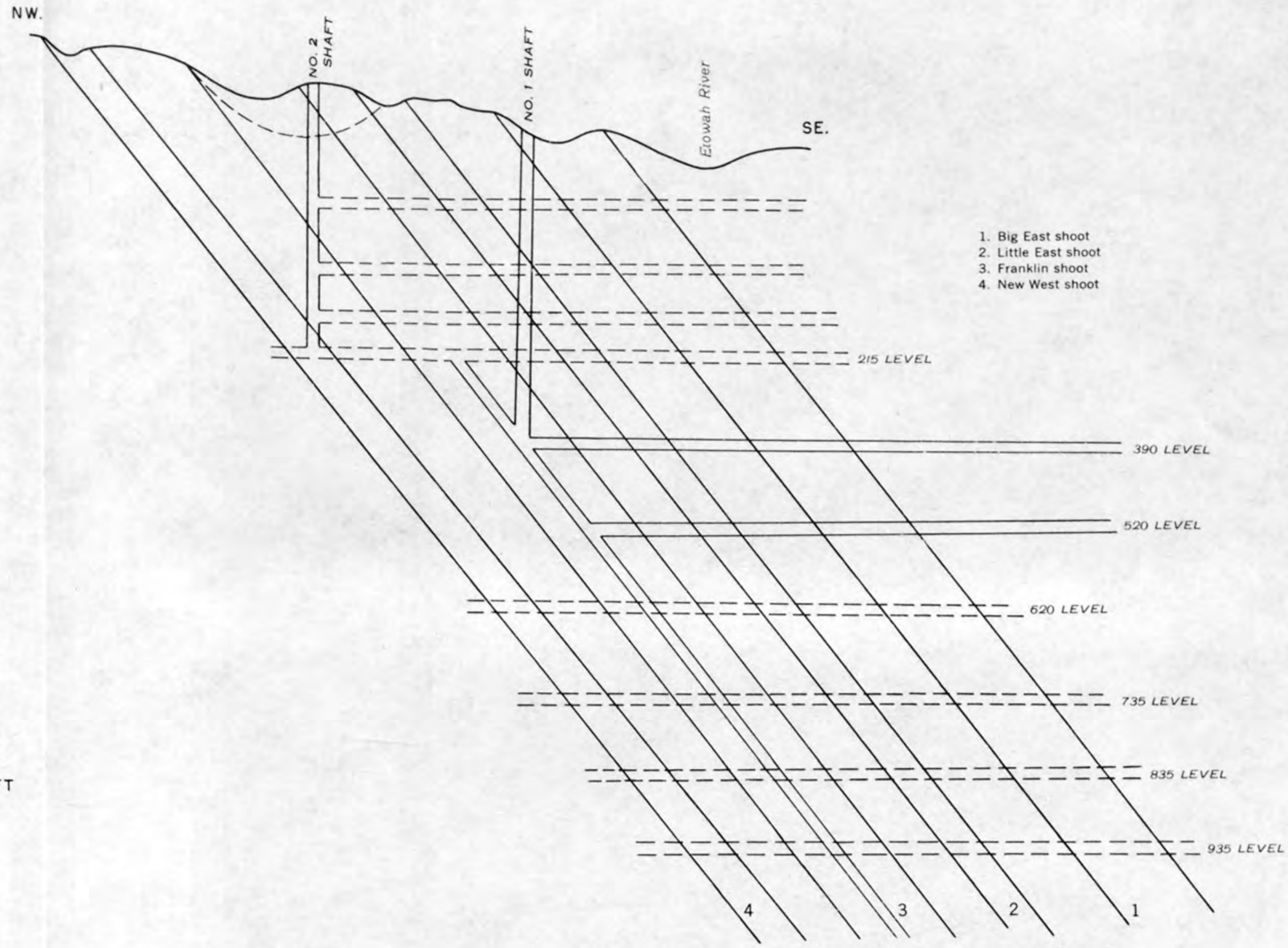
SECTION ALONG LINE B-B'
(Projected on plane of lode)
After R. A. Newton



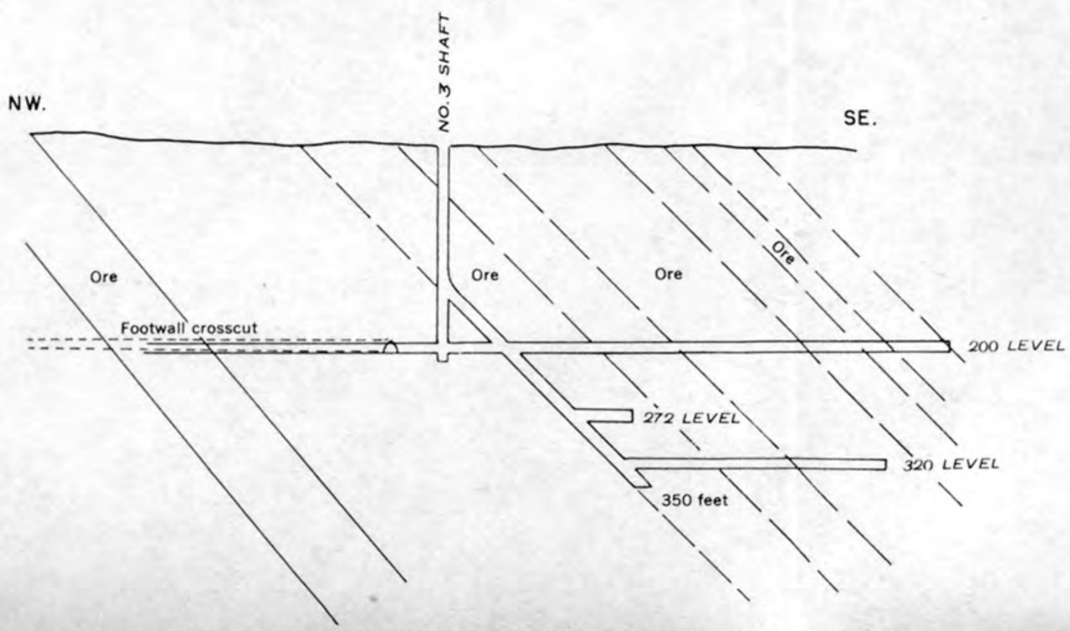
SURFACE MAP AND SECTIONS OF CHEROKEE MINE, CHEROKEE COUNTY, GEORGIA



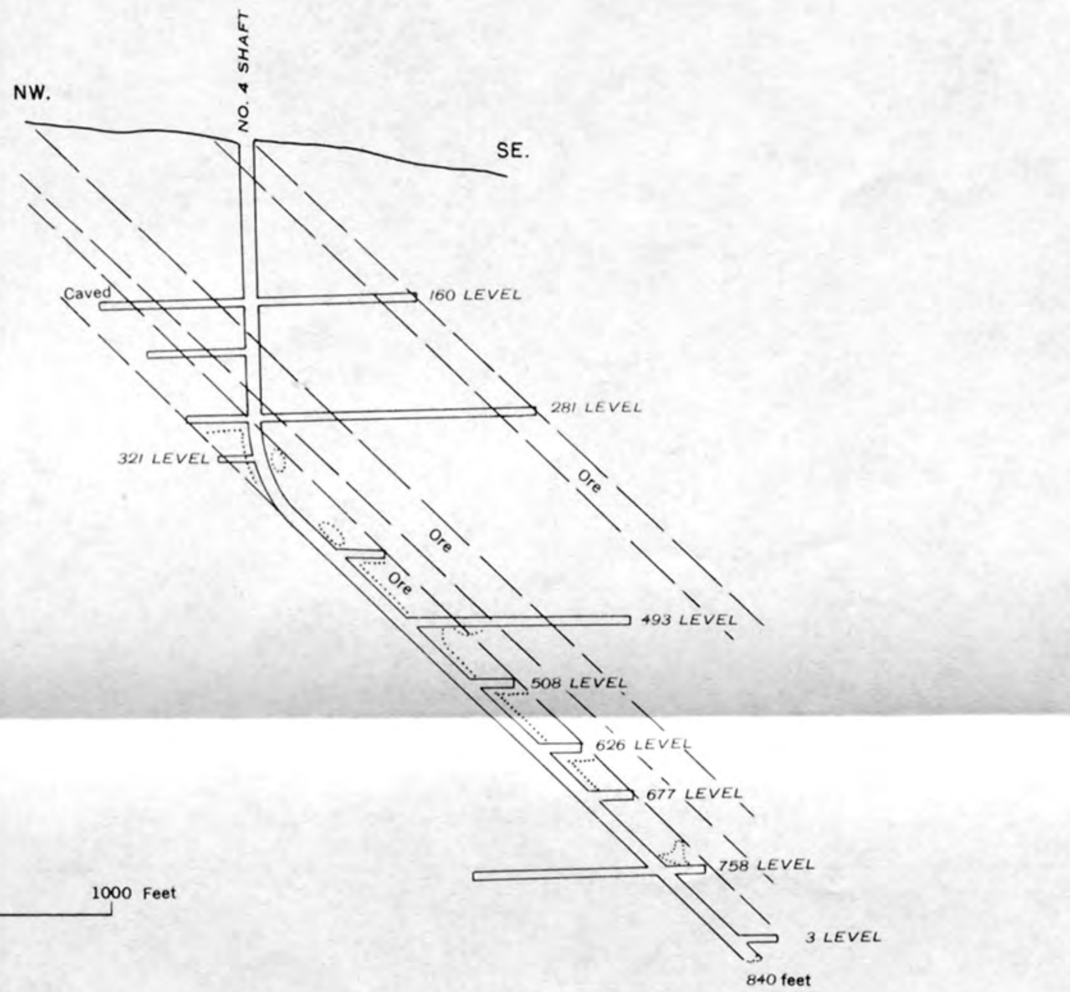
SECTION ON PLANE OF LODE THROUGH NO. 3½ SHAFT



SECTION ON PLANE OF LODE FROM SHAFTS NO. 1 AND NO. 2



SECTION ON PLANE OF LODE THROUGH WORKINGS FROM NO. 3 SHAFT



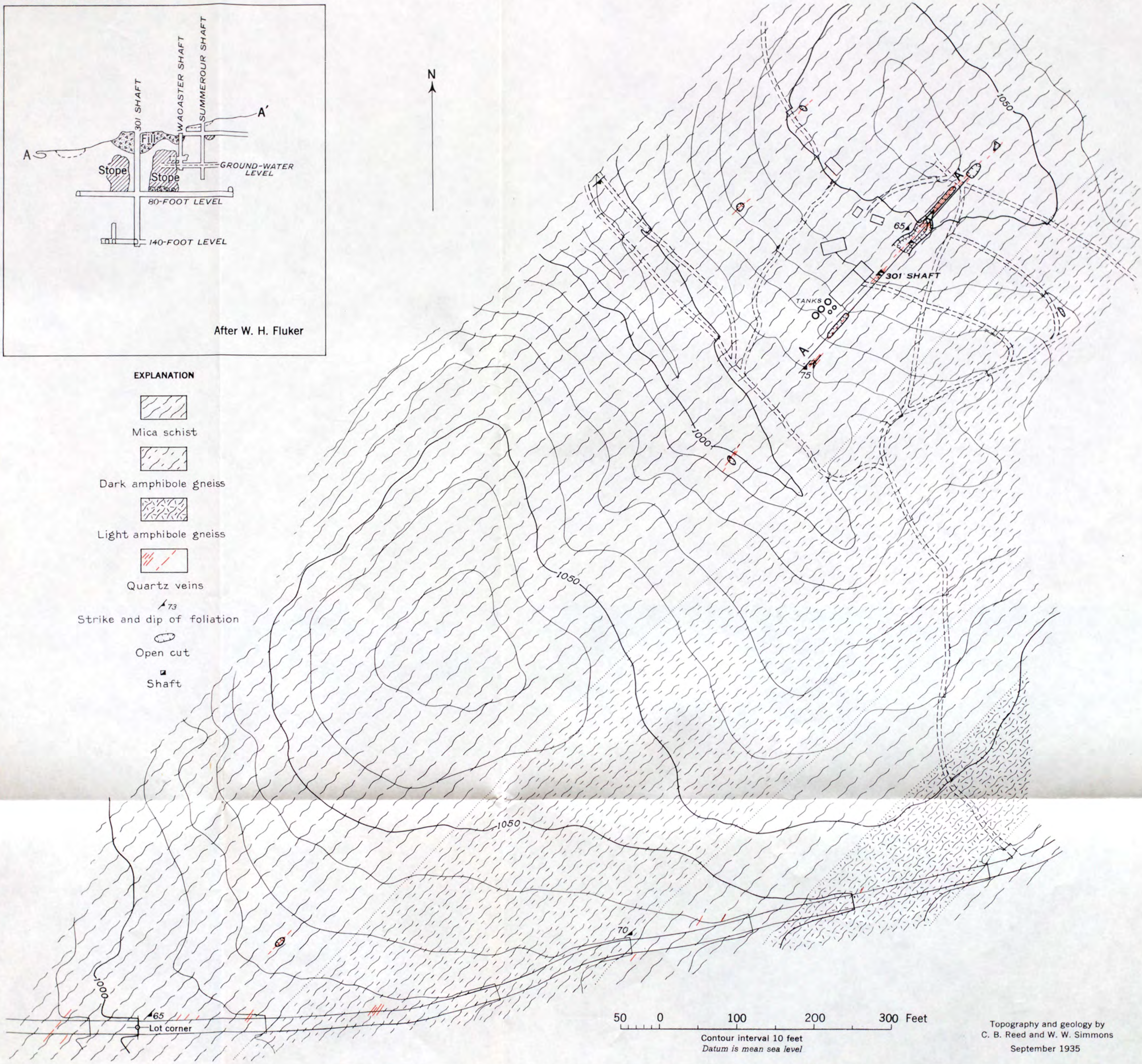
SECTION ON PLANE OF LODE THROUGH NO. 4 SHAFT

0 500 1000 Feet

After S. W. McCallie, September 1935

SECTIONS THROUGH CREIGHTON MINE, CHEROKEE COUNTY, GEORGIA

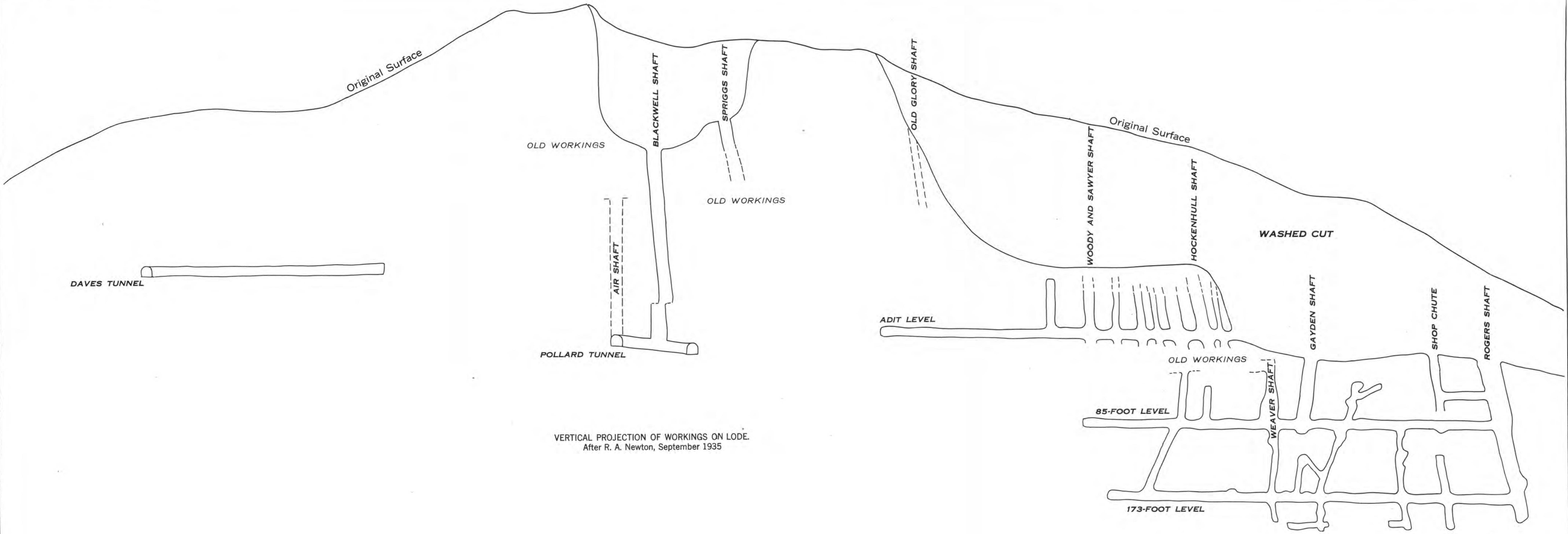
755400 O - 48 (In Pocket) No. 9



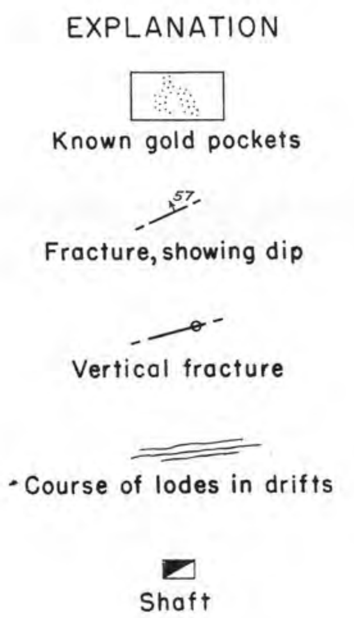
SURFACE MAP AND LONGITUDINAL PROJECTION ON THE LODE, 301 MINE, CHEROKEE COUNTY, GEORGIA

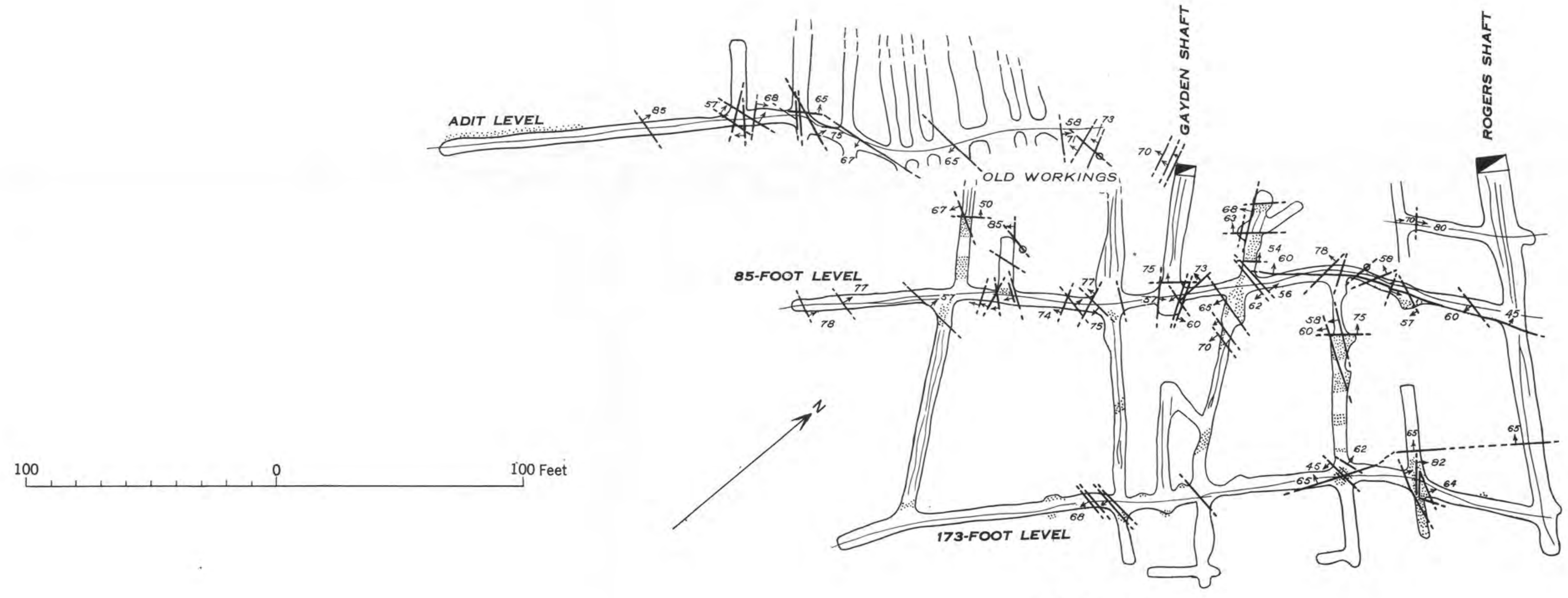
SURFACE MAP OF KIN MORI MINE, DAWSON COUNTY, GEORGIA

MAP SHOWING HYDRAULIC PIT, BARLOW MINE, LUMPKIN COUNTY, GEORGIA



VERTICAL PROJECTION OF WORKINGS ON LODE.
After R. A. Newton, September 1935



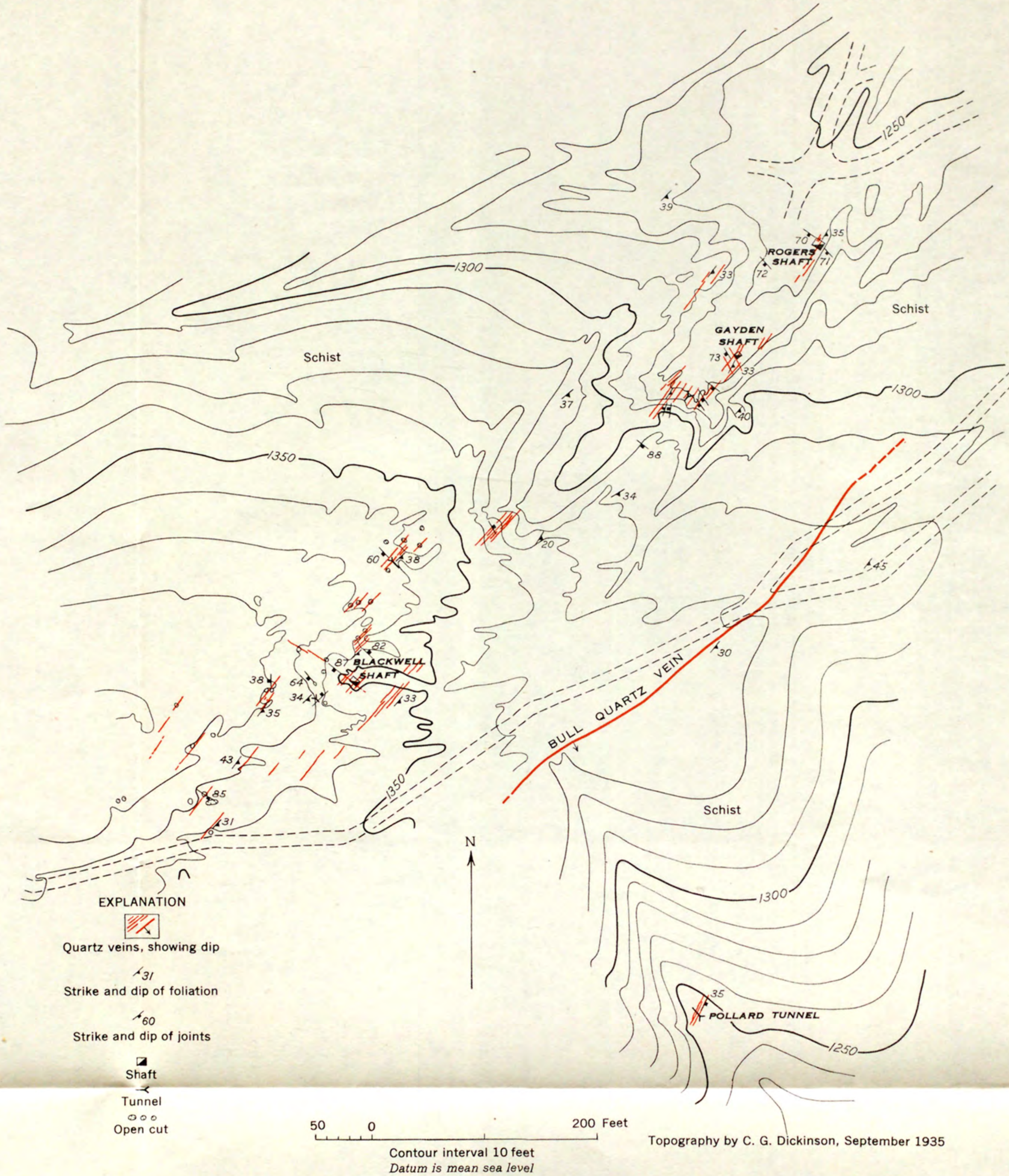


PLAN OF MAIN WORKINGS
September 1935

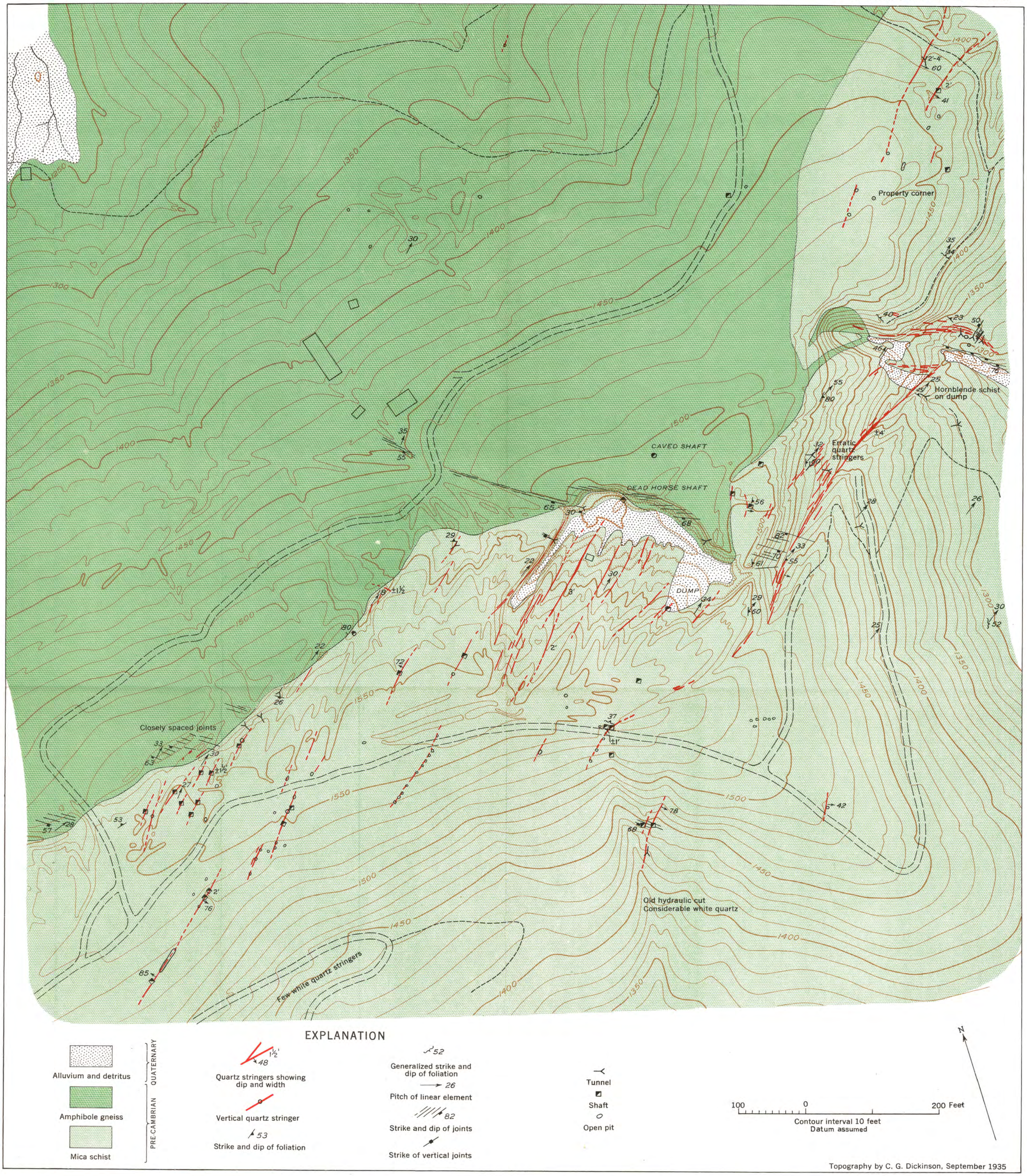
PLAN OF MAIN WORKINGS AND VERTICAL PROJECTION OF WORKINGS ON THE LODE, BATTLE BRANCH MINE, LUMPKIN COUNTY, GEORGIA

755400 O - 48 (In Pocket) No. 10

(200)
8B
no. 213



SURFACE MAP OF BATTLE BRANCH MINE, LUMPKIN COUNTY, GEORGIA



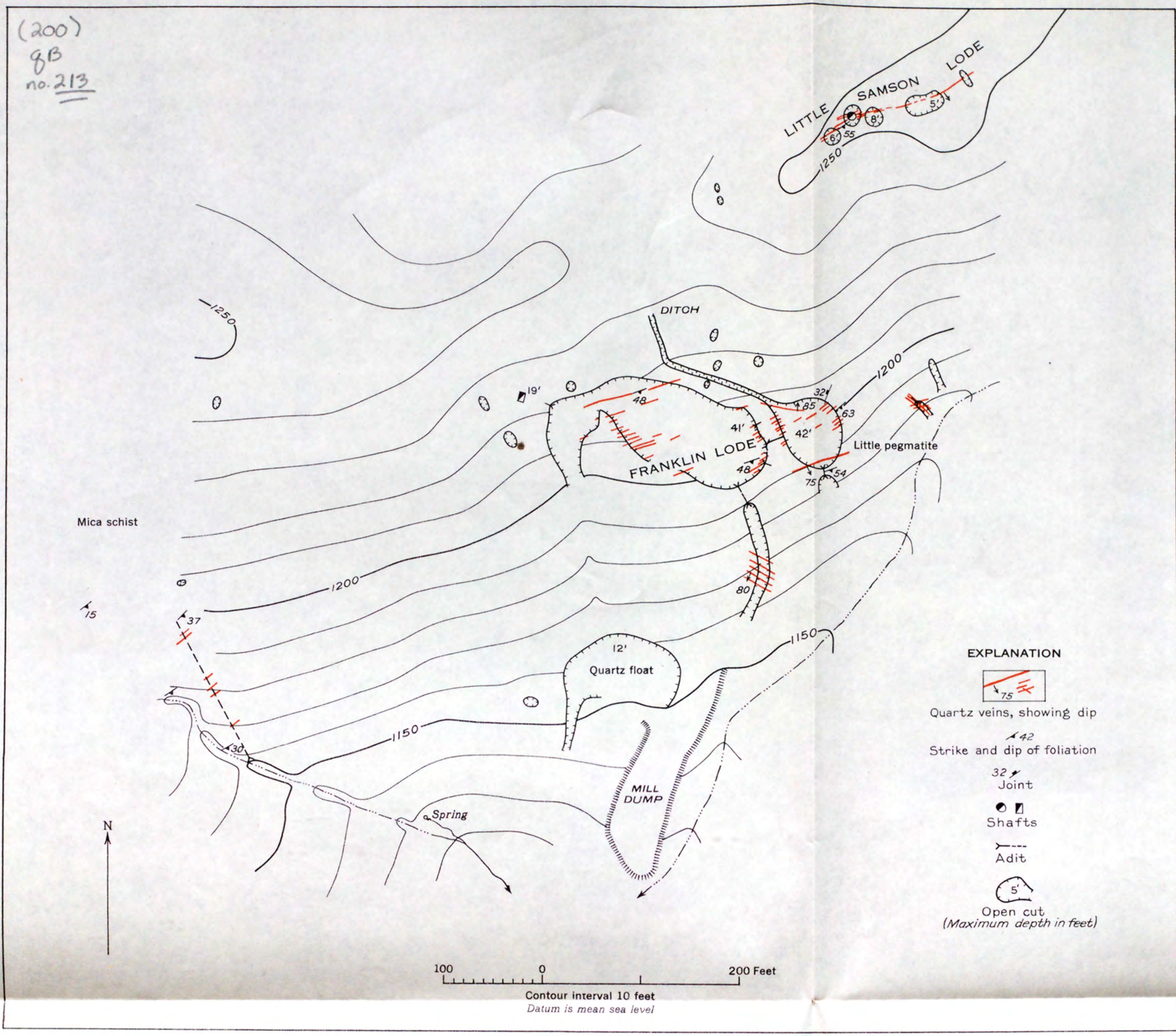
SURFACE MAP OF FINDLEY MINE, LUMPKIN COUNTY, GEORGIA

SURFACE MAP AND PLAN OF SOUTH TUNNEL, WHITE COUNTY MINE, GEORGIA

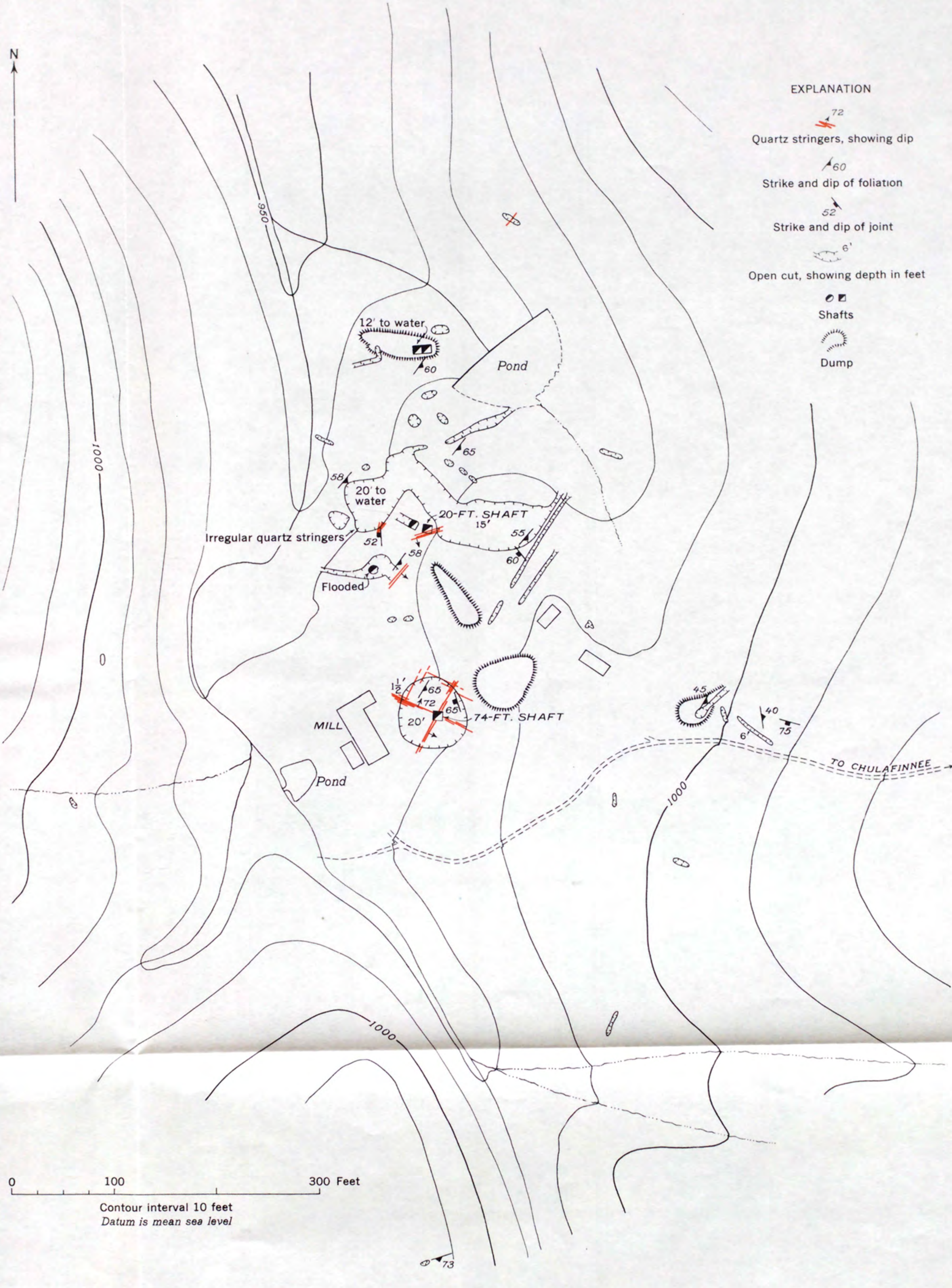
Geology after G.I. Adams

MAP OF ALABAMA, SHOWING LOCATION OF THE GOLD DEPOSITS

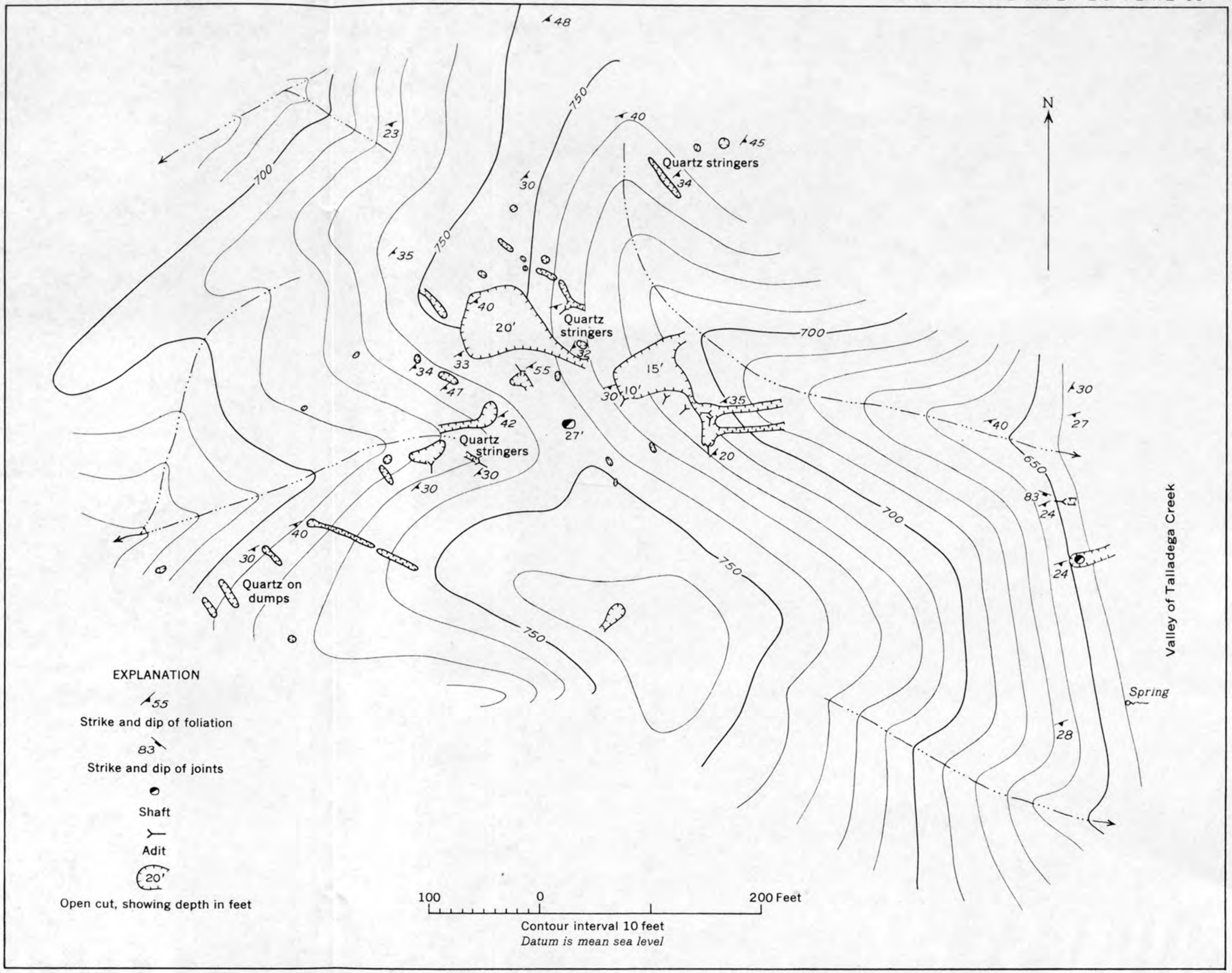
755400 O - 48 (In Pocket) No. 11



SURFACE PLAN, FRANKLIN MINE, CLAY COUNTY, ALABAMA

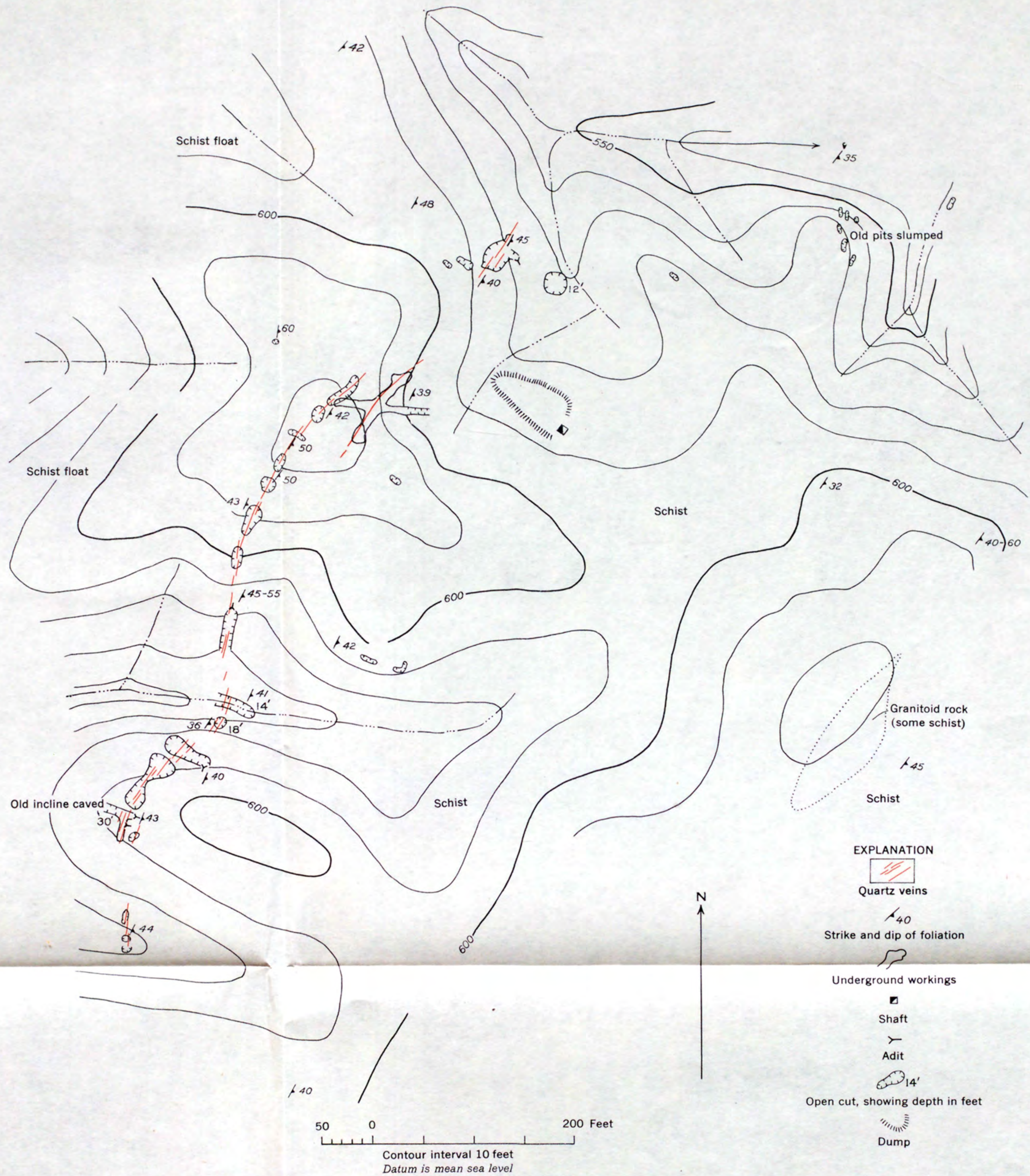


SURFACE PLAN, KING PROSPECT, CLEBURNE COUNTY, ALABAMA

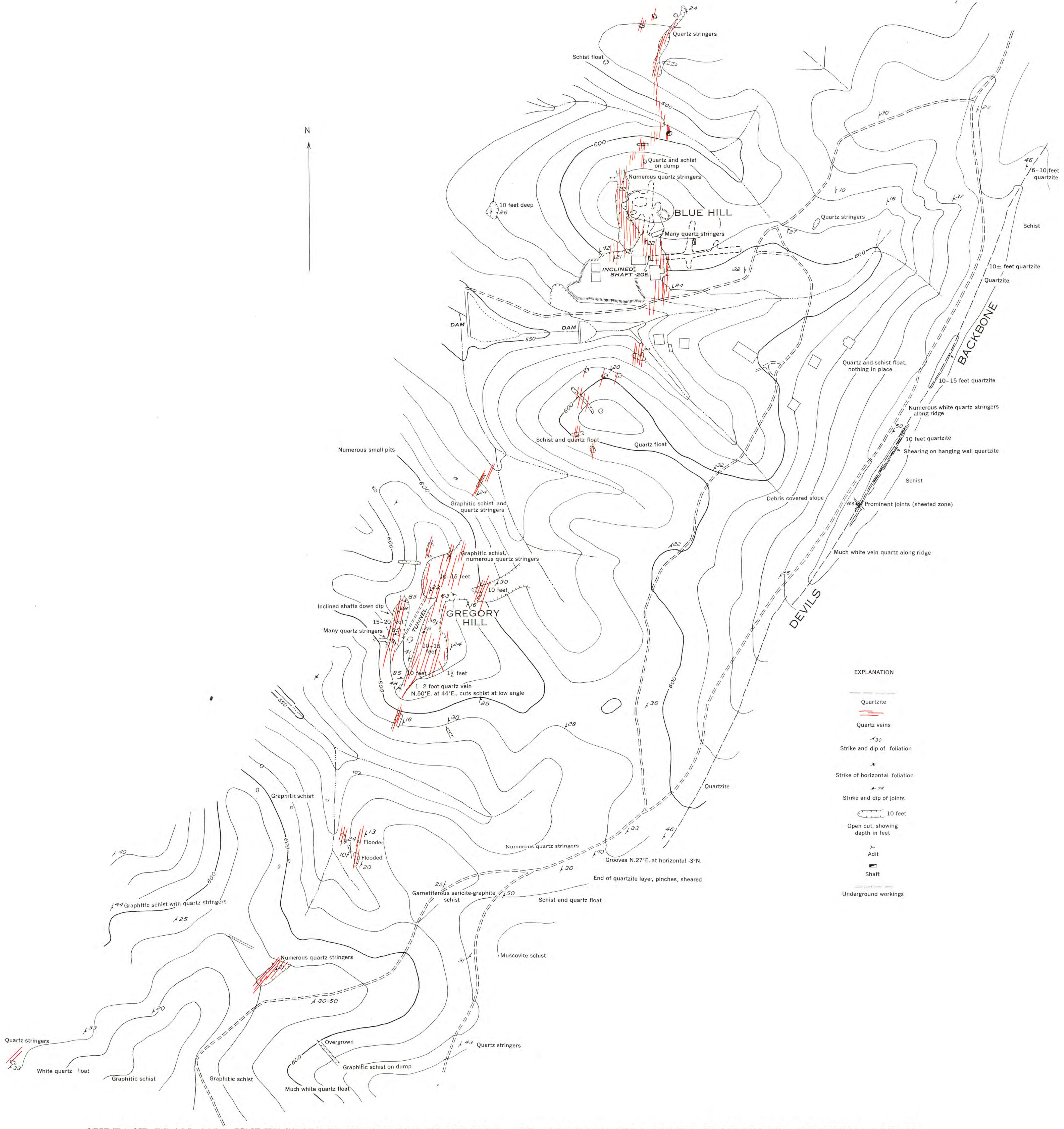


SURFACE PLAN, GOLD LOG MINE, TALLADEGA COUNTY, ALABAMA

755400 O - 48 (In Pocket) No. 12



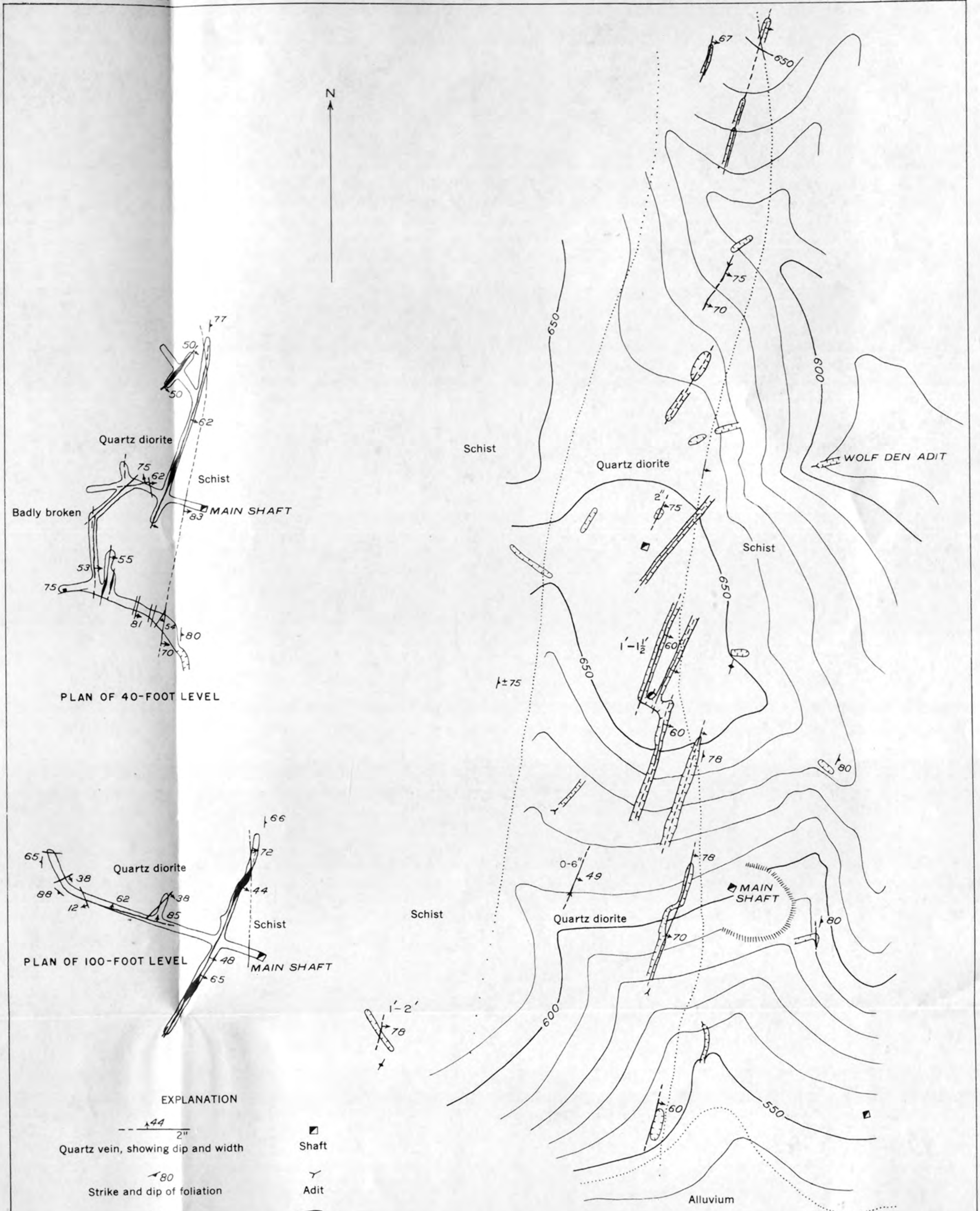
SURFACE PLAN AND WORKINGS, ALABAMA KING PROSPECT, TALLAPOOSA COUNTY, ALABAMA



SURFACE PLAN AND UNDERGROUND WORKINGS, BLUE HILL AND GREGORY HILL MINES, TALLAPOOSA COUNTY, ALABAMA

100 0 500 Feet

Contour interval 10 feet



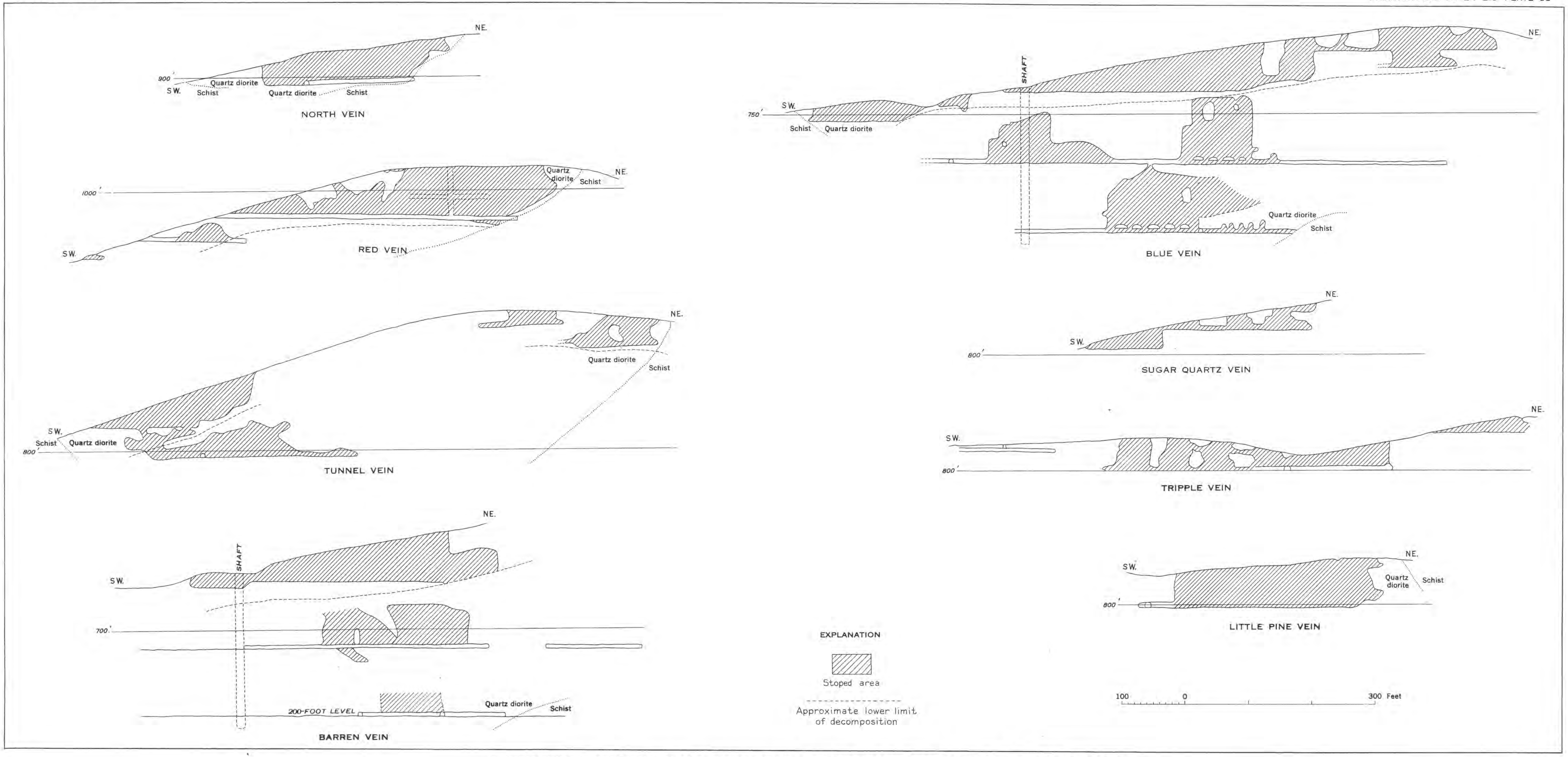
MAP SHOWING SURFACE WORKINGS AND PLANS OF THE 40-FOOT AND 100-FOOT LEVELS OF THE DUTCH BEND MINE, TALLAPOOSA COUNTY, ALABAMA

50 0 200 Feet

Contour interval 10 feet

Datum is mean sea level

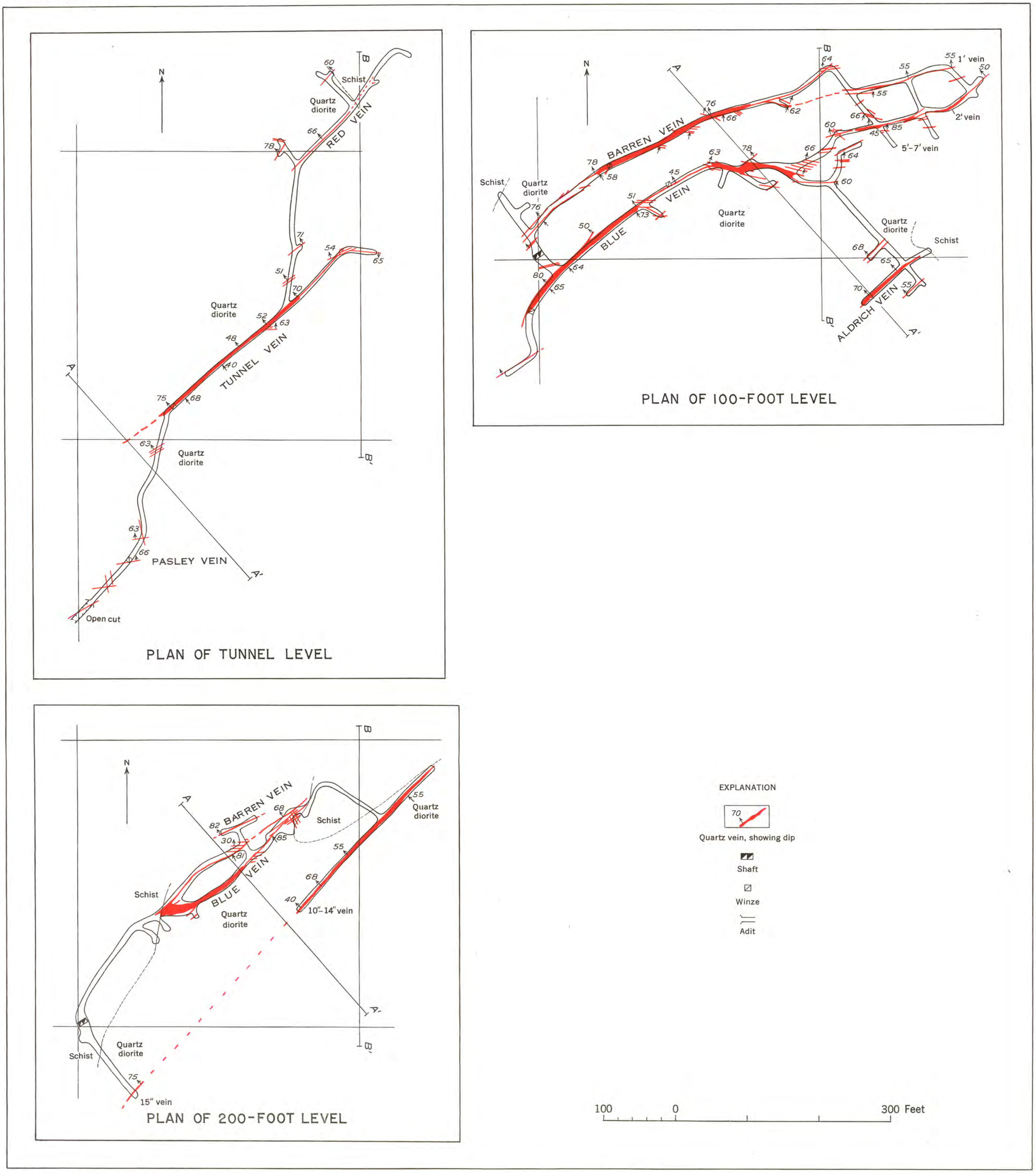
755400 O - 48 (In Pocket) No. 13



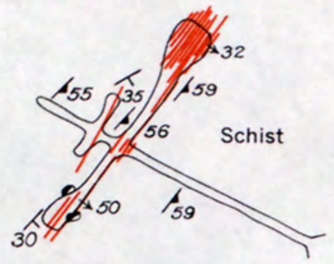
LONGITUDINAL SECTIONS ALONG EIGHT VEINS, HOG MOUNTAIN, TALLAPOOSA COUNTY, ALABAMA

Modified after T. H. Aldrich, Jr. Longitudinal projection of Blue vein workings compiled from all available data, 1934

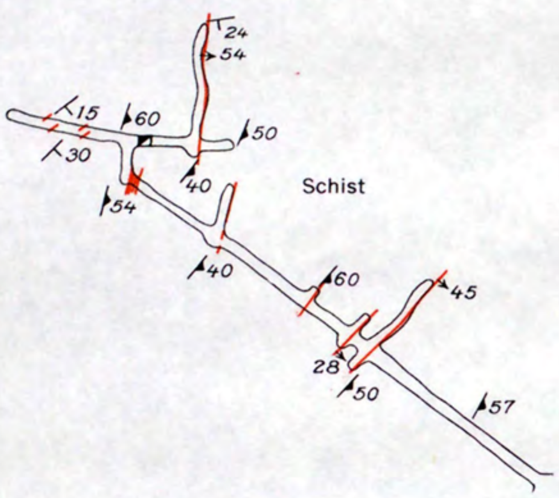
755400 O - 48 (In Pocket) No. 14



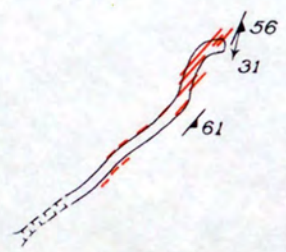
PLANS OF TUNNEL LEVEL, 100-FOOT LEVEL, AND 200-FOOT LEVEL OF HOG MOUNTAIN MINE, TALLAPOOSA COUNTY, ALABAMA



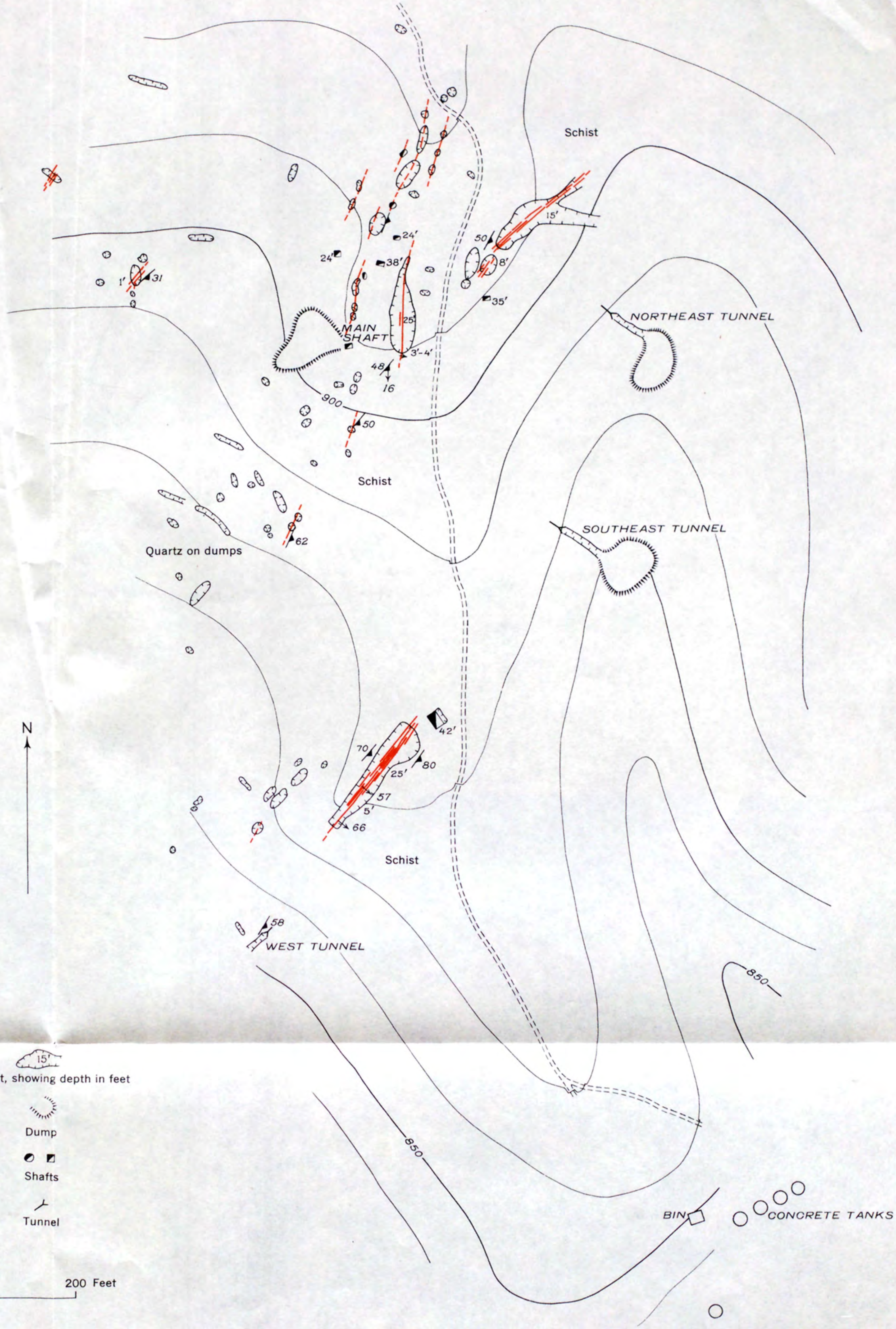
PLAN OF NORTHEAST TUNNEL



PLAN OF SOUTHEAST TUNNEL



PLAN OF WEST TUNNEL



EXPLANATION

Quartz stringers, showing dip

Open cut, showing depth in feet

Strike and dip of beds

Dump

Strike and dip of foliation

Shafts

Pitch of linear element

Tunnel

100 0 200 Feet

Contour interval 10 feet
Datum is mean sea level

SURFACE PLAN AND UNDERGROUND WORKINGS, LOWE MINE, TALLAPOOSA COUNTY, ALABAMA