STATE OF TENNESSEE

DEPARTMENT OF CONSERVATION

DIVISION OF GEOLOGY

REPORT OF INVESTIGATIONS No. 24

STRATIGRAPHY OF THE CHICKAMAUGA SUPERGROUP IN ITS TYPE AREA

By

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and

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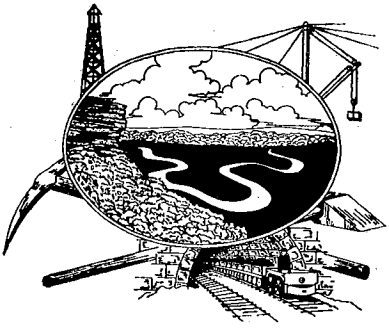

Reprinted from Georgia Geol. Survey Bull. 80,
Precambrian-Paleozoic Appalachian Problems

NASHVILLE, TENNESSEE

1969

STATE OF TENNESSEE

BUFORD ELLINGTON, Governor

DEPARTMENT OF CONSERVATION

E. BOYD GARRETT, Commissioner

DIVISION OF GEOLOGY

WILLIAM D. HARDEMAN, State Geologist

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ABSTRACT

The Chickamauga Limestone in its type area includes all strata from the top of the Knox Group to the base of the Upper Ordovician. In its type area the Chickamauga is composed of about 1450 feet of limestone and argillaceous limestone in formations of the Stones River and Nashville Groups. The Chickamauga is herein considered a Supergroup. The Chickamauga Supergroup overlies the Knox above a well-developed unconformity, and consists in ascending order of the following formations: Pond Spring Formation, Murfreesboro Limestone, Ridley Limestone, Lebanon Limestone, and Carters Limestone of the Stones River Group; and Hermitage Formation, Cannon Limestone, and Catheys Formation of the Nashville Group. The Catheys is overlain unconformably by the Sequatchie Formation in the valley of West Chickamauga Creek, and conformably by the Inman Formation in Lookout Valley.

INTRODUCTION

Regional Geologic Setting

Recent studies by the Tennessee Division of Geology have shown that Middle and Upper Ordovician rock units of the Central Basin and Sequatchie Valley extend eastward into the Valley and Ridge province of southeastern Tennessee and northwestern Georgia.

The present study, a cooperative project between the Georgia Department of Mines, Mining and Geology and the Tennessee Division of Geology, was undertaken to establish in more detail the stratigraphy of the Chickamauga Limestone of earlier usage in the type area, and thus to provide a common basis for continued stratigraphic studies in both states.

Correlation of Middle and Upper Ordovician strata of northwestern Georgia with the Central Basin and the Sequatchie Valley region is based primarily on detailed regional studies by Wilson (1949) and Milici (in preparation) and on many geologic quadrangles published by the Tennessee Division of Geology.

Many detailed measured sections of Middle Ordovician strata in Sequatchie Valley and selected mapped areas in the southwestern part of the Tennessee Valley and Ridge support the correlation. The studies in Tennessee have not yet been published.

The present study is confined to Ordovician strata in the northwestern corner of Georgia. The region is folded and broken by faults of only small displacement, and, except for the Sequatchie Valley Fault, is structurally continuous with Central Tennessee. Three major anticlines arch Ordovician limestones to the surface in the region—the McLemore Cove, Wills Creek, and Lookout Valley anticlines. The Pigeon Mountain syncline bounds the McLemore anticline on the east, and the Lookout Mountain syncline separates the McLemore, Wills Creek, and Lookout Valley anticlines (fig. 1).

The oldest strata of the region, those of the Knox Group, are exposed in the core of Wills Creek and McLemore Cove anticlines, where they underlie low but prominent hills and ridges. Missionary Ridge is one of these hills and separates the Chickamauga and Chattanooga Valleys in which much of our study was made. Chickamauga and Chattanooga Valleys merge southwestward and form McLemore Cove on the nose of the McLemore anticline.

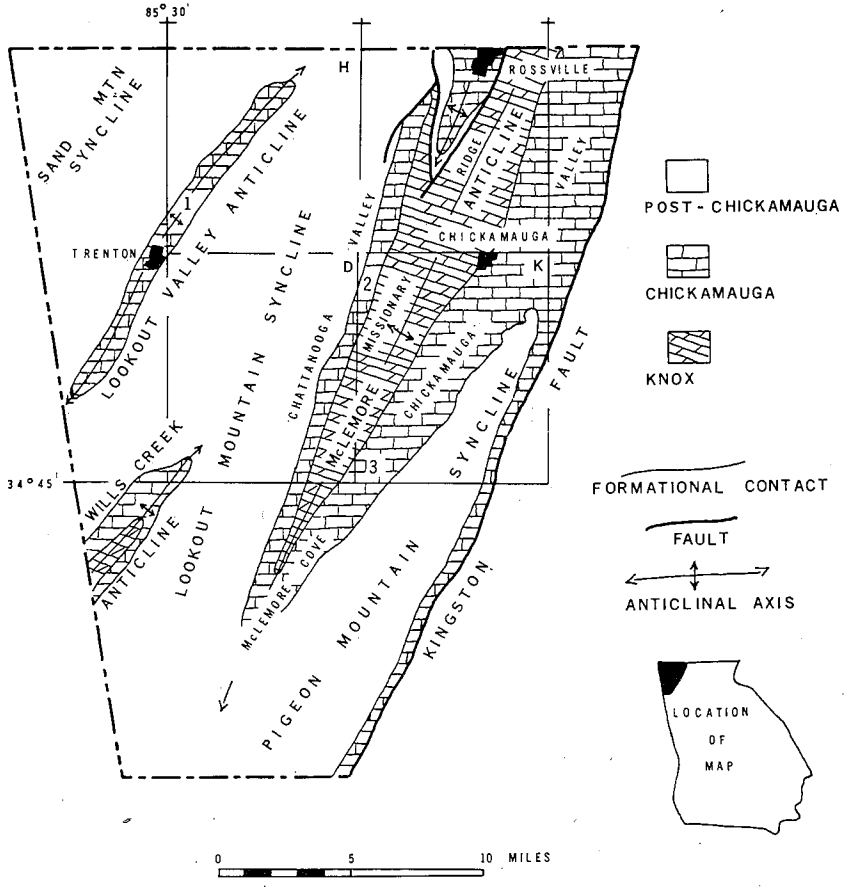

Figure 1—Generalized geologic map of northwestern Georgia, showing distribution of the Chickamauga Supergroup, after Butts and Gildersleeve (1948).

Map Number—1 is the I-59 section. Map Number—2 is the Mill Creek section, and Map Number—3 is the Davis Crossroads section. H is the Hooker quadrangle, D is the Durham quadrangle, K is the Kensington quadrangle.

Previous Investigations

The Chickamauga Limestone was named by Hayes (1891, p. 143) for exposures in the valley of West Chickamauga Creek in the Valley and Ridge Province of northwestern Georgia and adjacent portions of Tennessee. The formation (table 1) included all strata between the top of the Knox Group and the base of the Rockwood Formation(Hayes, 1894). The Rockwood Formation in the Ringgold quadrangle (Hayes, 1894) may have included

the Sequatchie Formation, as did the Rockwood Formation of early workers in Tennessee, until Ulrich (1911) defined the Sequatchie.

Spencer (1893) and Maynard (1912) described the Chickamauga of northwestern Georgia in general terms.

Butts and Gildersleeve (1948, p. 19) divided the Chickamauga

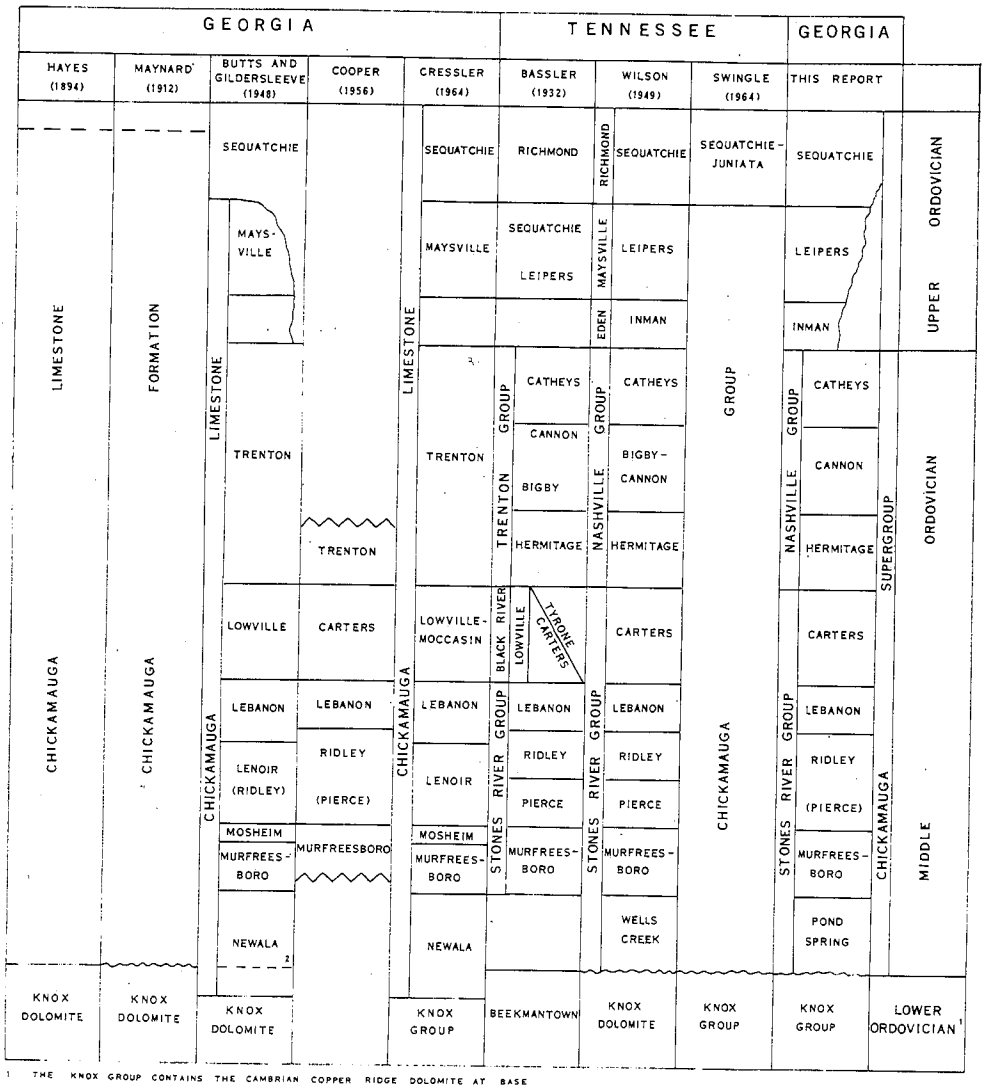

Table 1—Stratigraphic nomenclature of Ordovician strata in Tennessee and northwestern Georgia.

in its type area into the following formations: Newala, Murfreesboro, Mosheim, Lenoir (Ridley), Lebanon, Lowville, Trenton, and Maysville; they included the Murfreesboro, Mosheim, Lenoir (Ridley), and Lebanon within the Stones River Group. The Stones River Group of Butts and Gildersleeve in northwestern Georgia contains the same formations that Bassler (1932) included in the Stones River in Central Tennessee. Butts and Gildersleeve (1948, p. 27 et seq.) and Bassler (1932, p. 48) described the Blount Group (Ulrich, 1911) of the eastern Valley and Ridge as succeeding the Stones River, and they did not recognize that deposits formed in the shelf carbonate environment in Central Tennessee and in the Chickamauga area were deposited at least in part contemporaneously with Middle Ordovician terrigenous sediments in the eastern regions. Hayes (1894) earlier had noted that the Chickamauga "changed in character" between its western and eastern exposures.

Cooper (1956, p. 54-55) described the paleontology and stratigraphy of the Chickamauga in the area of the present study along the road from Pond Spring to Catlett Gap, Kensington quadrangle. He studied strata from the Murfreesboro to the Carters, and disagreed in detail with the correlations Butts and Gildersleeve (1948) made with the Central Tennessee formations and with formations elsewhere in the Valley and Ridge. Butts and Gildersleeve (1948) described Mosheim over Murfreesboro, and correlated the Ridley of northwestern Georgia with the Lenoir of eastern Tennessee. The Mosheim of Butts and Gildersleeve (1948) is a calcilutite at or near the top of the Murfreesboro Limestone. In the central Valley and Ridge of East Tennessee the Mosheim is a calcilutite member of the Lenoir Limestone (Rodgers, 1953, p. 69). Correlation of the Lenoir of Tennessee with the Ridley of northwestern Georgia by Butts and Gildersleeve (1948) was based on *Maclurites*. Cooper (1956, p. 55) showed that this correlation was incorrect and assigned the Mosheim and *Maclurites* beds of Butts and Gildersleeve to the Murfreesboro Limestone in the Chickamauga area. The present work is in agreement with the correlations of Cooper.

Rodgers (1953) and Allen and Lester (1957) described in some detail the lateral gradation of carbonate strata into terrigenous strata, thus correcting a misconception of some earlier workers.

Allen and Lester (1954) described the fossils of northwestern Georgia and later (1957) divided Middle and Upper Ordovician

strata there into zones. However, they made no attempt to define the Chickamauga Limestone as a formal unit.

In East Tennessee Swingle (1964) considered the Chickamauga a Group and included therein all strata between the top of the Knox Group and the base of the Sequatchie or Juniata. This usage was followed in the *Geologic Map of Tennessee* that was subsequently published (Hardeman, Miller, and Swingle, 1966).

Cressler (1964) included all strata between the base of the Newala and the top of the Sequatchie in the Chickamauga Limestone in Walker County, Georgia. In northwestern Georgia Butts and Gildersleeve recognized Maysville as a formation only in Taylor Ridge (1948, p. 33) and there included it in the Chickamauga. Cressler (1964) included both Maysville and Sequatchie in the Chickamauga, although Butts and Gildersleeve (1948) mapped the Sequatchie with Red Mountain (Silurian).

Croft (1964) included all strata between the top of the Knox Dolomite and the base of the Sequatchie Formation in the Chickamauga Limestone in Dade County, Georgia. There, Croft (p. 8) divided the Chickamauga into an upper limestone member and a lower limestone and dolomite member, "... at a thin zone of green chert and bentonite, which is about 20 feet thick. . . ."

The stratigraphy and nomenclature in the Central Basin of Tennessee have been described in detail by Wilson (1949) and are summarized only briefly here. The Stones River and Nashville Groups were named by Safford (1851) for exposures in the Central Basin of Tennessee. Subsequently, these Middle Ordovician groups and their constituent formations were defined and classified differently by workers in different areas (table 1). Wilson (1949, fig. 1, p. 24) defined the Stones River Group as including the Wells Creek Dolomite, Murfreesboro Limestone, Pierce Limestone, Ridley Limestone, Lebanon Limestone and Carters Limestone. He included in the Nashville Group the Hermitage Formation, the Bigby-Cannon Limestone, and the Catheys Formation.

Present Investigation

In the course of this study a detailed geologic map of Chickamauga Valley near the southern edge of the town of Chickamauga was prepared (fig. 2). Reference sections or areas of best exposure were described for formations of the Stones River and Nashville Groups in the mapped area and in places nearby where the strata are well exposed (figs. 1 and 3). The Stones

River and Nashville Groups constitute the Chickamauga Supergroup in its type area. The area mapped was selected because of good exposure of units between the Knox and Sequatchie and is an excellent reference area for the Chickamauga Supergroup. In its type area the Chickamauga ranges from about 1425 to 1475 feet thick.

Supergroup status was selected for the Chickamauga to provide maximum flexibility for future stratigraphic studies. It is anticipated that workers in the future will establish groups elsewhere that reflect different but approximately contemporaneous

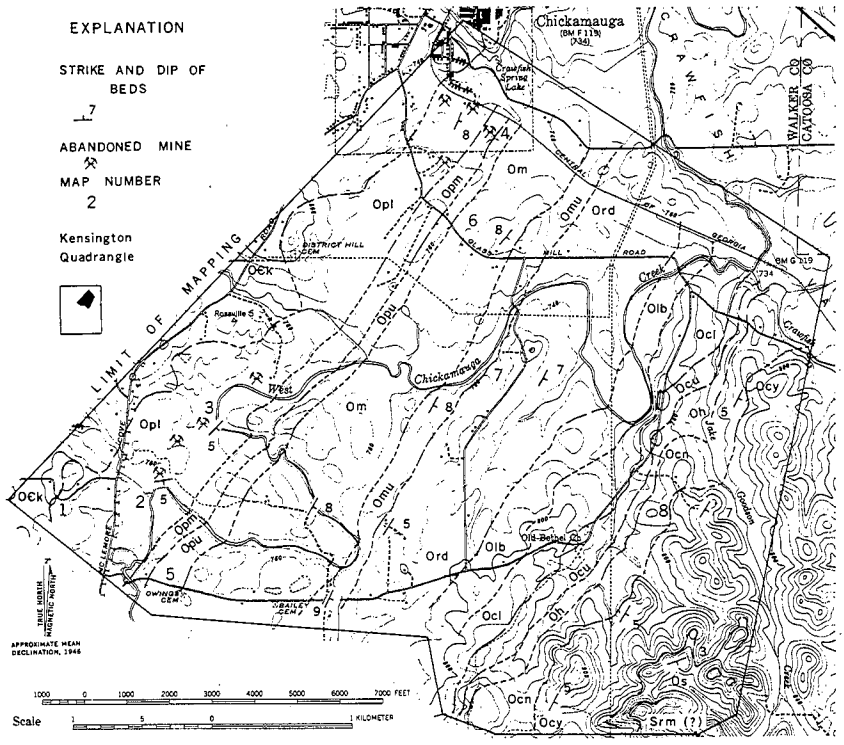

Figure 2—Geologic map of the Chickamauga Supergroup at its type area. Knox Group, undivided—O€k; Pond Spring Formation, lower member—Opl, middle member—Opm, upper member—Opu; Murfreesboro Limestone—Om, upper member—Omu; Ridley Limestone—Or; Lebanon Limestone—Olb; Carters Limestone, lower member—Ocl, upper member—Ocu; Hermitage Formation—Oh; Cannon Limestone—Ocn; Cathey s Formation—Ocy; Sequatchie Formation—Os; basal Red Mountain Formation(?)—Srm(?). Observed formational contacts are solid lines, long dashed where approximately located, short dashed where projected. Base from USGS-TVA Kensington Quadrangle, Georgia; contour interval is 20 feet.

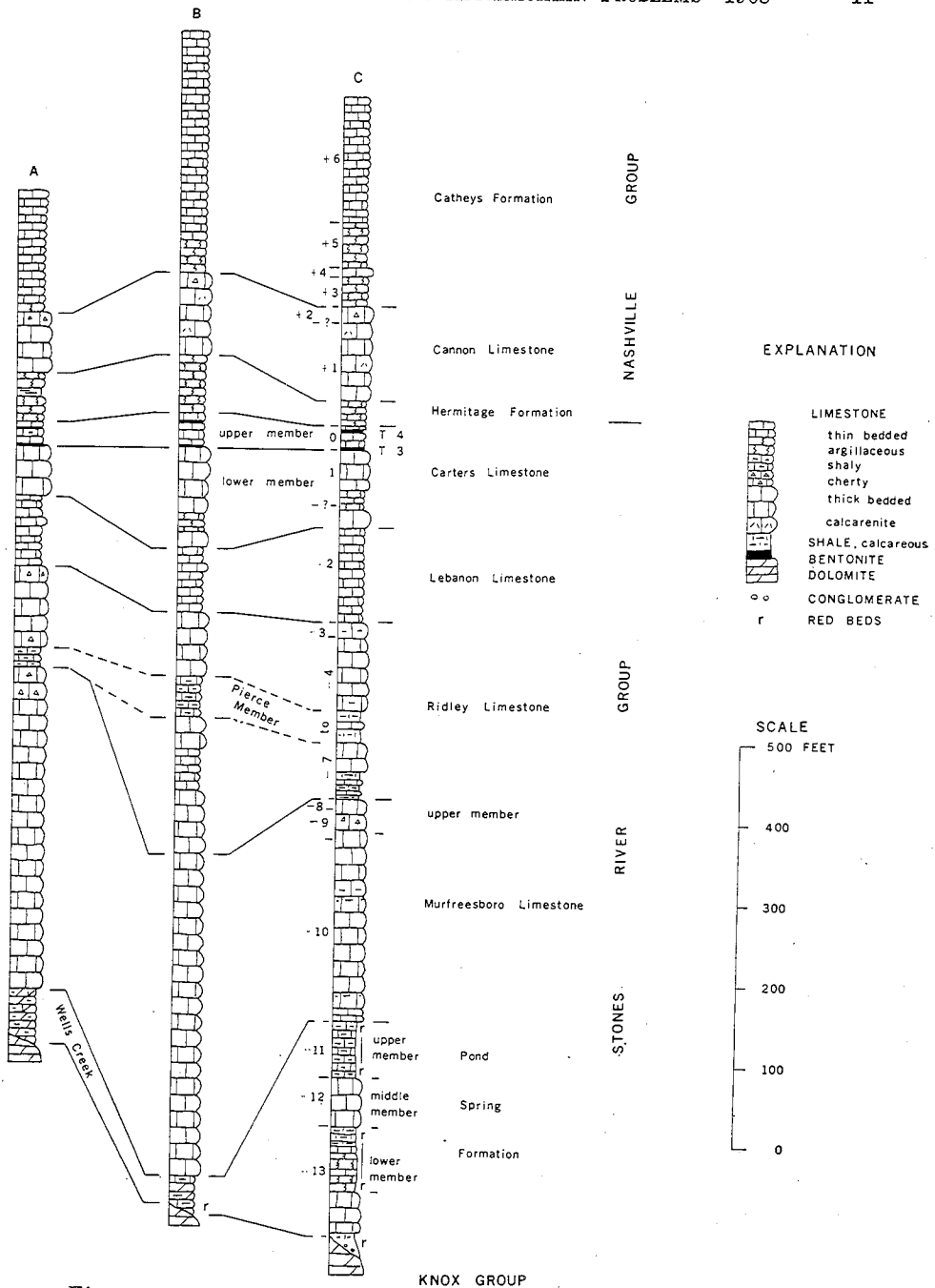

Figure 3—Columnar sections of Middle Ordovician rocks in Central Tennessee (A), Sequatchie Valley (B), and the Chickamauga area (C). The zones, offshore facies, of Allen and Lester (1957) are shown at the left margin of column C.

local sedimentary conditions. The names Stones River and Nashville may be applicable to Middle Ordovician shelf carbonate units established by Miller and Brosge (1954) in southwestern Virginia and mapped in the northwestern part of the Tennessee Valley and Ridge Province (for example, see Harris, 1965). If Stones River and Nashville cannot be extended further even in the shelf carbonate facies, new group names could be defined and correlated with established group sequences. Furthermore, such sequences as Lenoir-Athens-Holston-Tellico-Ottosee in the southeastern part of the Tennessee Valley and Ridge may constitute one or more groups (near shore facies of Allen and Lester, 1957), and the Lenoir-Sevier sequence may be a separate group in northeastern Tennessee. Group sequences thus defined would be useful in showing regional facies variations on maps of regional scale.

The classification of Wilson (1949) is used by the present writers with minor exception. The Pierce Limestone is a mappable unit in the Central Basin of Tennessee and in parts of Sequatchie Valley. In Sequatchie Valley (Tennessee) and northwestern Georgia, Ridley-type fucoidal limestones are above and below Pierce equivalents, and the Pierce is considered a member of the Ridley. Also, in northwestern Georgia the Richmond Group of Wilson (1949) is represented by the Sequatchie Formation. Fernvale-type variegated recrystallized limestones occur within the Sequatchie Formation in Lookout Valley, but precise correlations have not been demonstrated.

The Carters Limestone (this report) is equivalent to the Lowville of Butts and Gildersleeve and perhaps the upper part of the Lebanon of Butts and Gildersleeve (1948).

Age of the Chickamauga Supergroup

The Chickamauga Supergroup in the Chickamauga area includes all strata between the top of the Knox Group, which is marked regionally by an unconformity, and the base of Upper Ordovician red beds.

In Lookout Valley, where Inman (Eden) red beds are below Leipers (Maysville), Butts and Gildersleeve (1948) apparently included both formations in the Sequatchie. Similarly, Ulrich and Butts (cf. Burchard, 1913, p. 31-41) restricted the Sequatchie Formation to red beds above the Leipers in the Valley and Ridge of East Tennessee, but included Inman red beds and the Leipers in the Sequatchie Formation in the Sequatchie Valley and Chattanooga areas (Milici, in preparation).

In McLemore Cove near the town of Chickamauga, the Sequatchie overlies the Catheys unconformably and the Inman and Leipers are absent. Thus in its type area Butts and Gildersleeve (1948) excluded Upper Ordovician strata from the Chickamauga either by accident or design, and the youngest Chickamauga is Middle Ordovician.

The sequence Knox-Chickamauga-"Sequatchie" in the Chickamauga type area is the same as Knox-Stones River-Nashville-Inman-Leipers-Sequatchie in Sequatchie Valley.

The age of the oldest Chickamauga strata in the type area is questionable. Butts and Gildersleeve (1948) mapped Newala above the post-Knox unconformity in Chickamauga Valley. They noted *Ceratopea* in abundance within the formation and correlated the strata there with the upper Beekmantown (Kingsport-Mascot) of Tennessee and Virginia and the Cotter and Powell Limestones of Arkansas (1948, p. 21). If the geologic map and descriptions of Butts and Gildersleeve are accurate then the Chickamauga in some places contains Lower Ordovician beds. The geologic maps made by Butts and Gildersleeve (1948) and the writers are sufficiently similar to indicate that the specimens of *Ceratopea* described by them near Chickamauga are above the post-Knox unconformity (1948, p. 21-22).

Acknowledgments

The manuscript was critically reviewed and edited by L. D. Harris, R. A. Laurence, C. W. Wilson, Jr., L. Alberstadt, R. J. Floyd, E. T. Luther, and S. W. Maher.

STONES RIVER GROUP

The Newala Problem

The Newala Limestone was named by Butts (1928, p. 95) for exposures near Newala Station, Shelby County, Alabama. In its type area Butts described the formation as thick-bedded, fine-grained gray limestone and coarse-grained dolomite. There the Newala is beneath the Odenville Limestone, apparently is below the post-Knox unconformity (Butts, 1928, p. 95-104), and thus is part of the Knox Group.

In northwestern Georgia Butts and Gildersleeve (1948, p. 19) described the Newala as "a rather thick-bedded, pure, blue limestone. . . . The formation is massive, thick, or moderately thick-bedded. Blue-gray, finely crystalline, and some compact dove layers (vaughanite) occur."

Butts and Gildersleeve (1948) described only one lithologic type of the very complex formation, and did not recognize the basal dolomite and chert-pebble conglomerates and the extensive development of red shales, variegated dolomitic limestones, and "red-mottled" limestone that occur within the formation in the Chickamauga area. They recognized "red or red-mottled limestone interbedded with blue or dove beds" in eastern belts but included these (erroneously ?) within the Murfreesboro Limestone (1948, p. 22-23).

It has been known for many years that the Knox-Chickamauga boundary is marked by a regional unconformity that in places preserves considerable topographic relief on the ancient Knox erosion surface (for example, see Maynard, 1912, p. 95, 96; Born and Burwell, 1939, p. 28; Bentall and Collins, 1945; Rodgers, 1953, p. 69-70; Bridge, 1955; Harris, 1960; Wedow, 1961). Lowermost Chickamauga rests on different formations of the Knox Group in different places (Butts, 1928, p. 120-121; Butts and Gildersleeve, 1948, p. 18; Bridge, 1955). The unconformity is overlain in places by large amounts of conglomerates and sedimentary breccias. Bridge (1955) described one of the more spectacular of these in Tennessee, which he named the Douglas Lake Member of the Lenoir Limestone. Equally spectacular is the Attalla Conglomerate in Alabama, described by Butts (1928, p. 120-121).

The Newala of Butts and Gildersleeve (1948) is above the post-Knox unconformity in the Chickamauga area. Munyan, however, has shown that the Newala of Butts and Gildersleeve is below the post-Knox unconformity near Chatsworth, Georgia, and is there within the Knox Group (1951, p. 52-53). Butts and Gildersleeve thus appear to have either misidentified the Newala or to have mislocated the formation on their map in the Chickamauga area.

The "Newala" in the Chickamauga area is in the same stratigraphic position as the Wells Creek Dolomite of Lusk (1927) and Bentall and Collins (1945). The name Wells Creek is no longer used by the Tennessee Division of Geology because of misidentification at its type locality. Accordingly, the writers consider it improper to extend the name Wells Creek into Georgia and instead propose that the strata in the Chickamauga area between the top of the Knox Group and the base of the Murfreesboro Limestone be named the Pond Spring Formation. The name is taken from the town of Pond Spring, which is 1 mile southwest of Map Number 1, figure 2. The type section of the formation is a composite and is at Map Numbers 1, 2, 3, 4, and 5 (fig. 2).

The Pond Spring Formation is in the same stratigraphic position as the Wells Creek Dolomite of Bentall and Collins (1945), and by analogy to the classification of Wilson (1949) the Pond Spring is hereby included within the Stones River Group of northwestern Georgia.

The Pond Spring Formation in part contains strata called the Long Savannah Formation by Cooper (1956, p. 75-76), named from exposures in the Snow Hill quadrangle, Tennessee.

Pond Spring Formation

The Pond Spring Formation overlies the Knox Group unconformably and is overlain by the Murfreesboro Limestone. The basal conglomerate and red beds of the Chickamauga in the area mapped by the writers are consistently about 1000 feet east of the contact selected by Cressler (1964). The Newala of Cressler includes "much dolomite in lower part," and contains in the Chickamauga area some strata that Butts and Gildersleeve (1948) and the present writers mapped as Knox.

In the Chickamauga area the Pond Spring Formation is 250 to 300 feet thick and divisible into three members, which are herein called the lower, middle, and upper members. The lower member is best exposed on both sides of Ketner Branch and 2000 feet northeast of the Ketner Branch-West Chickamauga Creek confluence, along the southwestern bank of West Chickamauga Creek (fig. 2, Map Numbers—1, 2, 3). The middle member is almost completely exposed in the Chickamauga quarry (fig. 2, Map Number—4). The upper member is best exposed, although badly weathered, in roadcuts along Old Bethel Church road near Owings Cemetery (fig. 2, Map Number—5), and in the Chickamauga quarry where the lower 6 feet is exposed.

The lower member of the Pond Spring Formation ranges from about 140 to 170 feet in thickness. In the mapped area the member is thickest in the Ketner Branch sections and thinnest at the southern limits of the town of Chickamauga. The lower member overlies the Knox unconformably and may be subdivided further in some places into a lower conglomerate-red bed sequence, about 20 to 25 feet thick; a middle calcilutite, about 50 feet thick; and an upper red bed unit about 60 to 85 feet thick. The sequence of the lower member thus reflects the order of deposition of the entire formation.

The basal conglomerate of the lower member is commonly 1 to 2 feet thick in the Chickamauga area and consists of rounded

light-gray, sugary, fine-grained dolomite pebbles and boulders as large as 1 foot across in a matrix of porous, light-gray or light greenish-gray dolosiltite. Both matrix and conglomerate were derived from disintegration of the underlying Knox. In places dolosiltite matrix material fills joints and irregular open spaces in upper Knox beds below the unconformity. The dolosiltite matrix material extends about 10 feet above the basal conglomerate and is overlain by 10 or 15 feet of mottled grayish-red and greenish-gray calcisiltites. Thicknesses range widely because of topography developed on the ancient Knox erosion surface, and in this area the material in the conglomerate reflects the local character of the underlying Knox.

The middle calcilutite of the lower member is thick-bedded, light-gray limestone that is typical of the Mosheim member of the Lenoir Limestone in Tennessee. In places the calcilutite contains a few interbeds of porous, light greenish-gray calcisiltite similar to the porous dolosiltite matrix rock just above the unconformity. The lower red beds thin northeastward from Ketner Branch and appear to be absent at Chickamauga, where the middle calcilutite is on or near the top of the Knox.

Upper red beds of the lower member are calcisiltites, calcilutites, and mudstones similar to, but not as argillaceous as, the lower red beds. Greenish-gray and mottled greenish-gray and grayish-red limestones are well developed and have been quarried extensively for building stone. The building stone has been used locally as a veneer on the exterior of houses. The best rock for this purpose is 15 to 25 feet above the Mosheim-type calcilutite. A few gray calcilutites are interbedded with the mottled red beds, but these are generally less than 10 feet thick. The upper red beds also thin northward from Ketner Branch sections, where they are about 85 feet thick, to about 60 feet at Chickamauga.

Fossils are generally absent in the lower member of the Pond Spring Formation.

The middle member of the Pond Spring Formation is composed of about 60 feet of generally thick-bedded gray calcilutite and calcisiltite. Some beds are argillaceous and are light-olive gray. Fossils are generally lacking, although several beds are fossil-fragmental.

The contact of the lower and middle members is apparently conformable and is at the base of the first gray limestone above mottled greenish-gray, grayish-red and gray limestones. The greenish-gray and grayish-red colors of mottled rock of the lower

member are progressively more subdued upward, and are only poorly expressed in the upper beds of the member. The contact between the lower and middle members is exposed in the Chickamauga quarry (fig. 2, Map Number—4).

The contact between the middle and upper members also is exposed in the Chickamauga quarry and is above argillaceous medium-gray or yellowish-gray calcilutites and below greenish-gray and grayish-red mottled argillaceous calcisiltites. The upper and lower members weather more readily than the middle member, which contains much less argillaceous material, and as a result the middle member is comparatively well exposed.

The upper member of the Pond Spring Formation consists of about 70 feet of argillaceous calcisiltites that weather to calcareous mudstones and shales. Some of the rock is mottled grayish-red, pale-red and moderate yellowish-green. Bedding is generally ¼ inch to 6 inches thick. Thinner beds are even and have regular surfaces; thicker beds weather rounded.

The Pond Spring Formation is equivalent to zones –13 through –11 of Allen and Lester (1957) in the valley of West Chickamauga Creek.

Murfreesboro Limestone

The Murfreesboro Limestone was named by Safford and Killebrew (1900, p. 125) for exposures in and around Murfreesboro, Rutherford County, Tennessee. In northwestern Georgia the Murfreesboro Limestone overlies the Pond Spring Formation with apparent conformity and the basal Murfreesboro contact is mapped above red-mottled shales, limestones, or dolomitic limestones.

The Murfreesboro Limestone is best exposed in fields north of Glass Mill Road, between the road and the Chickamauga quarry (fig. 2, Map Number—6); along Old Bethel Church road between Owings Cemetery and Bailey Cemetery; along West Chickamauga Creek about 1500 feet north of the road; and along Mill Creek in Chattanooga Valley, between the Tennessee, Alabama, and Georgia Railroad and Chattanooga Creek (fig. 4). No one section is exposed completely, and the character of the formation was determined from study of the several sections.

The formation is about 275 feet thick and is composed predominantly of medium-dark gray to dark-gray calcilutite and calcisiltite. Light-gray and olive-gray limestones are common, and greenish-gray calcareous shales and shaly limestones are interbedded with the limestones.

The limestones are generally even textured and in beds 6 inches to 1 foot thick. Some beds ¼ to ½ inch thick occur in the lower part of the formation; and basal beds are laminated, very thin-bedded, and even-bedded argillaceous limestones that weather to calcareous shale. The Murfreesboro-Pond Spring contact and the basal laminated beds of the Murfreesboro are best exposed along West Chickamauga Creek 1500 feet northeast of Owings Cemetery.

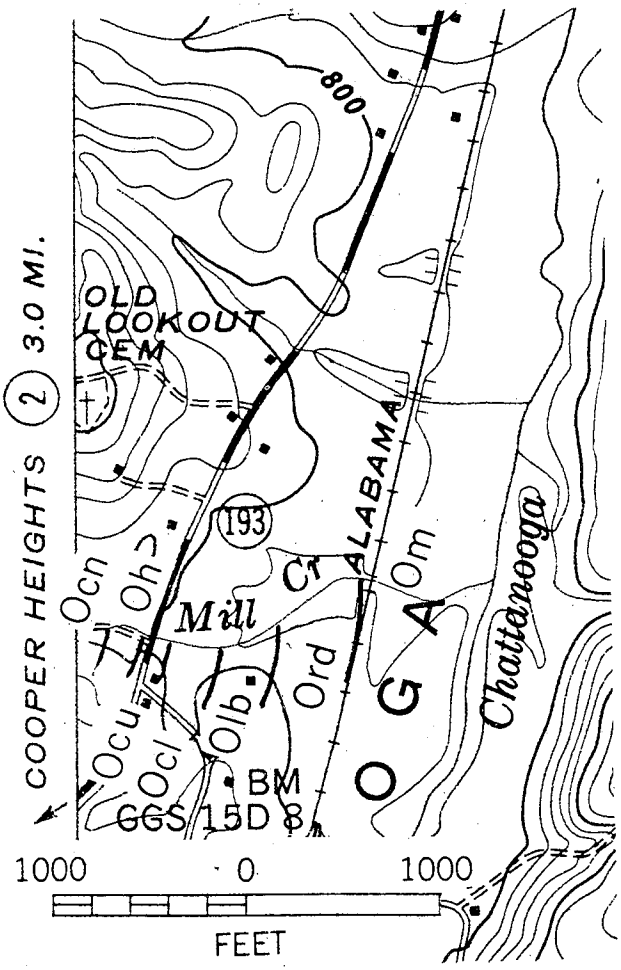

Figure 4—Geologic contacts at the Mill Creek Section, Chattanooga Valley, Kensington quadrangle (fig. 1, Map Number—2). Murfreesboro Limestone—Om; Ridley Limestone—Ord; Lebanon Limestone—Olb; Carters Limestone, lower member—Ocl, upper member—Ocu; Hermitage Formation—Oh; Cannon Limestone—Ocn. Base from USGS-TVA Kensington Quadrangle; contour interval 20 feet.

The bedding of Murfreesboro Limestone is generally even, and some beds have regular surfaces. Partings or seams of yellowish-gray-weathering argillaceous limestone are common. Some splotchy or fucoidal beds similar to Ridley limestones occur in the Murfreesboro, but these are generally less than 10 feet thick. Light- to medium-light gray calcilutite occurs in some places within the Murfreesboro, and in the Mill Creek section is at the contact between the Murfreesboro and Ridley.

The upper part of the formation contains a zone of ropy brownish-black chert that has been described both by Butts and Gildersleeve (1948, p. 22) and by Allen and Lester (1957, p. 89-91). The chert is in medium-dark gray calcilutite that contains many unevenly bedded seams of argillaceous calcilutite or calcisiltite ½ inch to 2 inches thick, and is in nodules or irregular lenses along and across bedding. Weathered chert in rectangular pieces is found in soil above the chert-bearing strata and is useful in identifying the upper Murfreesboro where only residuum is visible.

The ropy chert-bearing strata are overlain by light- to medium-gray calcilutite that may be in thin or laminated beds or in beds as much as 2 feet thick.

Allen and Lester (1957) described the ropy chert-bearing strata as zone –9 and measured thicknesses of 37 and 47 feet in the valley of West Chickamauga Creek and in Chattanooga Valley. They referred the overlying calcilutite to zone –8 and described it as 12 to 20 feet thick in this area.

The writers have mapped the ropy chert and calcilutite strata as an upper member of the Murfreesboro in the valley of West Chickamauga Creek; the base of the upper member was selected below the lowest beds of argillaceous limestone and above medium-dark gray pure calcilutites. The top of the member is the Murfreesboro-Ridley contact. The upper member of the Murfreesboro is best exposed on the southeast bank of West Chickamauga Creek in the center of the map area (fig. 2, Map Number—7).

Ridley Limestone

The Ridley Limestone was named by Safford (1869, p. 216) for exposures near Ridleys Mill in Rutherford County, Tennessee. The Ridley overlies the Murfreesboro with apparent conformity and the contact is selected above beds of well-bedded light- to medium-gray, laminated or thin- to thick-bedded calcilutite. Ridley-type limestones are "fucoidal" and not as well

bedded as Murfreesboro limestones, and in places are in the Murfreesboro. As far as is known Murfreesboro (Mosheim)-type calcilutites do not occur within the Ridley.

The Ridley Limestone is well exposed in fields south of Mill Creek, Chattanooga Valley, and in the mapped area (fig. 2) of the Kensington quadrangle. There it consists of about 260 feet of limestone and calcareous shale. Limestone ranges from calcilutite to coarse-grained calcarenite in shades of gray to olive-gray. Characteristic Ridley Limestone beds are medium-gray to medium-dark gray calcisiltite or fine-grained calcarenite. The rock contains irregular splotches of coarser-grained more argillaceous or dolomitic "fucoidal" limestone. Wilson (1949, p. 26-29) postulated that the fucoids were formed by selective dolomitization of organic debris during diagenesis of carbonate sediment. Chemical analyses of "sugary" coarser-grained materials show both a higher $MgCO_3$ and insoluble residue content than associated fine-grained rock (Wilson, 1949, p. 27). However, weathered fucoids effervesce in 10 percent HCl in a manner similar to the host rock.

In the Kensington quadrangle the Ridley contains two zones of calcareous shale and mudstone. In the Mill Creek section the lower shale-mudstone is 35 feet thick and is 34 feet above the base of the formation. The upper zone (Pierce Member) is approximately 41 feet thick and is 107 feet above the base of the formation. In Sequatchie Valley, Tennessee, the Ridley contains a prominent shale member (Pierce Member) in the middle or upper half of the formation.

The Ridley Limestone is equivalent to zones –7 through –3, and perhaps the lower part of zone –2 of Allen and Lester (1957) in Chattanooga Valley and in the valley of West Chickamauga Creek.

Lebanon Limestone

The Lebanon Limestone was named by Safford and Killebrew (1900, p. 125-126) for exposures in the vicinity of Lebanon, Wilson County, Tennessee. The Lebanon overlies the Ridley with apparent conformity. The Lebanon Limestone is well exposed in the Mill Creek section, where it is 113 feet thick. The formation consists of medium-gray to medium-dark gray calcilutite to coarse-grained calcarenite, and the rock contains numerous argillaceous or dolomitic fucoids. The Lebanon-Ridley contact is picked where beds as much as 8 inches thick give way to beds

generally 1 to 2 inches thick. In addition to being generally thinner bedded than the Ridley, the Lebanon is abundantly fossiliferous and contains numerous brachiopods (including *Sowerbyella*) and small bryozoans. Weathered Lebanon exposures generally are strewn with saucer-sized fragments of limestone which have rough, uneven surfaces.

In Tennessee Wilson (1949) was able to subdivide the Lebanon into a lower thin-bedded member, a middle massively bedded member, and an upper thin-bedded member. Some thicker beds occur locally within the middle part of the Lebanon in northwestern Georgia, but they are not known to be persistent laterally.

The Lebanon Limestone is approximately equivalent to zone –2 of Allen and Lester (1957) in Chattanooga Valley and in the valley of West Chickamauga Creek.

Carters Limestone

The Carters Limestone was named by Safford (1869, p. 258-268) for exposures along Carters Creek in Maury County, Tennessee. The Carters overlies the Lebanon paraconformably (Wilson, 1949, p. 54). The Carters-Lebanon contact is picked where beds 1 to 2 inches thick are overlain by beds 1 to 6 inches thick. Beds of the lower Carters generally are considerably less fossiliferous than the Lebanon, and weathered pieces are rounded rather than rough or irregular.

The Carters is divided into a lower and an upper member, separated by bentonite T-3 (Wilson, 1949, p. 46). Bentonite T-3 occurs at the base of the upper member of the Carters Limestone; bentonite T-4 is near the top of the Carters.

The lower member of the Carters is about 100 feet thick and consists of three units that in northwestern Georgia are much the same as in Sequatchie Valley, Tennessee. The lowest unit consists of 25 feet of calcilutite and fine-grained calcarenite in 1- to 6-inch beds. The rock is slightly fossiliferous and argillaceous, and is fucoidal as are most Stones River limestones.

In the Mill Creek section the middle unit consists of interbedded gray limestone and olive-gray calcareous mudstone and is at least 8 feet thick and possibly as much as 24 feet thick. The upper unit is medium-gray or medium olive-gray calcilutite or calcisiltite in beds 1 to 13 inches thick. The upper unit of the lower member of the Carters is at least 49 feet thick, and possibly as much as 65 feet thick.

Limestones of the lower member of the Carters are all medium-gray to medium-dark gray, medium-dark brownish-gray and olive-gray, fucoidal, and slightly fossiliferous. The range of beds to as much as 18 inches thick and the comparative scarcity of fossils separates the Carters from the underlying Lebanon.

Bentonite T-3 is yellowish-gray to grayish yellow-green; some is granular, some fissile. Weathered bentonite is soft, easily deformed clay. The bentonite is 4 to 5 feet thick and overlies a bed of chert 3 to 8 inches thick. The chert is olive-gray to dusky yellowish-green and weathers moderate yellowish-brown.

Underlying lower Carters limestones generally contain marine fossils, and in many places the T-3 chert contains chert-replaced marine fossils (brachiopods), indicating that T-3 volcanic ash fell into the sea.

The upper member of the Carters Limestone is 27 feet thick and consists generally of calcilutite with minor amounts of calcisiltite and very fine-grained calcarenite. The limestones are medium-gray to medium-dark gray, light olive-gray, and greenish-gray. The strata characteristically weather light-gray. Some of the rock is mud-cracked, some burrowed, and some contains intraclasts. Beds are 1 to 6 inches thick and average 2 inches. Bedding is even and regular, and some beds are finely cross-bedded. Marine fossils are generally absent.

The upper member of the Carters in northwestern Georgia apparently was deposited in an intertidal environment not conducive to marine life.

Bentonite T-4 is 2 feet thick and occurs within the upper Carters 4 to 10 feet below the top of the formation. The bentonite is grayish-orange and grayish yellow-green. The T-4 bentonite contains abundant biotite flakes and overlies a thin (¾-inch) platy chert. Bentonite T-4 may have accumulated at or near mean sea level in northwestern Georgia and adjacent parts of the Tennessee Valley and Ridge and in Sequatchie Valley, Tennessee. It would be interesting to determine if the occurrence of biotite is diagnostic of subaerial accumulation, or a characteristic of T-4 regardless of depositional environment.

The Carters Limestone is well exposed along both sides of the road between Old Bethel Church and Glass Mill Road, and the upper member is well exposed in the section along the Tennessee, Alabama, and Georgia railroad about 2500 feet east of McLemore Cove Road, near Davis Crossroads, Kensington quadrangle.

The Carters Limestone is equivalent to the 0 zone, zone –1 and

probably the upper part of zone –2 of Allen and Lester (1957) in Chattanooga Valley and in the valley of West Chickamauga Creek.

NASHVILLE GROUP

Hermitage Formation

The Hermitage Formation, which was named by Hayes and Ulrich (1903, p. 2) from exposures near the Hermitage community in Davidson County, Tennessee, overlies the Carters paraconformably (Wilson, 1949, p. 61).

In northwestern Georgia the Hermitage consists of 35 feet of argillaceous calcilutite to coarse-grained calcarenite. The contact with the Carters is picked where even-bedded, finely crossbedded, or mud-cracked limestones of the upper Carters are overlain by generally poorly bedded, medium- or olive-gray argillaceous limestone. Poorly preserved Hermitage bedding perhaps is related to the reworking of Hermitage sediments by burrowing organisms (bioturbation). The Hermitage contains numerous fossils of bryozoans, crinoids, brachiopods, and horn corals, and probably was deposited in a subtidal environment.

The Hermitage Formation is well exposed under the powerline (not on map) 1000 feet southwest of Glass Mill Road, and along the Tennessee, Alabama, and Georgia railroad near Davis Crossroads, Kensington quadrangle. It is equivalent to the lower beds of zone +1 of Allen and Lester (1957) in the valley of West Chickamauga Creek.

Cannon Limestone

The Cannon Limestone was named by Ulrich in 1911 for exposures in Cannon County, Tennessee, and a type section designated by Bassler (1932, p. 87-88) was established in Cannon and Rutherford Counties, Tennessee. The Cannon overlies the Hermitage with apparent conformity.

Wilson (1949) described the nomenclature and stratigraphy of the Bigby-Cannon Limestone in Central Tennessee in considerable detail and preferred the use of the dual nomenclature for the formation. Thus, in Central Tennessee workers refer to ". . . Bigby facies and Cannon facies of the Bigby-Cannon limestone . . ." (Wilson, 1949, p. 107).

The dual nomenclature is of little practical use in northwestern Georgia, and the writers prefer the use of Cannon Limestone in a formational sense, rather than as a lithofacies.

The Cannon Limestone consists of medium-dark gray calcilutite to calcarenite in well-defined beds generally 2 to 6 inches thick. *Tetradium* are abundant, as are brachiopods, bryozoans, and gastropods in some beds. The formation is 110 to 120 feet thick in the Chickamauga area and is best exposed between Jake Goodson Creek and Old Bethel Church (fig. 2, Map Number—8).

Chert lenses and nodules are common in the Cannon, and small rectangular chert fragments as much as 1 inch long are useful in mapping Cannon residuum where the formation is not exposed.

The Cannon Limestone is equivalent to the upper zone of zone +1 and zone +2 of Allen and Lester (1957) in the valley of West Chickamauga Creek.

Catheys Formation

The Catheys Formation, which was named by Hayes and Ulrich (1903, p. 2) for exposures along Catheys Creek in Lewis and Maury Counties, Tennessee, overlies the Cannon with apparent conformity. Upper beds of the Cannon in places are argillaceous or silty and weather yellowish-gray. The Cannon-Catheys contact is picked generally within the yellowish-gray-weathering strata, where typical thick beds of the Cannon give way to laminated or very thin- to thin-bedded limestones.

The Catheys Formation in Sequatchie Valley, Tennessee, and in northwestern Georgia consists of two main rock types. Lower beds of the formation are laminated or thin-bedded alternations of silty yellowish-gray-weathering calcilutite and calcisiltite and medium-gray fine-grained limestones. Weathered pieces are characteristically rounded, and the color alternations are strikingly similar to topographic contours; hence, the rock is sometimes called "contour-rock" in the field.

Wilson (1949, p. 144) subdivided the Catheys of Central Tennessee into several lithofacies and referred the lower laminated beds to the "laminated siltstone facies."

In northwestern Georgia and Sequatchie Valley, Tennessee, the laminated siltstone facies is typically unfossiliferous and some beds are mud-cracked, indicating that the strata were deposited in an intertidal environment.

The middle and upper half of the Catheys Formation consists of irregularly bedded medium-gray limestones (lutites to arenites), and is abundantly fossiliferous. Limestone beds are separated by partings or very thin beds of calcareous shale, and the weathered outcrop is strewn with pieces of limestone which have irregular, rough surfaces much like the Lebanon.

Bryozoans and brachiopods are abundant, including *Constellaria,* a characteristic fossil of the Catheys in Central Tennessee (Wilson, 1949). The fossils are little abraded but commonly broken, indicating that they were transported only a short distance before deposition. The middle and upper Catheys probably were deposited in a subtidal environment into which clastics periodically flooded. The most fossiliferous beds are relatively pure limestones and represent accumulations in relatively clear water. Periodic influx of terrigenous mud killed much of the life, presumably in local areas, and remains were preserved in a covering of limy ooze.

The Inman and upper part of the Catheys are well exposed in Lookout Valley along Interstate Highway 59 north of Trenton. The lower member of the Catheys is best seen between Old Bethel Church and Jake Goodson Creek (fig. 2, Map Number—8), and the Catheys-Sequatchie contact is exposed under the powerline 4100 feet south-southeast of Old Bethel Church.

The Catheys Formation is about 250 feet thick in the valley of West Chickamauga Creek. The lower member of the formation is 100 to 110 feet thick and is equivalent to zones +3, +4, and +5 of Allen and Lester (1957); the upper member of the Catheys is equivalent to zone +6 of Allen and Lester.

UPPER ORDOVICIAN FORMATIONS

The Catheys Formation is overlain paraconformably by the Inman Formation (Wilson, 1949, p. 177-179) in Lookout Valley, and unconformably by mottled grayish-red calcareous mudstones of the Sequatchie Formation near Chickamauga (fig. 2). The contact with the Inman is picked where medium-gray, thin- to medium-bedded argillaceous limestones are overlain by silty, greenish-gray calcilutites or calcisiltites. In northwestern Georgia the Catheys-Inman contact is best exposed along Interstate Highway 59, 2.8 miles north of the Trenton Interchange in Lookout Valley. The Inman contains red and green shales in Sequatchie Valley, Tennessee, in the Chattanooga area, and Lookout Valley, Georgia, and was included (along with the overlying Leipers) within the Sequatchie by earlier workers.

Upper Ordovician strata show marked facies changes in the Lookout Valley-McLemore Cove region. Red mudstones and calcisiltites of the Sequatchie overlie the Catheys at the nose of Pigeon Mountain between Old Bethel Church and Jake Goodson Creek, Kensington quadrangle, and the Inman and Leipers are

absent. The red mudstones apparently grade laterally into Sequatchie lagoonal or shallow-water gray and greenish-gray marine limestones in the 10-mile interval between Chickamauga and Lookout Valley.

The absence of Inman and Leipers in McLemore Cove and in the Interstate Highway 75 roadcut through Taylor Ridge near Ringgold probably is related to the regional unconformity recognized by Butts (1928, p. 133) and Rogers (1961) at the base of the Red Mountain Formation in Alabama.

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APPENDIX

Rock descriptions: Suffixes -lutite, -siltite, -arenite refer to grain size only. Colors are from The Geological Society of America Rock Color Chart, and for dry specimens. The words "even" and "uneven" refer to bedding thicknesses; "regular" and "irregular" refer to bedding surfaces.

Sections were measured with steel tape where possible. Sections up hills or along moderately dipping beds such as in Chattanooga Valley were hand-leveled. The thicknesses of the Murfreesboro Limestone and Catheys Formation were obtained from the geologic map.

I-59 SECTION, LOOKOUT VALLEY, Hooker Quadrangle, Ga.-Tenn.
UPPER PART OF CATHEYS FORMATION. Map Number —1, Fig. 1.

Interval	Thickness (feet)	Description
		INMAN FORMATION (upper part not measured)
0.0-6.0	6.0	CALCISILTITE to coarse-grained CALCARENITE, mottled, greenish-gray and grayish-red, with some color in layers; beds 1 inch to 1.5 feet thick, even, irregular, fossiliferous
6.0-9.0	3.0	CALCISILTITE, argillaceous, greenish-gray, with CALCARENITE, medium-grained, medium-gray, in lenses up to 1 inch thick, and partings of SHALE, greenish-gray; one bed, even, irregular, moderately fossiliferous
		BASE INMAN, TOP CATHEYS
9.0-20.2	11.2	INTERBEDDED, CALCISILTITE, argillaceous, olive-gray, and CALCARENITE, medium-grained, medium-gray; beds ½ inch to 4 inches thick, even, irregular but with some uneven lenses, abundantly fossiliferous; vugs as much as 1.5 inches across contain anhydrite
20.2-22.2	2.0	CALCISILTITE, argillaceous, to CALCARENITE, medium-grained, greenish-gray, medium-dark gray, argillaceous, fossiliferous, with partings of calcareous shale; one bed, even, irregular
22.2-25.3	3.1	CALCISILTITE, argillaceous, to CALCARENITE, medium-grained, medium-gray, greenish-gray, light olive-gray; beds ½ inch to 5 inches thick, even, regular, slightly fossiliferous
25.3-27.8	2.5	CALCISILTITE, argillaceous, to CALCARENITE, medium-grained, in lenses as much as 1 inch thick, greenish-gray, light olive-gray; one bed, even, irregular, fossiliferous
27.8-45.1	17.3	CALCISILTITE, medium-gray, to CALCARENITE, coarse-grained, medium-dark gray, argillaceous; beds 2 to 4 inches thick, even, irregular, with partings of gray calcareous shale; very fossiliferous, bryozoans, brachiopods
45.1-46.8	1.7	CALCISILTITE, argillaceous, to CALCARENITE, medium-grained, in lenses as much as 1 inch thick, greenish-gray, light olive-gray, medium-gray; one bed, even, irregular, fossiliferous
46.8-55.2	8.4	CALCISILTITE to CALCARENITE, coarse-grained, medium-dark gray, argillaceous; beds 2 to 4 inches thick, even, irregular, with partings of gray calcareous shale; very fossiliferous, bryozoans, brachiopods.
55.2-60.7	5.5	CALCISILTITE, argillaceous, to CALCARENITE, medium-grained, in lenses as much as 1 inch thick, greenish-gray, medium-gray; beds 1 to 3 feet thick, even irregular; fossiliferous, bryozoans; glauconitic
60.7-90.7	30.0	CALCISILTITE to CALCARENITE, coarse-grained, medium-dark gray, argillaceous; beds 2 to 4 inches thick, even, irregular, with partings of gray calcareous shale; very fossiliferous, bryozoans, brachiopods

OLD BETHEL CHURCH-JAKE GOODSON CREEK SECTION, Kensington Quadrangle, Georgia. LAMINATED SILTSTONE MEMBER OF CATHEYS FORMATION AND CANNON LIMESTONE. Map Number—8, Fig. 2.

Interval (feet from base of upper Catheys)	Thickness (feet)	Description
		CALCISILTITE, medium-dark gray, beds 1 to 4 inches thick, uneven; soil filled with fragments 2 to 8 inches across; lowest exposure of upper member of Catheys Formation
20	20	COVERED, BASE UPPER CATHEYS, TOP LAMINATED SILTSTONE MEMBER
75	55	CALCISILTITE, argillaceous, medium-gray, yellowish-gray, light olive-gray, with grayish-green splotches of glauconite; bedding from laminae to as much as 1 foot thick, even, regular; weathers to rounded outcrops; in some beds yellowish-gray-weathering laminae alternate with medium-gray or light olive-gray limestone; some beds are rippled, some mudcracked; intermittently exposed
88	13	CALCILUTITE to CALCARENITE, fine-grained, medium-dark gray, some slightly argillaceous and weathers yellowish-gray, some beds have brownish-gray argillaceous splotches or fucoids, bedding 1 inch to 1 foot thick, even, irregular
124	36	CALCILUTITE to CALCISILTITE, medium-gray to medium-dark gray, with argillaceous calcilutite to calcisiltite, yellowish-gray-weathering; beds even, regular, in alternating laminae or beds as much as 6 inches thick of argillaceous and less argillaceous limestone; intermittently exposed
		BASE CATHEYS, TOP CANNON
234	110	CALCILUTITE to CALCISILTITE, medium-gray to medium-dark gray, weathers light olive-gray, some argillaceous; upper beds are more argillaceous and weather yellowish-gray; bedding generally 4 inches to 1 foot thick, even, irregular, weather rounded. Beds about 15 feet above base are laminated "contour rock," about 10 feet thick; some argillaceous, medium-dark gray, light olive-gray, or brownish-gray weathering beds 2 to 3 feet thick and some fossiliferous fragmental beds of fine-grained calcarenite are in the section. *Tetradium* are abundant throughout
251	17	COVERED, base of Cannon estimated to be 10 feet below lowest exposure of Cannon. Top uppermost exposure of Hermitage

DAVIS CROSSROADS SECTION, Kensington Quarangle, Georgia. Section measured along north side of Tennessee, Alabama, and Georgia Railroad, CANNON LIMESTONE, HERMITAGE FORMATION AND CARTERS LIMESTONE. Map Number—3, Fig. 1.

Interval (feet from top of section)	Thickness (feet)	Description
		CANNON LIMESTONE, lower part
0.0-30.5	30.5	CALCILUTITE, medium-dark gray, with some partings of argillaceous limestone; beds ½ inch to 6 inches thick, even, some regular; fossiliferous, brachiopods, bryozoans, and gastropods, near top, *Tetradium* abundant; petroliferous; some beds with a few intraclasts
		BASE CANNON, TOP HERMITAGE
30.5-32.0	1.5	Gradational zone as below, but with some *Tetradium*
32.0-65.5	33.5	CALCILUTITE to CALCARENITE, coarse-grained, olive-gray, medium-gray, argillaceous, with partings of argillaceous limestone; bedding about 1 inch thick, even, very irregular, cobbly weathering; fossiliferous, bryozoans, crinoids, brachiopods, horn corals
		BASE HERMITAGE, TOP CARTERS (UPPER MEMBER)
65.5-71.5	6.0	CALCILUTITE to CALCARENITE, very fine-grained, medium-gray to medium-dark gray; beds 1 to 6 inches thick, about 2 inches average; even, regular; with partings of argillaceous limestone; with some intraclasts; some beds finely crossbedded some mudcracked, some with calcite-filled burrows
71.5-72.0	0.5	SHALE, calcareous, light olive-gray, fissile
72.0-74.0	2.0	BENTONITE, T-4, grayish-orange, grayish yellow-green, with abundant biotite; with thick chert at base, dusky yellow, about ¾ inch thick, platy
74.0-84.5	10.5	CALCILUTITE, medium-gray, greenish-gray, argillaceous, beds 2 to 8 inches thick; with interbeds of CALCARENITE, very fine-grained, medium-dark gray, beds 1 to 4 inches thick, even, regular
84.5-91.5	7.0	CALCILUTITE, to CALCISILTITE, medium-gray to medium-dark gray; beds ½ inch to 4 inches thick, even, regular; some weathers very light-gray; with small amounts of intraclasts, mudcracked, some beds finely crossbedded
91.5-92.5	1.0	SHALE, calcareous, yellowish-gray, fissile, tough
92.5-96.5	4.0	BENTONITE, T-3, yellowish-gray, grayish yellow-green, fissile, granular, soft; CHERT, olive-gray, dusky yellowish-green, bed about 4 inches thick, even, regular, at base of clay
		(LOWER MEMBER)
96.5-108.5	12.0	CALCILUTITE, medium-gray to medium-dark gray; with argillaceous splotches and partings; beds ½ inch to 6 inches thick, even, irregular; moderately fossiliferous, with brachiopods, crinoids, bryozoans, cup corals
		COVERED

MILL CREEK SECTION, CHATTANOOGA VALLEY, Kensington Quadrangle, Georgia. CARTERS, LEBANON, AND RIDLEY LIMESTONES. Fig. 4, and Map Number—2, Fig. 1.

Interval (feet below T-4)	Thickness (feet)	Description
———	———	BENTONITE, T-4, with weathered biotite, poorly exposed
0.0-18.0	18.0	CALCILUTITE to CALCISILTITE, light olive-gray, medium-gray, some argillaceous; beds ½ inch to 1 inch thick, even, regular, some with irregular surface, some mudcracked
18.0-23.0	5.0	BENTONITE, T-3, as in Davis Cross Roads Section. Chert at base is 3 to 8 inches thick, dusky yellowish-green, moderate yellowish-brown (weathered surface)
23.0-72.0	49.0	CALCILUTITE to CALCISILTITE, medium-gray, some medium olive-gray, with light olive-gray argillaceous splotches and partings; bed 1 to 18 inches thick, even, irregular; slightly fossiliferous, with gastropods, crinoids, brachiopods, horn corals
72.0-88.0	16.0	COVERED
88.0-96.0	8.0	INTERBEDDED, CALCILUTITE to CALCARENITE, fine-grained, and some limestone-pebble CONGLOMERATE, medium-gray to medium-dark gray, medium-dark brownish-gray, olive-gray, some argillaceous, and MUDSTONE, calcareous, olive-gray; beds 1 to 3 inches thick, even, some irregular; intermittently exposed
96.0-121.0	25.0	CALCILUTITE to CALCARENITE, fine-grained, medium-gray to medium-dark gray, medium-dark brownish-gray, slightly argillaceous; beds 1 to 6 inches thick, even, irregular, with argillaceous splotches and partings; slightly fossiliferous, with brachiopods, bryozoans, gastropods, cephalopods, crinoids
		BASE CARTERS, TOP LEBANON
121.0-234.0	113.0	CALCILUTITE to CALCARENITE, coarse-grained, medium-gray to medium-dark gray, slightly argillaceous; beds ½ inch to 4 inches thick, generally 1 to 2 inches, even, irregular, with argillaceous splotches. Some very fossiliferous with numerous brachiopods, bryozoans, cephalopods, crinoids, *Sowerbyella* abundant in some beds; exposed intermittently on hill, exposure strewn with saucer-sized fragments
		BASE LEBANON, TOP RIDLEY
234.0-237.0	3.0	CALCARENITE, medium- to very coarse-grained, medium-light gray to medium-gray; beds 1 to 8 inches thick, even, irregular, fossil-fragmental
237.0-266.0	29.0	COVERED, but with beds of CALCILUTITE, olive-gray, some argillaceous, and CALCARENITE, medium- to very coarse-grained, medium-gray, brownish-gray, olive-gray; exposed beds as much as 4 inches thick, even, some irregular; fossiliferous, with trilobite, bryozoans, crinoids

Interval (feet below T-4)	Thickness (feet)	Description
266.0-284.0	18.0	CALCILUTITE to CALCARENITE, coarse-grained, medium-dark gray, medium-dark brownish-gray; beds 1 to 8 inches thick, even, irregular, with argillaceous splotches and partings; fossiliferous, with brachiopods, crinoids, gastropods
284.0-293.0	9.0	COVERED
293.0-330.0	37.0	CALCILUTITE to CALCARENITE, coarse-grained, medium-dark gray, medium-dark brownish-gray; beds 1 inch to 2 feet thick, even, outcrops rounded, with argillaceous partings and splotches; with a few irregular lenses of chert, dark-gray, ½ inch to 1 inch thick, lenses up to 6 inches long; moderately fossiliferous, with brachiopods, bryozoans
330.0-348.0	18.0	COVERED
348.0-389.0	41.0	COVERED, but with float and beds of SHALE, yellowish-gray and dusky-yellow, fissile, and CALCILUTITE to CALCISILTITE, light olive-gray, argillaceous
389.0-427.0	38.0	CALCILUTITE to CALCARENITE, coarse-grained, medium-dark gray, some argillaceous; beds 1 to 18 inches thick, even, irregular, with argillaceous partings and splotches; fossiliferous, with gastropods, brachiopods, crinoids
427.0-462.0	35.0	MUDSTONE, calcareous, yellowish-gray, dusky-yellow, with a few beds of CALCISILTITE, argillaceous, medium-gray, light olive-gray, beds as much as 4 inches thick; poorly exposed
462.0-496.0	34.0	CALCILUTITE, medium-gray to medium-dark gray, light olive-gray, some with argillaceous splotches and partings; beds ⅛ inch to 8 inches thick, some beds platy, outcrops rounded; intermittently exposed in field
		BASE RIDLEY, TOP MURFREESBORO
496.0-511.0	15.0	CALCILUTITE, medium-gray to medium-light gray; beds 2 inches to 2 feet thick, even, some irregular; intermittently exposed on west side of railroad in field near Mill Creek
		Intermittent exposures, not measured, on east side of railroad, in field and woods near Mill Creek

CHICKAMAUGA QUARRY SECTION, Kensington Quadrangle, Georgia.
POND SPRING FORMATION, MIDDLE MEMBER. Map Number—4, Fig. 2.

Interval (feet from uppermost exposure)	Thickness (feet)	Description
0.0-6.0	6.0	CALCISILTITE, argillaceous, mottled greenish-gray and grayish-red; beds 1 to 2 feet thick, even, irregular; weathers to yellowish-gray and grayish-red shale
		Base upper member of Pond Spring, top middle member of Pond Spring
6.0-8.5	2.5	CALCILUTITE, argillaceous, medium-gray or yellowish-gray; beds 6 inches to 1 foot thick, even, irregular

Interval (feet from uppermost exposure)	Thickness (feet)	Description
8.5-10.2	1.7	CALCILUTITE, laminated, as below but in beds 2 to 3 inches thick
10.2-12.2	2.0	CALCILUTITE, light olive-gray; beds laminated to ½ inch thick, even, irregular, show sedimentary slump features
12.2-17.7	5.5	CALCILUTITE, medium-gray, and CALCILUTITE, argillaceous, yellowish-gray and light olive-gray; beds ½ foot to 1 foot thick, even, irregular
17.7-21.2	3.5	COVERED
21.2-27.2	6.0	INTERBEDDED, CALCILUTITE, and CALCILUTITE, argillaceous, medium-gray, light olive-gray, some beds glauconitic; beds 2 inches to 1 foot thick, even, irregular
27.2-38.2	11.0	CALCILUTITE, medium-light gray to medium-dark gray with some light olive-gray; beds 1 to 2 feet thick, even, irregular
38.2-42.2	4.0	CALCILUTITE to CALCISILTITE, argillaceous, medium-gray, some light olive-gray, some beds with intraclasts, some fossil-fragmental; beds generally 1 to 3 feet thick, even, irregular
42.2-67.2	25.0	CALCILUTITE to CALCISILTITE, medium-light gray to medium-gray, some light olive-gray, some beds with intraclasts, some fossil-fragmental; beds generally 1 to 3 feet thick, even, irregular
67.2-70.0	0.8	CALCILUTITE, medium-dark gray; one bed, even, irregular
		Base middle member of Pond Spring, top lower member of Pond Spring
70.0-82.0	12.0	CALCILUTITE to CALCARENITE, very fine-grained, mostly CALCISILTITE, light-gray to medium-light gray, some beds mottled greenish-gray and grayish-red and weather yellowish-gray; beds 6 inches to 2 feet thick, even, irregular; some beds are silty or sandy (very fine-grained) and have thin weathering crusts, some beds are laminated, some have intraclasts
		Base of Quarry, water level

KETNER BRANCH SECTIONS, Kensington Quadrangle, Georgia. POND SPRING FORMATION, LOWER MEMBER. Map Numbers—1, 2, and 3, Fig. 3.

Interval (feet below base of middle member)	Thickness (feet)	Description
		Section is exposed on the south bank of West Chickamauga Creek, and in fields south of the creek about 2000 feet northwest of Ketner Branch.
		Basal exposures, Middle member of Pond Spring Formation
0-15	15	COVERED

Interval (feet below base of middle member)	Thickness (feet)	Description
15-25	10	CALCILUTITE to CALCISILTITE, argillaceous, greenish-gray, grayish-red, mottled, some yellowish-gray with small amounts of medium-gray calcilutite; poorly exposed
25-35	10	CALCILUTITE, medium-gray, some slightly argillaceous, beds 1 inch to 1 foot thick, even, irregular
35-57	22	CALCISILTITE, argillaceous, and MUDSTONE, calcareous, grayish-red and greenish-gray, mottled; bedding uneven; poorly exposed
		Section is exposed in fields 300 to 400 feet north of Ketner Branch between McLemore Cove Road and West Chickamauga Creek. Section continuous with above.
57-59.5	2.5	CALCISILTITE, medium-light gray, light olive-gray; one bed, even, irregular, marks upper limit of rock quarried for building stone
59.5-85.5	26	CALCISILTITE, argillaceous, some mottled, greenish-gray and grayish-red, some light greenish-gray, medium-gray, glauconite common; beds 6 inches to 2 feet thick, even, irregular, weathers to rough angular pieces; quarried for building stone, upper 15 feet preferred
85.5-135.5	50	CALCILUTITE, light-gray, some slightly argillaceous (Mosheim type), with some beds of calcisiltite, light greenish-gray, porous; beds generally 6 inches to 2 feet thick, even, outcrops rounded
		Section exposed in fields and along secondary road 500 to 1500 feet southwest of Ketner Branch. Section approximately continuous with above.
135.5-138.5	3	CALCILUTITE, medium-gray, slightly argillaceous; beds 6 inches to 1 foot thick, outcrops rounded
138.5-143.5	5	COVERED
143.5-147.5	4	CALCISILTITE to CALCARENITE, fine-grained, light-gray, some mottled greenish-gray and grayish-red, some light greenish-gray and grayish-red, some light-gray, some mottled greenish-gray and grayish-thick, even, outcrops rounded
147.5-157.5	10	SILTSTONE, calcareous, grayish-red, poorly exposed
157.5-167.5	10	DOLOSILTITE and CALCISILTITE, dolomitic, very light- to light-gray, light greenish-gray; beds generally 6 to 18 inches thick, even, regular, porous, weathered outcrops rounded
167.5-169.5	2	CONGLOMERATE; pebbles to boulders as large as 1 foot across of dolarenite, fine-grained, medium-light gray, sugary, are in a matrix of dolosiltite, light greenish-gray, porous, glauconitic (?)
		Base Pond Spring Formation, top Knox
		DOLARENITE, very fine- to fine-grained, medium-light gray, sugary, irregularly bedded, weathers to rough irregular surfaces