# ROAD LOG FOR THE ANNUAL EXCURSION OF THE CAROLINA GEOLOGICAL SOCIETY[1]

### OCTOBER 24 — 25, 1953

**W.C. Overstreet, P.K. Theobald, Jr., and N.P. Cuppels**

1.Publication authorized by the Director, U.S. Geological Survey.

The Carolina Geological Society wishes to express its appreciation and thanks to the members of the United States Geological Survey who were responsible for the preparation of this road log and field trip. Mr. W.C. Overstreet has had the task of leading the trip. Mr. Overstreet, Mr. P.K. Theobald, Jr., and Mr. N.P. Cuppels prepared the road log and geological summary. Mr. A.M. White and Mr. J.W. Whitlow assisted in the field during the excursion.

Mimeographed by the Department of Geology, Duke University

**NOTE:** This guidebook has been retyped, reformatted and lightly edited from the original. May 1999

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# ROAD LOG FOR THE ANNUAL EXCURSION OF THE CAROLINA GEOLOGICAL SOCIETY

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## INTRODUCTION

The variety of features that can be reviewed in this excursion of the Carolina Geological Society are circumscribed by accessibility and time available. The excursion has been planned to show relations among granites and gneisses along the boundary between the Shelby and Lincolnton quadrangles, North Carolina. Some discussion of distribution and utility of petrographic subdivisions of the Carolina gneiss will be given.

Field work upon which this trip is based was done for the most part between May 1948 and June 1951 by R.G. Yates, W.R. Griffitts, and W.C. Overstreet. Descriptions of the rocks are drawn from the work (Yates *et al.*, in preparation) and other sources (Keith and Sterrett, 1931; Sterrett, 1912; Griffitts and Overstreet, 1952; and Kesler, 1944). Figure 1 is a recent geologic revision of a compilation published in 1952 (Griffitts and Overstreet, 1952, fig. 1) that covers the Shelby, Lincolnton, Gaffney, and Kings Mountain quadrangles, and a small part of Morganton quadrangle, N.C.-- S.C.

## GEOLOGICAL SUMMARY

The summary below applies to the quadrangles compiled as figure 1. Most of the area is a gently southeastward-sloping upland surface with an average altitude of 750 feet and an average relief of 160 feet per square mile. In the northwest corner of the Shelby quadrangle an altitude of 1619 feet is attained at Lisenberry Mountain on the southeast edge of the South Mountains. Pasour Mountain, which is crossed by the east boundary of the Lincolnton quadrangle, rises 200 feet above surrounding interstream areas to an altitude of 1140 feet. It is one of a group of monadnocks that extend southwest across the Gaffney and Kings Mountain quadrangles. The maximum altitude in the four-quadrangle area, 1705 feet, is on the crest of one of these monadnocks, the Pinnacle of Kings Mountain.

Deep chemical weathering has converted most of the exposed rock to saprolite, a thoroughly- decomposed rock in which texture and structure may be sufficiently well preserved to allow measurement of planar and linear elements. Structures mapped across alternate areas of saprolite and unweathered rock are continuous, which indicates that no detectable movement accompanied the weathering.

The area is underlain by high- rank metamorphic rocks intruded by mafic and granitic rocks. A belt of low- rank metamorphic rocks extends from the southeast part of the Lincolnton quadrangle across the Kings Mountain and Gaffney quadrangles. The excursion will not visit the low-rank metamorphic rocks, nor will the participants see the Bessemer and Yorkville granites.

### Low-rank Metamorphic Rocks

The low-rank metamorphic rocks occupy a narrow synclinal belt that passes east of Gaffney and Kings Mountain. Keith and Sterrett (1931, pp. 4-6) named these rocks Battleground schist which was called late pre-Cambrian, and Kings Mountain quartzite, Blacksburg schist, and Gaffney marble, which were assigned to the Cambrian. Fossils have not been found in these rocks.

Battleground schist is pelitic sediment and tuff metamorphosed to sericite schist; some conglomeratic layers are preserved. Magnetite is common throughout the unit; staurolite, chloritoid, and chlorite and locally abundant. The Kings Mountain quartzite, which forms the higher monadnocks south of Kings Mountain community, ranges from gneissic conglomerate, white quartzite. The Blacksburg schist includes rocks ranging in texture from fine-grained graywacke to fine-grained schist and phyllite. The Gaffney marble is a banded to schistose, fine-grained, bluish-gray to white marble that contains quartz, mica, and tremolite.

### Bessemer Granite

The Bessemer granite (Keith and Sterrett, 1917, p.129) is a locally-porphyritic, medium-to fine-grained muscovite-biotite granite. Granitic textures are rare; the rock commonly is metamorphosed to light-colored quartz-sericite schist. Bessemer granite intrudes the high-rank metamorphic rocks but does not intrude the lower-rank metamorphic rocks. It is thought to be pre-Cambrian.

### Yorkville Granite

The Yorkville granite is a gray to dark-gray, coarse-grained, porphyritic rock in which feldspar phenocrysts mark local lineations. Blocks of dioritic Roan gneiss are included in the granite. It is assigned to late Carboniferous.

### High-rank Metamorphic Rocks

For convenience in preparing the map (fig. 1), most of the Carolina gneiss was combined with the Roan gneiss to constitute a unit of high-rank metamorphic rocks. The biotite gneiss unit of the Carolina gneiss, however, was separated from the unit to emphasize its distribution.

### Carolina Gneiss

The Carolina gneiss consists of interlayered schists and

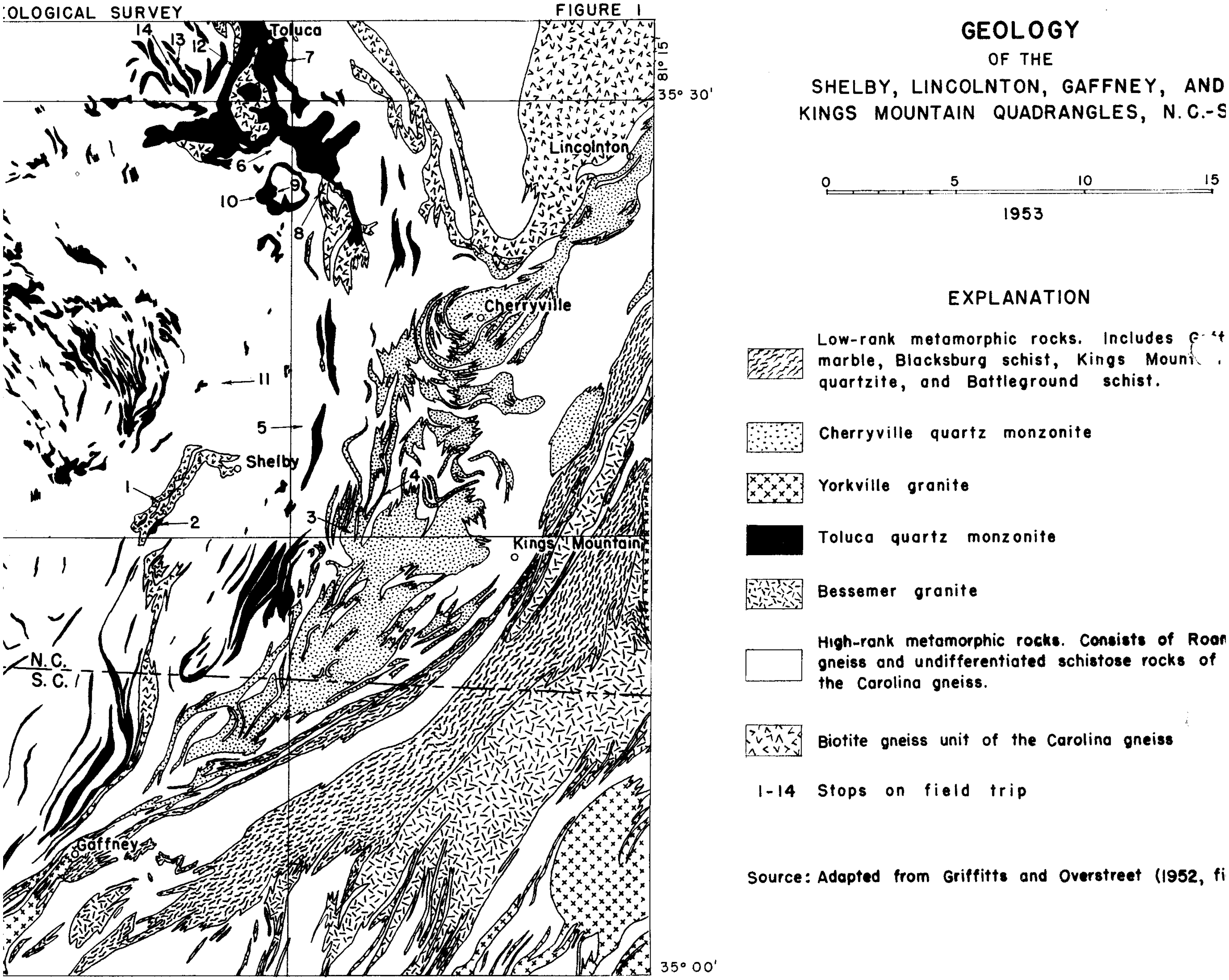


**Figure 1. Geology of the Shelby, Lincolnton, Gaffney, and Kings Mountain quadrangles, N.C.- S.C.**

gneiss of considerable compositional and textural variety. These variations reflect differences in lithology of the original sediments upon which have been impressed regional metamorphism that increases from east to west, abundant introduction of granitic material, and structural complications that result from close folding. At least two dozen petrographically different types of schist and gneiss have been included under the term Carolina gneiss. All have been lumped into one unit in the quadrangles east and south of the Shelby quadrangle. By such lumping, implications of metamorphic differences are lost and the fabric of the country obscured rather than defined. Of course, even in reasonably detailed mapping it is rarely possible in the field to draw every distinction that can be made in the laboratory. However, field work in the Shelby quadrangle, where the Carolina gneiss is all of one metamorphic facies, showed that it was practicable to divide the Carolina gneiss into three units: a biotite schist unit, and sillimanite schist unit, and a biotite gneiss unit. Farther east other units appear possible.

The Carolina gneiss in the four-quadrangle area spans the amphibolite facies of regionally-metamorphosed rocks from a staurolite subfacies to a sillimanite subfacies. Staurolite-bearing schist appears in a narrow and discontinuous zone bordering the western edge of the low-rank metamorphic rocks shown on figure 1. Staurolite decreases in abundance westward as kyanite and garnet increase. Farther west kyanite gives way to sillimanite in garnetiferous muscovite-biotite schist. The zone of transition from staurolite to sillimanite is only a few miles wide; the sillimanite zone has a maximum width of about 40 miles. Sillimanite schist appears on the east side of the Cherryville quartz monzonite pluton in the Lincolnton quadrangle and crops out as far west as the South Mountains. At many places from Lincoln County, N.C., to Spartanburg County, S.C., there is no evidence of metamorphic gradation; the belt of low-rank metamorphic rocks apparently is faulted against sillimanite schist.

This simplified interpretation of metamorphism fails to consider several features. One is the repeated local appearance of staurolite and kyanite across the wide sillimanite zone, a condition of disequilibrium suggesting either that the ideal mineral assemblages of the zone were never fully attained or that the area has undergone late retrogressive metamorphism. A second feature is that staurolite-muscovite schist in the eastern part of the Carolina gneiss appears to be identical with some rocks in the Battleground schist. This may hold the clue to age interpretations of the local Carolina gneiss. A third feature is the composition of biotitic rocks interlayered with the sillimanitic rocks and their adjustments to metamorphism. If relations could be worked out petrologically and structurally, they would form the basis for an interpretation of the lithology of the original sediments and might give some notion of the degree of coincidence between foliation and bedding. One of these biotitic rocks, the biotite gneiss unit of the Carolina gneiss is discusses below.

Sillimanite schist is relatively incompetent compared with the biotite schist and the biotite gneiss which are also included in the Carolina gneiss. Differential movement among layers in the sillimanite schist and movement of competent rocks on the schist exceed adjustments permitted by folding and pass into faulting. The total movement accumulated in small increments from layer to layer could be great; added to that is the possibility of massive dislocations along some of the same planes. Larger faults have not been observed; their existence might be appraised after mapping is completed farther to the northwest.

The Carolina gneiss in the Shelby-quadrangle was divided into sillimanite schist, biotite schist, and biotite gneiss, rocks of different composition but of equivalent metamorphic grade. The divisions can be traced from Yancy County, N.C., to Oconee County, Ga., in a belt that passes through Shelby. From place to place in the belt other rocks crop out. To the east and west the rocks grade into lower-rank subfacies of the amphibolite facies. The marginal reduction in grade of metamorphism appears to close around the northern end of the sillimanitic belt southwest of Mount Airy, N.C. We do not know the details of this closure. Also, we know nothing about rocks of these types southwest of the Oconee River. The sillimanite subfacies zone appears to mark the area of highest-level regional metamorphism in the Piedmont of North and South Carolina.

Roan gneiss, not shown separately on figure 1, comprises hornblende gneiss, hornblende schist, and schistose diorite. Keith and Sterrett (1931, pp 3-4) interpreted the Roan gneiss to be intrusive into the Carolina gneiss and to be pre-Cambrian, although they stated that the origin of some Roan gneiss is uncertain. That uncertainty persists (Kesler, 1944, pp. 779,780; Yates et al., unpublished).

## Biotite Gneiss Unit of the Carolina Gneiss

The biotite gneiss unit of the Carolina gneiss is a completely recrystallized sediment. In the Gaffney quadrangle this rock was mapped as part of the Whiteside granite (Keith and Sterrett, 1931). Sterrett (1912) called this rock Whiteside granite in the western part of the Lincolnton quadrangle, but he regarded similar rock in the northeast part of the quadrangle as a dioritic member of the Roan gneiss. The rock in the Shelby quadrangle (Yates, et al., unpublished) was called biotite gneiss. Studies made by Griffitts (personal communication) in the northeastern part of the Lincolnton quadrangle and in the Gaffney quadrangle showed that this rock in the various areas was the same; so the name used for it in the Shelby quadrangle has now been extended to the other areas.

The biotite gneiss unit can be divided on texture and structure into three types of rock, but gradation among the types and small outcrop are of two prevent separate mapping. The three types are a coarse-grained gneissic rock, which is most common; a schistose rock, which is least common; and a fine-grained granular rock. Bodies of the biotite gneiss unit too small to map are intercalated in the schists of the Carolina gneiss. Rare inclusions of the biotite gneiss unit are in the Toluca quartz monzonite.

The biotite gneiss unit can be further subdivided on the basis of composition into high-biotite and low-biotite gneiss, into rocks with and without microcline, and into hornblende-bearing and hornblende-free gneiss. These divisions cannot be suitably shown on small-scale maps.

The biotite gneiss unit is composed essentially of plagioclase, quartz, and biotite. Poorly-twinned and rarely-zoned plagioclase makes up 57 percent of the microcline-free gneiss and 42 percent of the microcline-bearing gneiss. The plagioclase ranges in composition from andesine to oligoclase and has an average composition of calcic oligoclase. Microcline varies widely in abundance, is present in about 30 percent of the gneiss, and is most common near contacts between the gneiss and the Toluca quartz monzonite. Quartz and biotite respectively make up 17 to 40 and 4 to 25 percent of the rock. In some layers of the gneiss there is 5 to 10 percent of hornblende.

## Toluca quartz monzonite

Toluca quartz monzonite (Griffitts and Overstreet, 1952, p. 779) is exposed in the western part of the four-quadrangle area. This rock together with Cherryville quartz monzonite and the biotite gneiss unit of the Carolina gneiss was included in the unit mapped by Keith and Sterrett (1931) as Whiteside granite in the Gaffney and Kings Mountain quadrangles. Toluca quartz monzonite varies widely in composition and texture. The rock is composed of oligoclase, microcline, orthoclase, quartz, and biotite. Minor amounts of muscovite, garnet, and monazite are characteristic. Toluca quartz monzonite generally conforms to the structure of the enclosing Carolina gneiss. The quartz monzonite is strongly gneissic along conformable contacts, but it may be nearly massive away from the contacts. Locally the quartz monzonite cuts across the foliation of the enclosing rocks. The Toluca quartz monzonite is probably pre-Carboniferous in age.

## Cherryville Quartz Monzonite

The Cherryville quartz monzonite is exposed in the eastern part of the four-quadrangle area. The rock is a massive to faintly-gneissic, locally-lineated muscovite-biotite quartz monzonite consisting of oligoclase, microcline, quartz, biotite, and muscovite. Accessory minerals are rare; traces of zircon, ilmenite, and apatite have been found; but garnet and monazite are absent. Biotite-free Cherryville quartz monzonite occurs as dikes in the biotite-bearing rock. The pluton of Cherryville quartz monzonite, which cuts across the structure of the Carolina gneiss, is thought to be late Carboniferous in age.

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## ROAD LOG

Assemble on Bowman Street in Shelby (fig. 2) with cars headed south. All participants should bring lunch. Departure 8:00 A.M. Figure 3 shows the location of roads and field localities.

| Miles | Saturday |
|---|---|
| 0.0 | Assembly area, Bowman Street, Shelby, N.C. South on Bowman Street to U.S. 74A. Left turn on U.S. 74A. |
| 0.2 | Right turn from U.S. 74A to Gold Street. South on Gold Street. |
| 0.8 | Right turn to West Elm Street. |
| 1.0 | Cross U.S. 74. Continue on dirt road. Chiefly sillimanite schist unit of the Carolina gneiss. Some interlayered biotite schist and pegmatite. All schists seen on this trip are part of the Carolina gneiss. To avoid repetition the term Carolina gneiss will not be used after this in the log. |
| 1.2 | Left turn on dirt road. |
| 2.6 | Continuous sillimanite schist with some interlayered biotite schist. Road cut at crest of hill leading to First Broad River exposes saprolite of coarse-grained, high-biotite, biotite gneiss |
| 2.8 | First Broad River. |
| 3.3 | Biotite schist with some layers of biotite gneiss. |
| 3.5 | Interlayered biotite schist and sillimanite schist. |

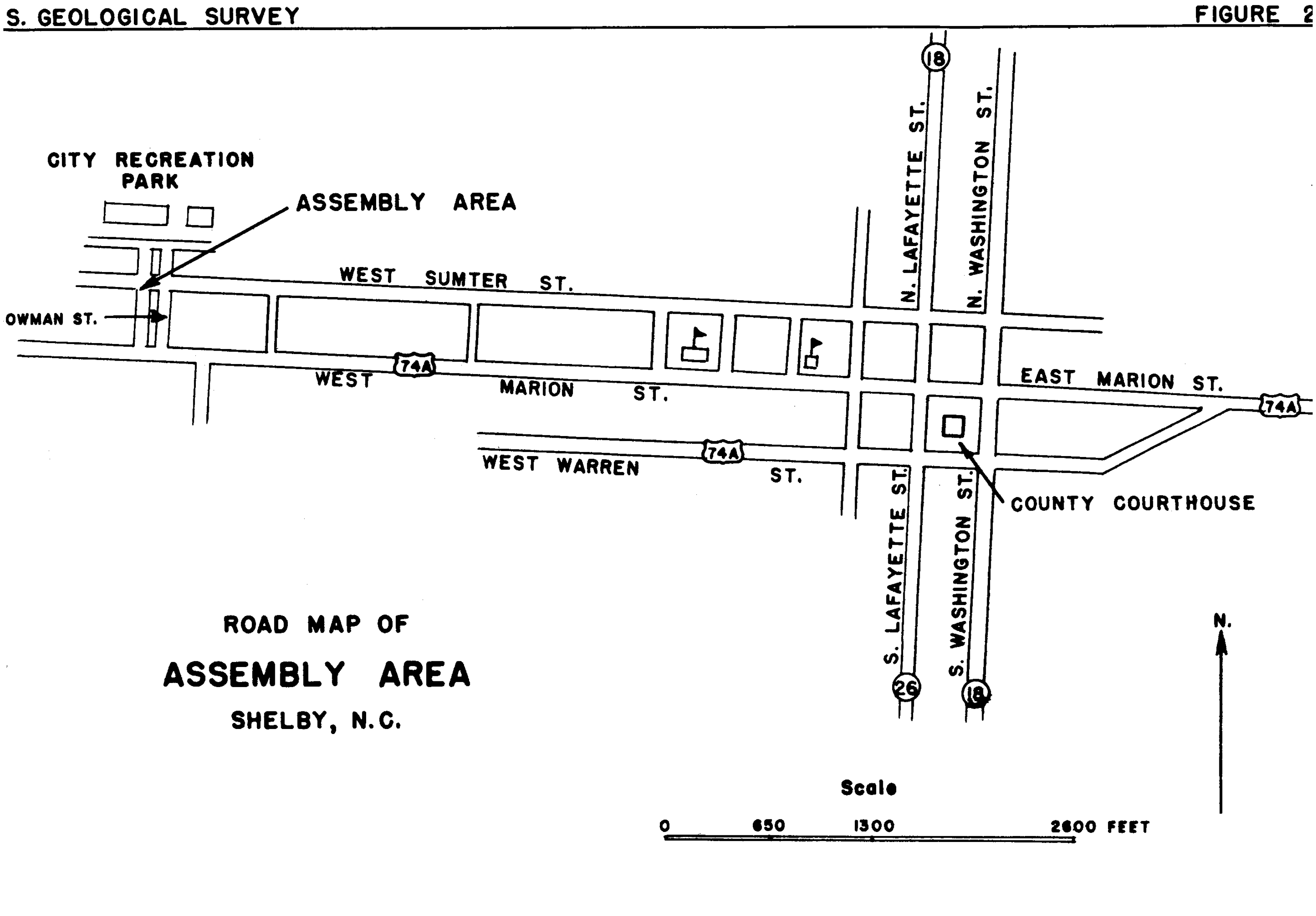


**Figure 2. Road map of assembly area, Shelby, N.C.**

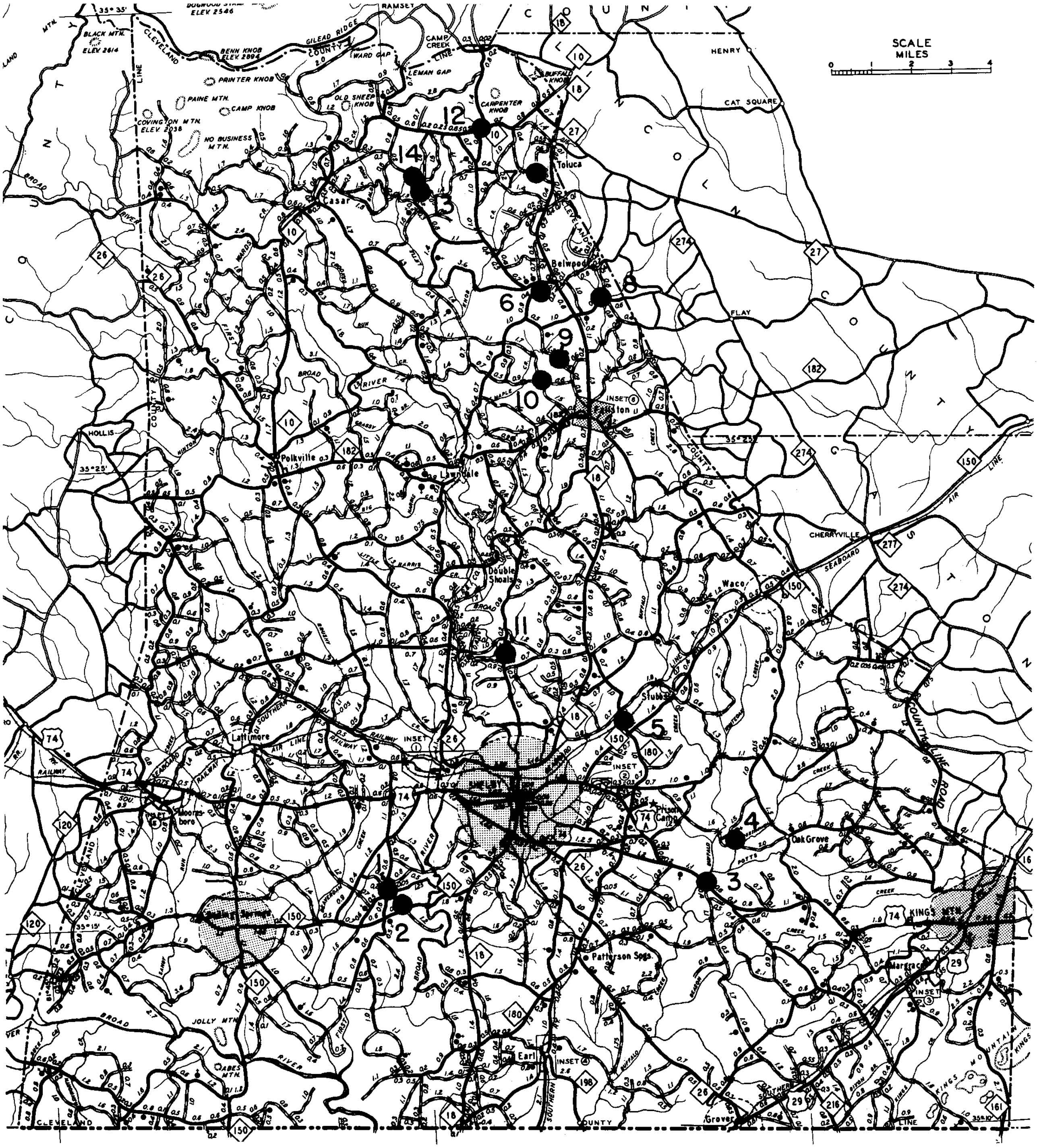


Figure 3. Field trip stops.

3.7 Biotite schist.

4.0 Sillimanite schist. Across the stream to the left the sillimanite schist is overlain by biotite gneiss which has been thrust westward over the schist

4.3 Intersection of hard-surfaced road at Shanghai School. Left turn.

4.5 **Stop #1.** Southwest part of the large body of biotite gneiss in the southeast part of the Shelby quadrangle. Exposure is chiefly saprolite; there are some remnants of unweathered rock. Note that the cotton in the field to the east is planted directly in plowed saprolite. The exposure shows coarse-grained biotite gneiss extensively intruded by pegmatite; locally, metacrysts of potash feldspar can be seen. Irregular foliation of the gneiss dips gently southeast. At the intersection of the dirt road leading east: small layer of sillimanite schist, calc-silicate rock, and pegmatite in the gneiss. Evidence of strong differential movement in this layer, but movement antedates crystallization of garnet in the pagmatite. Garnets retain dodecahedral shape.

4.7 Left turn on dirt road marked: Shelby 5 mi.

5.1 **Stop #2.** Toluca quartz monzonite, biotite rich, foliation contorted, rare small inclusions of micaceous biotite gneiss, concordant and discordant pegmatite bodies.

5.2 Left turn on N.C. 150. Sillimanite schist exposed here is structurally above the biotite gneiss unit and Toluca quartz monzonite to the west.

5.6 Road cut approaching First Broad River exposes tourmaline-bearing sillimanite schist. Black layers are rich in tourmaline. Tourmaline is later mineral than the sillimanite.

5.7 First Broad River. Sillimanite schist continuous eastward.

6.1 Thin bodies of biotite gneiss in sillimanite schist. These are on the strike of the biotite gneiss in the northeast part of the Gaffney quadrangle.

6.2 Thin layers of hornblende gneiss in sillimanite schist. Forms blocky, dark red saprolite, greenish-black unweathered rock. Some massive gabbroic bodies. Possibly most of the hornblende gneiss in these road cuts originated as sills or dikes of gabbro.

6.5 Thin layers of hornblende gneiss in sillimanite schist.

6.8 More hornblende gneiss interlayered with sillimanite schist.

7.1 Intersection of N.C. 18 with N.C. 150. Left turn. Sillimanite schist.

8.3 Right turn on Morton Street, Shelby.

8.6 Left turn on South Morgan Street.

9.0 Right turn on Textile Street.

9.2 Left turn on South Washington Street.

9.3 Right turn on U.S. 74. Sillimanite schist.

9.9 Sillimanite schist with some layers of biotite schist and some pegmatite.

10.5 Broad area of biotite schist with some layers of sillimanite schist.

12.0 Sillimanite schist.

14.0 Contact Cherryville quartz monzonite on east with biotite schist and sillimanite schist on west. Some thin marginal septa of sillimanite schist included in the Cherryille quartz monzonite.

14.5 **Stop #3.** Buffalo Fish Club at Buffalo Creek. Fine-grained Cherryville biotite-muscovite quartz monzonite. Weathered and fresh. Cut by muscovite-bearing pegmatite. Faint planar structure in the quartz monzonite indicated by blades of quartz.

15.7 Cherryville quartz monzonite.

17.3 Bethware school.

17.4 Left turn from U.S. 74 to county hard-surfaced road. Sign marked: Oak Grove Ch. 2 mi. Cherryville quartz monzonite and septa of schist from the Buffalo Creek exposure continuous to this turn.

18.5 Cherryville quartz monzonite.

19.1 Septum of sillimanite schist in Cherryville quartz monzonite. Across stream nearly vertical dikes of Cherryville quartz monzonite cut across the moderately-dipping foliation of sillimanite schist.

19.5 Left turn on dirt road. Sign marked: Shelby 8 1/2 mi. Cherryville quartz monzonite.

19.7 Sillimanite schist continuous westward. Thin dikes and sills of Cherryville quartz monzonite. Muscovite bearing pegmatite associated with the quartz monzonite.

20.6 Contact between Cherryville quartz monzonite and sillimanite-bearing muscovite-biotite schist.

20.9 **Stop #4.** Muddy Creek exposure of Cherryville quartz monzonite. Blocky inclusions of muscovite-biotite schist with muscovite metacrysts. Hornblende gneiss layers in the schist inclusions. Biotite-bearing pegmatite.

21.8 Buffalo Creek. Cherryville quartz monzonite on the west side of the stream is in contact with sillimanitic muscovite-biotite schist.

23.7 Fine-grained biotite schist interlayered with sillimanite schist; biotite schist increasing in abundance.

24.0 Left turn on hard-surfaced road.

24.3 Biotite schist.

24.7 Elizabeth Church community. Right turn on N.C. 180.

26.4 Cross N.C. 150, continue on N.C. 180 which follows divide, hence the poor exposures. Sillimanite schist.

26.7 **Stop #5.** Deep cut of Seaboard Air Line Railroad is in varicolored saprolite of sillimanite schist. East of bridge the cut exposes unweathered sillimanite schist. Note that the high point of the present land surface is underlain by the saprolite.

28. Turn right on N.C. 18.

29.2 Biotite schist.

32.6 Biotite schist.

33.6 Biotite schist

35.0 Fallston.

35.6 South edge of south rim of basin-shaped synclinal sill of Toluca quartz monzonite that has circular outcrop pattern. Cross from underlying biotite schist into the quartz monzonite.

35.8 North edge of southern rim of Toluca quartz monzonite sill. Contact with overlying biotite schist.

35.9 Biotite schist, pegmatite, gabbro. Schist and gabbro are older than the quartz monzonite; the pegmatite is contemporaneous or younger than the quartz monzonite.

36.3 Hornblende gabbro. Contains thin dikes of hypersthene hornblendite.

36.4 Biotite schist.

37.3 South edge of north rim of basin-shaped sill of Toluca quartz monzonite. Pass out of overlying schist.

37.5 North edge of north rim. Underlying interlayered biotite schist and sillimanite schist appear.

37.9 Biotite schist.

38.6 Biotite gneiss.

38.8 Left turn. Biotite schist.

39.3 **Stop # 6.** Belwood School. Service Stations. Luncheon stop. Rest room facilities in the school. After lunch the trip continues northward along N.C. 18. Forty-five minutes allowed for lunch.

40.4 Toluca quartz monzonite.

40.7 Biotite schist.

41.1 Gilead Ridge of the South Mountains is to the northwest. It is composed of biotite gneiss, biotite schist, and kyanitic and sillimanitic muscovite-biotite schist.

42.4 Left turn on dirt road at Sam Sain Gin. Carpenter Knob is to the north. The Knob is a northeast-plunging syncline with centripetal dips complicated by an anticlinal cross warp. It is made up chiefly of biotite gneiss with thin sills of Toluca quartz monzonite.

43.0 **Stop #7.** Acre Rock quarry. This is the type locality of the Toluca quartz monzonite. The rock contains a few angular inclusions of biotite gneiss, veins and pods of quartz, concordant and discordant masses of pegmatite. Strongest jointing trends about N. 10 W. and is intersected by other joints that trend nearly west. Most joints are healed by pegmatite or aplite. Strong lineation on foliation surfaces is marked by clusters of biotite and blades of quartz. Perfect dodecahedrons of garnet are later than the foliation.

43.5 Biotite gneiss.

44.6 Turn right on dirt road to Toluca. Biotite schist.

44.9 Biotite gneiss.

45.2 Biotite gneiss.

45.9 Right turn on N.C. 18.

50.8 Left turn on hard-surfaced road. Sign marked: Kadesh C. 1/2 mi. Biotite schist.

51.7 **Stop #8.** Buffalo Creek (Dixon Ford bridge). Coarse-grained biotite gneiss dips steeply east.

52.0 Good exposures of biotite gneiss saprolite from Stop #8 to this point where sillimanite schist, biotite schist, and pegmatite appear.

52.4 Right turn on dirt road. Biotite schist.

53.1 Sillimanite schist.

53.4 Buffalo Creek. Sillimanite schist continuous to flood plain.

53.5 Toluca quartz monzonite near base of hill is the east edge of the east rim (bottom) of the synclinal sill. The quartz monzonite extends nearly to the top of the hill where it is overlain by westward-dipping biotite schist.

54.0 Left turn on N.C. 18. Biotite schist.

54.1 Right turn on dirt road. Sign marked Flat Rock School 1 mi. Biotite schist.

54.6 Right turn on dirt road at sign marked Flat Rock School. Biotite schist

55.0 **Stop #9.** Flat Rock School and Church. This is near the east edge of the west rim of the basin-shaped sill. Toluca quartz monzonite and biotite schist are in contact along a post quartz monzonite fault. In places the fault surface is covered with pegmatite; elsewhere the quartz monzonite and biotite schist are in direct contact. The common dip of foliation and plunge of lineation in the quartz monzonite near this part of the sill is eastward into the center of the syncline, but here, as a result of faulting, the dip and plunge are locally reversed so that they are directed away from the center of the basin. Thin layers of pegmatite, generally parallel to the foliation of the biotite schist, at first glance appear to be complexly folded. It is soon seen, however, that the complicated outlines are not due to tight folding but to the intersection of the erosion surface with gently-dimpled rock layers. Good drag folds in biotite schist are along a nearly vertical fault that trends N. 20 W. The fault is healed by a pegmatite dike.

55.5 Maple Creek. Contact at west edge of rim of sill. Toluca quartz monzonite above, biotite schist below (across stream).

56.2 Left turn on hard-surface road. Sign marked: Belwood Sch. 1 1/2 mi. Biotite schist.

56.7 Left turn on hard-surface road. Sign marked: Lawndale 4 1/2 mi.

57.7 Left turn on dirt road. Sign marked: Fallston 3 1/2 mi. Biotite schist.

58.5 Maple Creek. Chiefly biotite schist from the crossroads. Some thin layers of biotite gneiss are in the schist at the bridge.

59.1 Road is nearly tangent to the west edge of the west rim of the Toluca quartz monzonite sill. Contact of biotite schist and quartz monzonite. A few thin layers of sillimanite schist in the biotite schist.

59.3 Pass out of quartz monzonite into underlying biotite schist.

59.3 Left turn on dirt road. Sign marked: Fallston 2 mi.

59.4 Small stream practically on contact between underlying schist and overlying quartz monzonite.

59.5 **Stop #10.** Toluca quartz monzonite that contains wispy, folded and faulted inclusions of biotite gneiss.*

60.1 Pass across east edge of west rim of folded quartz monzonite sill into overlying biotite schist. Toluca quartz monzonite on hills to right.

60.4 Right turn on dirt road. Sign marked: Fallston 1 mi. Biotite schist.

60.7 Cross north edge of south rim into Toluca quartz monzonite.

60.9 Cross south edge of south rim into underlying biotite schist.

61.3 Right turn on N.C. 18. Fallston ahead. Biotite schist.

*End of Saturday's trip. The road log has been continued to complete the loop to Fallston and N.C. Route 18. Shelby is 10 miles south of Fallston; route 18 is on weathered, southeast-dipping biotite schist to the north edge of shelby where the biotite schist is overlain by sillimanite schist.

## SUNDAY

Four stops are planned. The trip will end about noon, hence no stop for lunch is planned. Cars will assemble at Bowman Street, Shelby, (Fig.2) headed north. Departure at 8:00 A.M.

Miles Sunday

0.0 Assembly area, Bowman Street, Shelby, Headed north. At start right turn (east) on Sumter Street

0.9 Left turn (north) on North Washington Street.

2.0 At bridge over stream on north outshirts of Shelby the contact between southeast-dipping sillimanite schist and underlying biotite schist is exposed. The schist rise in a great, gentle anticlinal flexure which warps the sillimanite schist up and eastward, exposing biotite schist for 14 miles to the north. Some thin layers of sillimanite schist in the biotite schist will be seen along the route of the excursion.

2.9 Biotite schist saprolite.

3.1 Biotite schist saprolite with foliation planes traceable directly to land surface.

3.5 Biotite schist saprolite.

4.0 Biotite schist saprolite. Foliation planes intersect present land surface with no slumping.

4.5 **Stop #11.** Weathered and unweathered biotite schist is south of the stream; sillimanite schist saprolite is north of the stream. Wide compositional variation from layer to layer in the biotite schist. Crumpling, faserkiesel in the sillimanite schist.

5.1 Contact between sillimanite schist and biotite schist.

5.3 Sillimanite schist saprolite.

6.2 Sillimanite schist saprolite.

6.3 Biotite schist saprolite. Excellent compositional layering.

6.9 Biotite schist saprolite.

7.1 Biotite schist saprolite; unweathered biotite schist in bed of stream to east.

7.6 Pegmatite in biotite schist.

7.9 Right turn on hard-surface road. Biotite schist at turn. Ridge road, hence few exposures. Chiefly biotite schist to route 18.

10.5 Left turn (north) on N.C. Route 18. Drive north along route 18 duplicates part of Saturday's trip. This intersection is 3.8 miles south of Fallston. First exposure is one at mile 32.6 Saturday which is 1.4 miles north of this intersection.

14.3 Fallston.

18.1 Left turn (west) on hard surface road.

18.6 Belwood School.

18.9 Toluca quartz monzonite saprolite.

19.5 Biotite gneiss saprolite.

20.0 Biotite gneiss saprolite.

20.2 Bridge over Knob Creek. Biotite gneiss.

20.5 Biotite gneiss and biotite schist.

50.7 Biotite gneiss.

21.1 Toluca quartz monzonite.

22.0 Sillimanite schist.

22.6 Right turn (northeast) on hard surface road at Coffey Grocery. Sillimanite schist.

22.8 Biotite gneiss.

23.0 Biotite gneiss and biotite schist.

23.2 Sillimanite schist.

23.3 Interlayered sillimanite schist, biotite schist, and hornblende gneiss saprolite. Thin layers and lens-shaped bodies of pegmatite and Toluca quartz monzonite. Some layers of the sillimanite schist contain garnets up to 3 inches in diameter.

23.4 Intersection with N.C. Route 10. Turn left (west) and park cars on right side of road heading uphill.

**Stop #12.** A long series of exposures in road cuts on route 10: Toluca quartz monzonite and biotite gneiss are on the east side of Knob Creek; sillimanite schist is on the west side of the stream. The exposures will be viewed by walking through three road cuts on the east side of the stream and through two cuts on the west side of the stream.

**Section east of stream:** -- East of Knob Creek 100 yards the first cut exposes relatively coarse-grained, garnetiferous Toluca quartz monzonite that ranges in dip from horizontal to 10-20 NE. Strong lineation on the foliation planes of the quartz monzonite consist of aggregates of biotite and flattened leaves of quartz.

In the deep cut at the bend of the road saprolite of Toluca quartz monzonite ranges in dip from gently northwest through horizontal to gently northeast. Septa of fine-grained biotite schist are included in the Toluca quartz monzonite. Many stringers of pegmatite cut across the quartz monzonite.

The third road cut to the east exposes biotite gneiss overlying the Toluca quartz monzonite. Features of the biotite gneiss that aid in distinguishing it from the Toluca quartz monzonite are: larger and more abundant biotite flakes; absence of monazite (local); average composition close to quartz diorite.

**Section west of stream:** -- At the bridge over Knob Creek virtually horizontal biotite gneiss and Toluca quartz monzonite are exposed. Within 50 yards of the stream the western road cut exposes steeply-dipping sillimanite schist abundantly intruded by pegmatite. Near the center of the road cut is a body of biotite schist that thins up dip. The sillimanite schist and biotite schist are in contact along a high-angle normal fault. On the west of the biotite schist an in fault contact with it is coarse-grained Toluca quartz monzonite. It is inferred that the western side of the Knob Creek valley marks a fault between gently-dipping biotite gneiss and Toluca quartz monzonite on the east and steeply-dipping sillimanite schist on the west.

At the top of the hill to the west the road cut exposes folded and faulted interlayered sillimanite schist and biotite schist.

24.1 Sillimanite schist and pegmatite saprolite.

24.4 Biotite schist saprolite.

24.5 Sillimanite schist and pegmatite; biotite schist layer near west end of cut.

24.8 Interlayered biotite schist, sillimanite schist, and pegmatite.

24.9 Left turn (south) on dirt road marked: St. Pauls Ch. Sillimanite schist.

26.4 Sillimanite schist continuous from mile 24.9.

26.6 Right turn (west) on dirt road at Glen Mead's Store.

26.7 **Stop #13.** Erosion gully on south side of road exposes inclusions of gabbro in Toluca quartz monzonite. Even in this saprolite exposure it is possible to distinguish the thick reaction rims of coarse-grained biotite around the inclusions. Wispy, biotite-rich layers may originally have been thin gabbro inclusions.

27.1 **Stop #14.** Between the two stops is sillimanite schist. At this stop is an unweathered exposure of sillimanite schist; this rock is rarely found in an unweathered condition. All the features repeatedly noted in saprolite may be seen here. Many thin sills of Toluca quartz monzonite and pegmatite intrude the sillimanite schist to make it an infection gneiss. A layer of garnetiferous, calc- silicate rock in the sillimanite schist serves to show differences in the composition of the sediments from which the sillimanite schist was derived. Close folding that is typical of the sillimanite schist can be seen in the small recumbent anticline at this outcrop.

This is the last stop on the trip. The road log is continued to complete the loop back to mile 20.2 of this morning's drive.

27.8 Left turn (south) on dirt road; sillimanite schist.

28.6 Bear left at fork in road.

28.7 Left turn (east) at intersection of dirt roads; sillimanite schist.

28.9 Sillimanite schist, thin layers of biotite gneiss and biotite schist. Kyanitic layers in the sillimanite schist 300 yards southeast off the road, but not exposed on road.

29.2 Biotite schist.

29.6 Straight ahead on hard-surfaced road. Few exposures along this ridge.

30.5 Toluca quartz monzonite.

30.7 Right turn (south) on hard-surfaced road marked: Knob Crk. 2 mi. Biotite gneiss. From this point the traverse duplicates the morning route back to N.C. Route 18 from mile 20.2.

33.2 N.C. Route 18. End trip. For those who plan to travel south and southeast, turn right toward Shelby. For those who plan to travel east, north, or west, turn left on N.C. Route 18 toward Toluca whence N.C. Route 27 east leads to Lincolnton, N.C. Route 10 leads to Newton, and N.C. Route 18 leads to Morganton.