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To the Graduate Council:

I am submitting herewith a thesis written by Robert Calvin Milici entitled "The Geology of the Sequatchie Valley Overthrust Block, Sequatchie Valley, Tennessee." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Geology.

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THE GEOLOGY OF THE SEQUATCHIE VALLEY OVERTHRUST BLOCK
SEQUATCHIE VALLEY, TENNESSEE

A Dissertation
Presented to
the Graduate Council of
the University of Tennessee

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

by
Robert Calvin Milici
June 1960

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No time
make pocket in back
for maps

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CHAPTER I. INTRODUCTION

LOCATION AND EXTENT

The Sequatchie anticline, a major structure of the Cumberland Plateau, parallels the regional strike of the Appalachians for a distance of over 200 miles (Fig. 1). It extends "southwestward from the south side of the Emory River in Morgan County, Tennessee, nearly to the forks of the Black Warrior River in Walker and Jefferson Counties, Alabama . . ." (Rodgers, 1950, p. 672).

The present study is concerned with the overthrust block of the Sequatchie Valley fault which extends approximately 80 miles from the Tennessee-Alabama state line northeast to the Crab Orchard Mountains, Cumberland County, Tennessee. The width of the portion of the overthrust block mapped averages four miles; hence the area mapped approximates 300 to 350 square miles.

TOPOGRAPHIC EXPRESSION OF THE STRUCTURE

Rodgers (1950, pp. 672-674) gave the following description of the Sequatchie anticline:

At its north end it is a low, nearly symmetrical arch in the Pennsylvanian rocks of the Cumberland Plateau, the uparched Pennsylvanian sandstone and conglomerate beds forming a prominent line of hills (the Crab Orchard Mountains). Traced southwest, the fold rises so that the Pennsylvanian rocks are breached,

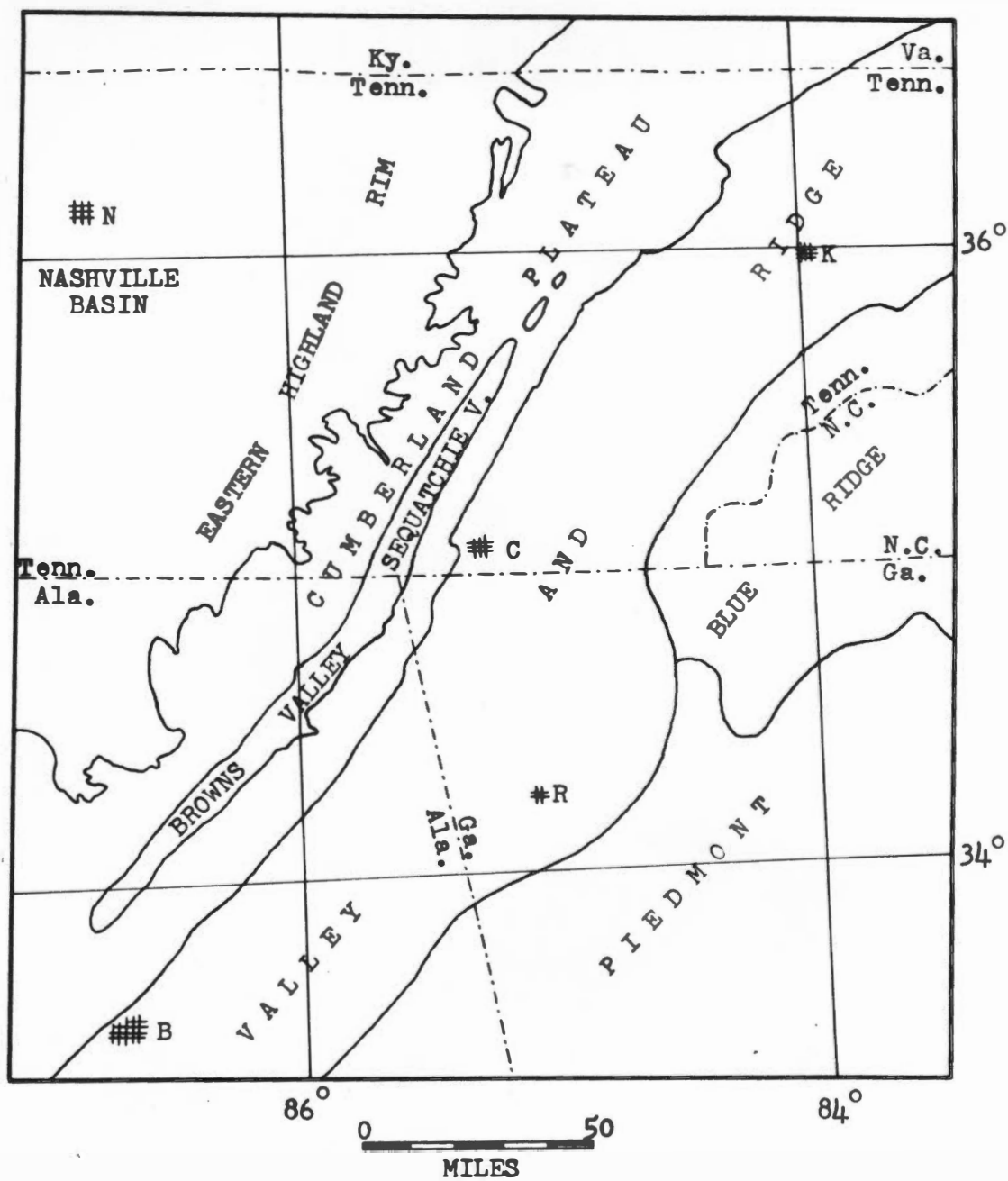


Figure 1. Location and extent of Sequatchie Valley

and the underlying Mississippian limestone is exposed in a series of topographic lows, the largest of which is Grassy Cove. A little southwest of Grassy Cove, the anticline rises sharply, exposing Ordovician carbonate rocks, which are the surface rocks along its crest for most of its length. Here the fold is markedly asymmetrical, its northwest flank being much the steeper, and only a little farther southwest that flank is broken by a thrust fault, whose increasing displacement thrusts Ordovician rocks over Mississippian rocks. The anticline retains approximately this magnitude for nearly 130 miles, to a point nearly 20 miles southwest of Guntersville, Alabama; the fault is present for most of this distance. Throughout this segment the anticline has been eroded to form a narrow and fertile valley, called Sequatchie Valley in Tennessee and Browns Valley in Alabama, and followed by the Sequatchie and Tennessee rivers. Beyond Guntersville, the fold passes in reverse order through all the stages exhibited at its northeast end and ends as a gentle symmetrical arch in the Black Warrior coal field.

In Tennessee, the relief and pronounced linearity of the valley, and the consistently rugged valley walls, are the most striking topographic features of the structure. Maximum elevations of the eastern valley wall, which ranges in altitude from 2000 feet in the southern part of the area mapped to 3000 feet at the head of the valley, are generally 100 to 400 feet greater than those at the western side of the valley. The relief from the top of the Cumberland Plateau to the floor of the valley is consistently greater than 1000 feet throughout the length of the Sequatchie Valley from the Tennessee-Alabama state line to the head of the valley.

PURPOSE OF INVESTIGATION

The purpose of this investigation was twofold: (1)

to decipher the nature of the thrust faulting of the anticline; and, (2) to study the stratigraphy of the Paleozoic formations of the Sequatchie Valley.

PREVIOUS INVESTIGATIONS

Investigations prior to 1926

The early geologic studies of the Sequatchie Valley region were of the general geology or mineral resources of the area. Troost (1840) and Safford (1869) described the physiography, stratigraphy, and structural geology of the Sequatchie Valley in general terms. Safford noted the asymmetry of the fold, but recognized the Sequatchie Valley fault only south of Jasper, Tennessee. Hayes (1895a) was the first to publish a large scale map of a portion of the Sequatchie Valley in Tennessee.

Bowron (1886, 1888, and 1889), Phalen (1911), and Burchard (1913a) published works which primarily considered the coal and iron resources in and adjacent to the Sequatchie Valley. Bowron (1886) discussed the stratigraphy, structure, physiography, and coal and iron of Sequatchie Valley. In 1888 he published a handbook in which he described the general geology of the region and discussed its economic resources. His final work, published in 1889, considered the economics of the Sequatchie Valley iron industry in detail. Phalen

(1911) described the stratigraphy of the coal measures of the Pikeville Special quadrangle. Burchard (1913a) described the Rockwood iron ore at Inman, Marion county, publishing measured sections and a map showing the distribution of the hematite.

Butts worked in and adjacent to the Sequatchie Valley during the first thirty years of the century. In 1916 Butts considered the oil and gas possibilities of the southern part of Cumberland county, to the northwest of the head of the Sequatchie, Vandever quadrangle. In 1925 Butts and Nelson elaborated on Butts' 1916 report. Their work impinges upon a small portion of the Sequatchie Valley in which they located the Sequatchie Valley fault in approximately the same position as the present writer. Nelson (1925) briefly described the Sequatchie Valley fault and the stratigraphy and economics of the coal measures in the Sequatchie Valley area.

Investigations after 1926

Investigations in the Sequatchie Valley region after 1926 were more concerned with the stratigraphy and structural geology of the area than with general and economic geology. Bassler (1932) published a generalized section of the formations exposed in Sequatchie Valley, Tennessee, compiled from notes furnished by E. O. Ulrich and Charles Butts. Martin (1940) recognized the units described by Bassler, in

his consideration of the geology of the northern part of the Sequatchie Valley and Grassy Cove. Bean (1942) measured two Mississippian sections in the northern part of Sequatchie Valley. Wilson (1949) revised Bassler's concept of the pre-Chattanooga stratigraphy of the Central Basin and Sequatchie Valley.

Butts initiated additional detailed investigations of the aerial and structural geology of the Sequatchie Valley and related structures during this period. He probably did the field work during the 1920's for an unpublished map (in files of the Tennessee Division of Geology) of a portion of the Sequatchie Valley on the Pikeville Special quadrangle. This map, however, is not of sufficient detail to demonstrate the generally low-angle nature of the overthrust fault in the northern part of the valley. Butts (1927a) was the first to recognize fensters in the Cumberland overthrust block. His work precipitated the "thin-skinned" concept of Appalachian deformation, which maintains that overthrust faults expressed at the surface in sedimentary formations of the Valley and Ridge and Cumberland Plateau do not extend into crystalline rocks immediately below the surface structure, but rather extend for considerable horizontal distances in thin-bedded, incompetent units.

Rich (1934) and Rodgers (1950) speculated concerning the mechanics of overthrust faulting. Rich undertook to

explain the mechanics of deformation of the Cumberland overthrust block. He hypothesized that the Sequatchie anticline resulted from a low-angle overthrust similar to the Pine Mountain fault "but carried not so far". Rodgers also considered the Sequatchie Valley structure to be analogous to that of the Cumberland overthrust block. Stearns (1954 and 1955), Wilson Jewell, and Luther (1956), and Wilson and Stearns (1958) studied the stratigraphy and structural geology of the Cumberland Plateau of Tennessee. Their explanation of the structures of the Cumberland Plateau follows the "thin-skinned" concept as described by Rich.

PRESENT INVESTIGATION

Introduction

This study, except for a few brief periods, was pursued from mid-June 1958 until April 1959, and from November 1959 until May 1960. The field work was divided into three consecutive phases: reconnaissance mapping, detailed mapping, and measurement of rock sections.

Geologic Mapping

Reconnaissance mapping was effected by making road traverses along all of the interconnecting roads and lanes within and adjacent to Sequatchie Valley. Major rock units

were noted, and attitudes of easily accessible outcrops were measured with a Brunton compass and plotted on TVA-USGS 1/24000 topographic maps, covering $7\frac{1}{2}$ ' quadrangles.

Since the eastern side of the valley with its gently dipping formations presented quite different problems in mapping than the faulted western side, two different procedures were used in detailed mapping. The eastern side of the valley was mapped by making selected traverses normal to the strike. These traverses generally were one to two miles apart, although several mile-wide bands were mapped in detail. Formational contacts were interpolated between traverses, with additional information provided by scattered outcrops observed in road cuts and other places of easy access.

The fault trace on the western side of the valley was mapped in much more detail. Traverses were made both normal and parallel to the strike of the fault. Thus, except in places of large alluvial and colluvial accumulations, the fault trace may be considered "walked-out" from Devilstep Hollow, Grassy Cove quadrangle, to the Tennessee-Alabama state line.

The foot wall was mapped in detail only adjacent to the fault trace from the latitude of Rankins Gap, Billingsley Gap quadrangle, south. North of Rankins Gap, the foot wall was mapped to the base of the Sewanee conglomerate, one-half to three-quarters of a mile to the northwest of the fault trace.

Stratigraphic Sections

Comparatively well exposed Middle and Upper Ordovician, Silurian, Devonian-Mississippian, Mississippian, and Pennsylvanian rock sections were measured upon completion of the detailed mapping of the fault trace phase. The writer attempted to compile composite sections for the southern, central, and northern parts of the valley since single complete sections of Ordovician to Pennsylvanian strata were not exposed. These sections were measured by: (1) plane-table surveying of scattered outcrops exposed in hilly fields; (2) taping exposures of complete rock units; (3) hand leveling and taping exposures on steep hill sides; and, (4) locating formational contacts on the escarpments of the valley walls with a Taylor altimeter, graduated to 20 feet.

CHAPTER II. STRATIGRAPHY

INTRODUCTION

The Sequatchie Valley, situated in the Cumberland Plateau, and between the Central Basin of Tennessee and the Highland Rim to the west and the Valley and Ridge to the east, is an ideal place to effect east-west stratigraphic correlation of exposed Paleozoic formations.

Paleozoic sedimentary rocks, ranging in age from Ordovician to Pennsylvanian, crop out in and adjacent to the Sequatchie Valley. The oldest formations exposed along the crest of the anticline are those of the Lower Ordovician portion of the Knox group. These cherty carbonates are overlain by limestones and shales of the Middle and Upper Ordovician formations of the Stones River, Nashville, Eden, Maysville, and Richmond groups. Well exposed sections of calcareous shales and shaly limestones of Silurian age, Devonian-Mississippian black shales, Mississippian carbonates and fine-grained clastics, and Pennsylvanian fine- to coarse-grained clastics are also present. The names and locations of type sections of units mapped by the writer in the present investigation are listed in Table 1.

The exposed portion of the Knox group of Early Ordovician age was not subdivided into formations. Middle and Upper Ordovician formations were considered in somewhat

TABLE I

STRATIGRAPHIC UNITS OF THE SEQUATCHIE VALLEY REGION

SYSTEM SERIES	GROUP	FORMATION	NAME AND TYPE LOCALITY
PENNSYLVANIAN LEE	Crab Orchard Mountains	Sewanee conglomerate	Safford, J. M., 1893 (Tenn. State Bd. Health Bull., vol. 8, No. 6, pp. 89-98). Named for Sewanee, Franklin Co., Tenn.
	Gizzard	Signal Point shale	Wilson, C. W., et al, 1956 (Penn. Geol. of the Cumberland Plateau, p. 4). Named for exposures on Tenn. Hwy. 8 east of Signal Mt., Hamilton Co., Tenn.
		Warren Point sandstone	Wilson, C. W., et al, 1956 (Penn. Geol. of the Cumberland Plateau p. 4). Nelson, W. A., 1925, originally designated this unit the Warren Point sandstone member of the Gizzard formation. Safford, 1869, referred to this unit as the Cliff sandstone. Named for exposures at Warren Point just north of Monteagle, Grundy Co., Tennessee.
		Raccoon Mountain formation	Wilson, C. W., et al, 1956 (Penn. Geol. of the Cumberland Plateau, pp. 1, 4). Named for exposures on Tenn. Hwy 8 east of Signal Point and South of the town of Signal Mountain, Hamilton Co., Tenn.
	MISSISSIPPIAN CHESTERIAN	Pennington formation	Campbell, M. R., 1893 (U. S. G. S. Bull. 111, pp. 28, 37). Named for Pennington Gap, Lee Co., Va.
		Glen Dean limestone	Butts, Charles, 1917 (Ky. Geol. Surv. Mississippian formations of western Ky., p. 97). Named for exposures along railroad on both sides of Glen Dean, Breckenridge Co., Ky.

TABLE I (CONTINUED)

MISSISSIPPIAN	CHESTERIAN	Big Clifty sandstone	Norwood, C. J., 1876 (Ky. Geol. Surv. n.s., vol. 1, pt. 6). Named for exposures on Big Clifty Creek, Grayson Co., Ky.
		Gasper formation	Butts, Charles, 1917 (Ky. Geol. Surv. Mississippian formations of western Ky., pt. 1, pp. 64-84). Named for exposures along the Gasper River in Warren Co., Ky.
MISSISSIPPIAN	MERRAMECIAN	Ste. Genevieve limestone	Shumard, B. F., 1860 (St. Louis Acad. Sci. Trans., vol. 1, p. 406). Named for exposures in Mississippi River bluffs below Ste. Genevieve, Ste. Genevieve Co., Mo.
		St. Louis limestone	Englemann, G., 1847 (Amer. Jour. Sci., 2d, vol. 3, pp. 119-120). Named for exposures at St. Louis, Mo.
		Warsaw limestone	Hall, James, 1857 (Am. Assoc. Adv. Sci. Proc., vol. 10, pt. 2, pp. 54-56). Named for exposures at Warsaw, Hancock Co., Ill.
MISSISSIPPIAN	OSAGE-AN	Fort Payne chert	Smith, E. A., 1890 (Ala. Geol. Surv. Rept. on Cahaba Coal Field). Named for exposures at Fort Payne, De Kalb Co., Ala.
		Mauzy shale	Safford, J. M., and Killebrew, J. B., 1900 (Elements of Geol. of Tenn.). Named for Mauzy Co., Tennessee
		Chattanooga shale (upper part)	Hayes, C. W., 1891 (Geol. Soc. Amer. Bull., vol. 2, p. 143). Named for exposures at Chattanooga, Hamilton Co., Tennessee.
DEVON- SILURIAN	BRADFO- RDIAN	Chattanooga shale (lower part)	?
		Rockwood formation	Hayes, W. C., 1891 (Geol. Soc. Amer. Bull., vol. 2, p. 143). Named for exposures at Rockwood, Roane Co., Tennessee. The formation originally included the Sequatchie formation
		Richmond Sequatchie formation	Ulrich, E. O., 1912 (12th Int. Geol. Cong., Canada). Named for Sequatchie Valley, Tennessee.

TABLE I (CONTINUED)

CINCINNATIAN	Maysville	Leipers formation	Hayes, C. W., and Ulrich, E. O., 1903 (U.S.G.S. Columbia folio, No. 95, p. 2). Named for Leipers Creek, Maury Co., Tennessee.
	Eden	Inman formation	Wilson, C. W., 1949 (Tenn. Div. Geol. Bull. 56, p. 175). Named for exposures at Inman Point, Marion Co., Tennessee
ORDOVICIAN	Nashville	Catheys formation	Hayes, C. W., and Ulrich, E. O., 1903 (U.S.G.S. Columbia folio, No. 95, p. 2). Named for exposures on Catheys Creek, Lewis and Maury counties, Tennessee
		Cannon limestone	Ulrich, E. O., 1911 (Geol. Soc. Amer. Bull., vol. 22, pp. 417, 418, 429, pl. 27). Named for exposures in Cannon Co., Tennessee
		Hermitage limestone	Hayes, C. W., and Ulrich, E. O., 1903 (U.S.G.S. Columbia folio, No. 95, p. 1). Named for Hermitage Station, Davidson Co., Tennessee
	Stones River	Carters limestone	Safford, J. M., 1869 (Geol. of Tenn., pp. 258-268). Renamed the Upper Lebanon limestone of the Stones River group the Carter's Creek limestone. Hayes and Ulrich, 1903, shortened the name to Carters limestone. Named for exposures on Carter's Creek, Maury Co., Tenn.
		Lebanon limestone	Safford, J. M. and Killebrew, J. B., 1900 (Elements of the Geology of Tennessee, pp. 125-126). Originally the Glade limestone of Safford; named for exposures near Lebanon, Wilson Co., Tennessee.
		Ridley limestone	Safford, J. M., 1869 (Geol. of Tenn., p. 216). Named for exposures near Judge Ridley's mill near Old Jefferson, Rutherford Co., Tenn. The mill is now Davis mill.
		Pierce limestone	Safford, J. M., 1869 (Geol. of Tenn., pp. 256-262). Named for exposures near Pierce's mill, Rutherford Co., Tennessee.
CHAMPLANIAN			

TABLE I (CONTINUED)

ORDOVICIAN CANADIAN CHAM- PLANIAN	Stones River	Murfrees- boro limestone	Safford, J. M., and Killebrew, J. B., 1900 (Elements of the Geology of Tennessee, p. 125). Originally named the Central limestone by Safford; named for exposures near Murfreesboro, Rutherford Co., Tenn.
	Knox	Undivided	Safford, J. M., 1869 (Geol. of Tenn., p. 151). Originally included the Rome, Conasauga, and Knox dolomite; now restricted to the formations of the Knox dolomite. Named for ex- posures in Knox Co., Tennessee.

This table was compiled from Wilmarth (1938), Wilson (1949), and Wilson, Luther, and Jewell (1956).

more detail than the underlying and overlying formations. Distinct lithologic units of Silurian, Devonian-Mississippian, Mississippian, and Pennsylvanian age were also mapped in detail.

TOPOGRAPHIC EXPRESSION OF FORMATIONS

Figure 2 illustrates the topographic expression of formations in the northern part of Sequatchie Valley. The highly siliceous carbonates of the Knox group produce a very cherty residuum upon weathering. The relatively insoluble chert forms a prominent longitudinal ridge that extends into Tennessee from Alabama. The ridge may be traced to a few miles north of Pikeville, where the topographic "spine" or "backbone" of the valley disappears as the formations of the Knox group plunge beneath younger and less siliceous limestones.

The cherty carbonates are almost completely surrounded by relatively soluble carbonates of Middle Ordovician age, and carbonates and clastics of Mississippian age. The Knox group is unconformably overlain by Middle Ordovician limestones and shaly limestones throughout the length of its exposure in the eastern side of the valley, across the crest of the anticline north of Pikeville, and north of Dunlap on the western side of the valley. A mile or so south of Dunlap, the Knox group is in fault contact with Mississippian lime-

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OVERTHRUST BLOCK**

KLIPPEN AND FAULT SLICES

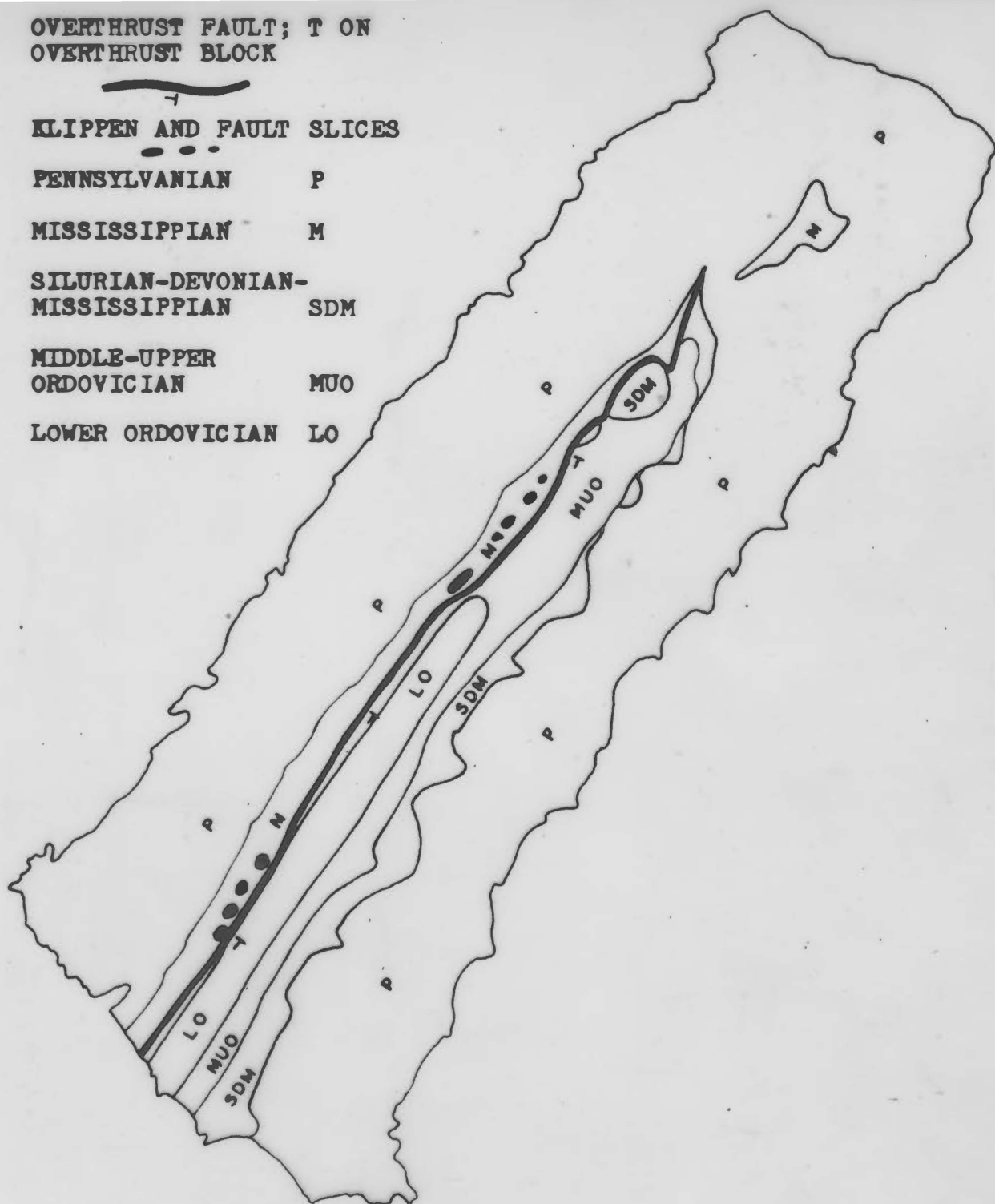
PENNSYLVANIAN P

MISSISSIPPIAN M

**SILURIAN-DEVONIAN-
MISSISSIPPIAN SDM**

**MIDDLE-UPPER
ORDOVICIAN MUO**

LOWER ORDOVICIAN LO



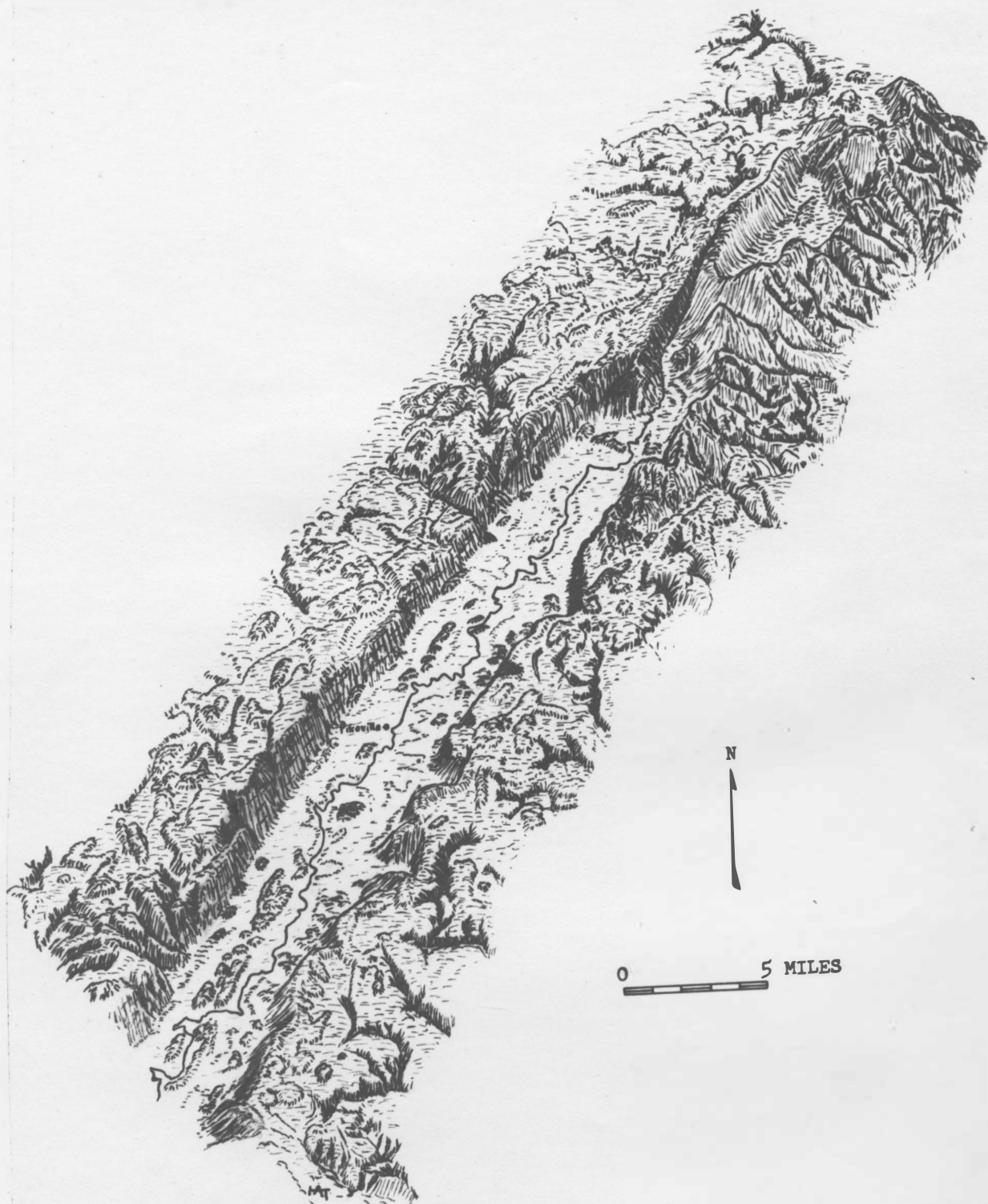


Figure 2. Topographic expression of formations in the northern portion of Sequatchie Valley

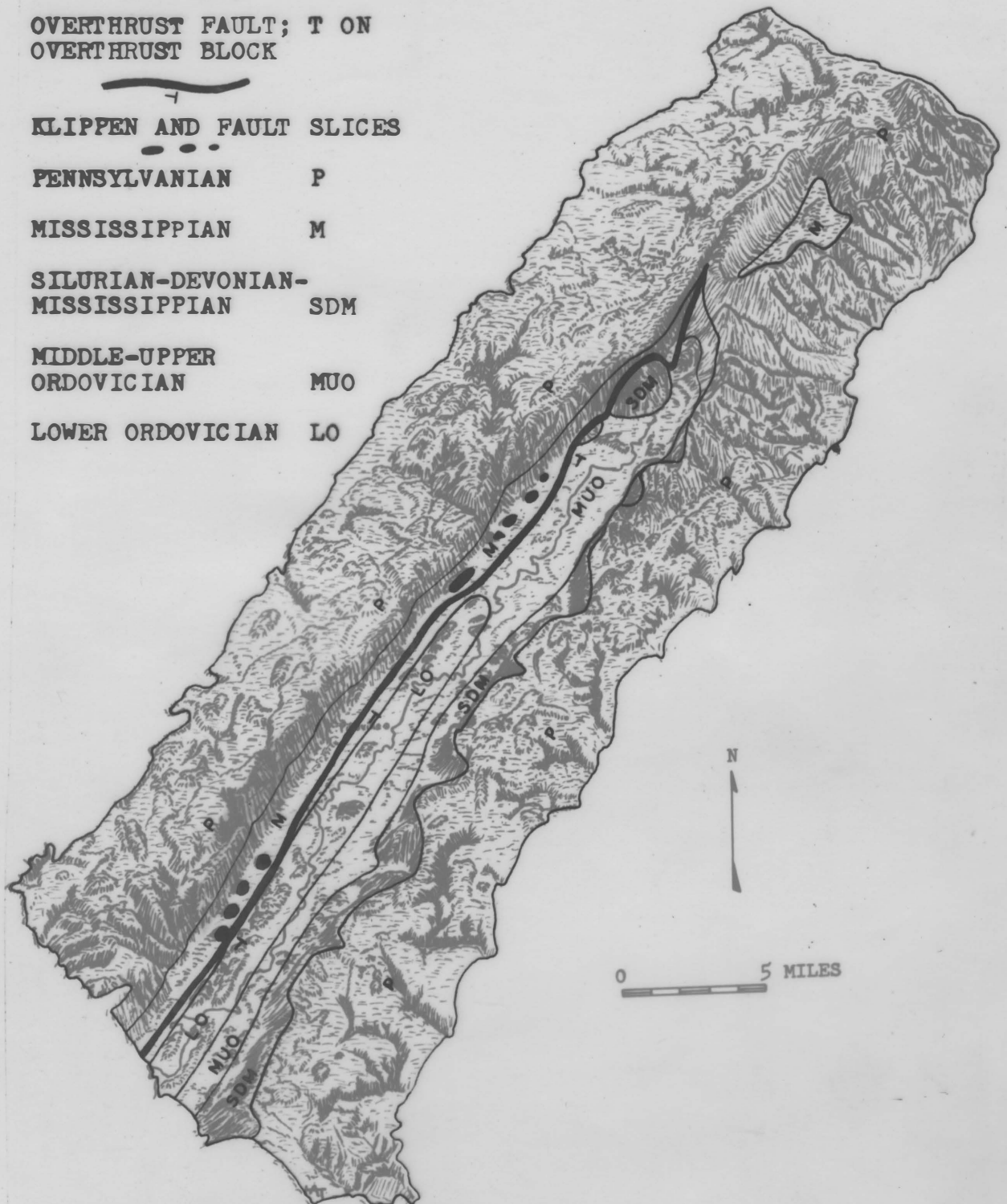


Figure 2. Topographic expression of formations in the northern portion of Sequatchie Valley

stone. This relationship persists generally from the vicinity of Dunlap south to the Alabama state line.

Silurian, Devonian-Mississippian and Mississippian formations crop out at the eastern and northern perimeter of the valley floor. The western perimeter of the valley floor is marked by outcrops of Mississippian clastics and carbonates. Pennsylvanian clastics crop out around the lip of the valley, and cap the adjacent uplands of the Cumberland Plateau.

ORDOVICIAN FORMATIONS

Introduction

Ordovician formations mapped by the writer in Sequatchie Valley are those of the Knox, Stones River, Nashville, Eden, Maysville, and Richmond groups.

No attempt was made to map the variations of lithology or residuum of the Knox group. All rocks, limestone and dolomite, siliceous or not, below the Murfreesboro formation were mapped as one unit. Figure 3, based on the work of Hayes (1895b) and Butts (unpublished map, files of the Tenn. Div. Geol.), summarizes the stratigraphy of the Knox in this area.

The fossiliferous Middle and Upper Ordovician formations of the Stones River and Nashville groups, respectively, comprise a series of relatively pure, massive limestone formations

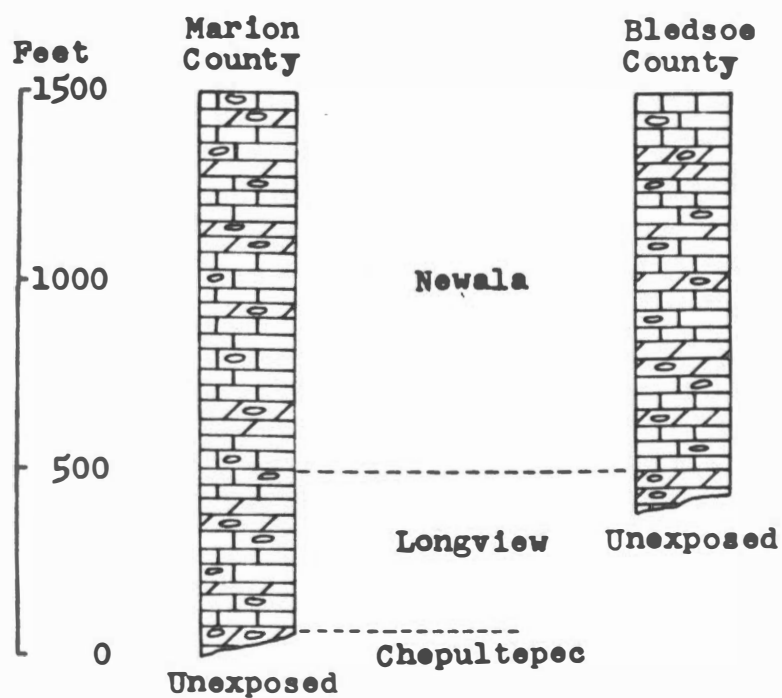


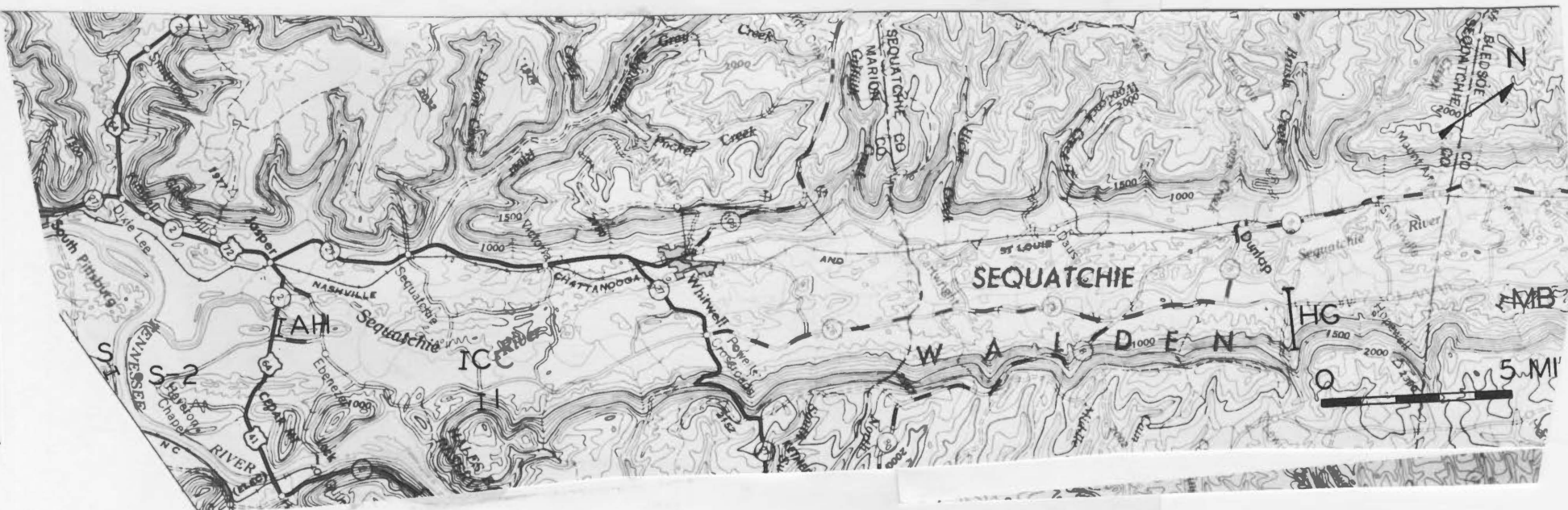
Figure 3. General stratigraphic sections of the Knox group in the Sequatchie Valley, Tennessee (after Hayes, 1895b, and Butts, unpublished map, files of the Tennessee Division of Geology)

and members, alternating with relatively impure, flaggy or thin-bedded limestones or shaly limestones. Except for three key lithologies or zones, none of the formations of the two groups may be unequivocally identified entirely on the basis of appearance. Sequences of formations must be mapped and key beds located before identification can be made with certainty.

The key beds, stratigraphic units which are not vertically recurrent, are: (1) the dense limestone of the "white" Murfreesboro formation; (2) the two bentonite beds, T-3 and T-4; and, (3) the "contour-rock" at the base of the Catheys formation.

The Eden, Maysville, and Richmond groups are represented by one formation each, the Leipers, Inman, and Sequatchie formations, respectively. These formations are more shaly than those of the Stones River and Nashville groups. The Inman formation, where present, and the Sequatchie formation locally contain red beds.

Locations of detailed stratigraphic sections are shown on Figure 4. The section for the southern part of Sequatchie Valley was obtained from drill hole data for the TVA Widows Creek and Sequatchie No. 2 steam plant sites in northern Alabama and southern Tennessee. Sections measured by the writer and C. P. Finlayson are the Caroline Chapel and Inman sections, Sequatchie quadrangle, Henson Creek section, Henson Gap quadrangle, Swafford Pond section, Pikeville quadrangle,



	Name of Section	Symbol	Tennessee Coordinates	
Glover (1959)	Grassy Cove	GC	2,320,850E	529,800N
	Litton	L	2,289,800E	487,400N
	McWilliams Branch	MB	2,210,500E	380,300N
	Anderson Hill	AH	2,124,500E	237,500N
Wedow (1959 personal communi- cation)	Brown Gap	BG	2,290,400E	505,500N
	Skillern Cove	SC	2,247,500E	433,600N
	Inman	I	2,141,800E	261,800N
	Anderson Hill	AH	2,124,500E	237,500N
	Shellmound	S	2,112,000E	222,800N
Kellberg (1959 personal communi- cation)	Sequatchie No. 2		2,114,000E	225,000N
	Widows Creek (not shown)		2,073,200E	178,500N
This report	Parham Chapel	PC	2,292,400E	504,300N
	Litton	L	2,289,800E	487,400N
	Swafford Pond	SP	2,251,300E	448,000N
	Henson Gap	HG	2,195,200E	356,800N
	Inman	I	2,141,800E	261,800N
	Caroline Chapel	CC	2,137,000E	262,100N
	Drill hole section	•		
	Outcrop section	I		

Figure 4. Locations of measured stratigraphic sections in Sequatchie Valley, Tennessee



and the Litton section, Melvine quadrangle. Richmond sections measured by H. Wedow are at or near Brown Gap. Melvine quadrangle, Skillern Cove, Pikeville quadrangle, Inman and Anderson Hill, Sequatchie quadrangle, and Shellmound, South Pittsburg quadrangle. Locations of four of the measured sections of Chattanooga shale reported by Glover (1959) are also shown in Figure 4.

Figure 5 summarizes the stratigraphy of Middle and Upper Ordovician formations in Sequatchie Valley.

Knox Group

Introduction.-- The exposed thickness of the Knox group ranges from approximately 1500 feet near the Tennessee-Alabama state line to 1000 feet near Pikeville (Hayes, 1895b).

The oldest formation exposed in the Sequatchie Valley is the Chepultepec dolomite. This formation is shown on the Geologic Map of Alabama (Adams, et al, 1926) as a thin outcrop belt in the center of the valley near the Tennessee-Alabama state line.

Charles Butts mapped Longview dolomite and Beekmantown limestone in the Sequatchie Valley near Pikeville, Tennessee (Pikeville Special quadrangle, USGS 1/62500; unpublished map, files Tenn. Div. Geol.). The Beekmantown limestone, as mapped here by Butts, is correlative to the Newala of later reports.

Chepultepec dolomite.-- According to Butts (Adams, et

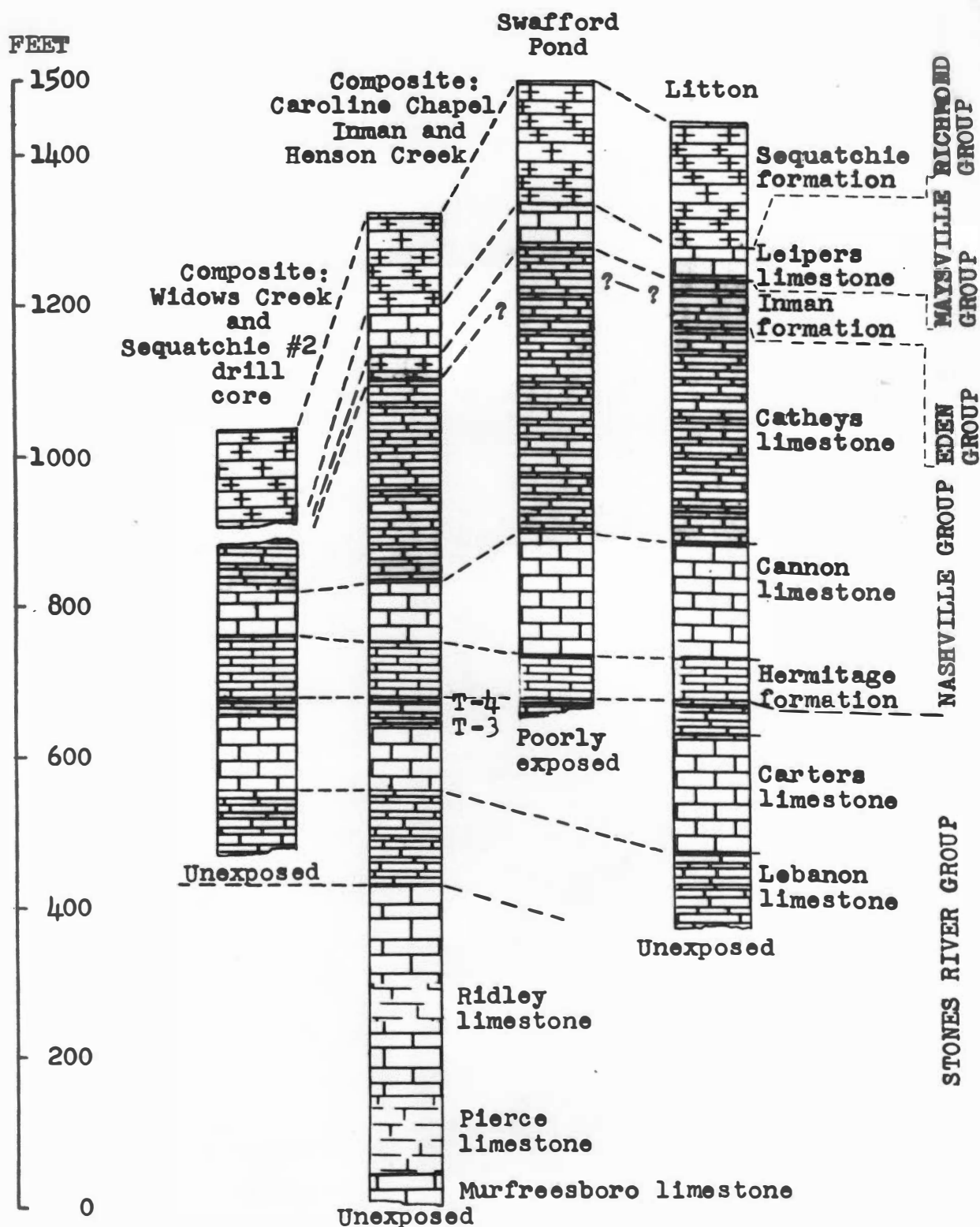


Figure 5. Stratigraphic sections of Middle and Upper Ordovician formations in Sequatchie Valley

al, 1926, p. 89) the upper 700 to 800 feet of the Chepultepec is:

all dark-bluish, coarsely crystalline dolomite, both thick-bedded and thin-bedded. It yields abundant cavernous and fossiliferous chert. . . . The Chepultepec is particularly distinguished by a soft, mealy, cavernous chert which looks like a piece of worm-eaten wood. . . .

Longview limestone.-- In Cahaba and Sequatchie Valleys . . . The Chepultepec dolomite is succeeded above by several hundred feet of chert producing rocks which seem to be mainly limestone, but include some dolomite (Butts, 1926, p. 92).

The Longview is composed of cherty limestone and dolomite, mostly limestone. The limestone is thick-bedded and light gray. The chert of the Longview is compact but brittle and fragile, so that most of it weathers down to small fragments. The larger chunks generally leave a smooth, even surface. Through its chert the Longview can be distinguished from the overlying Newala limestone, which yields no chert or very little, from the underlying Chepultepec dolomite, which is characterized by mealy, cavernous chert. . . (Adams, et al, 1926. p. 93).

Newala limestone.-- The Newala is composed of much limestone and proportionately little dolomite. Most of the limestone is thick bedded, compact or non-crystalline or textureless, dark gray, pearl-gray, and bluish gray The dolomite of the formation occurs either as aggregate of separate layers as much as 20 feet or more thick or as interfingerings of dolomite in layers of limestone which produce a mottled rock that characterizes limestone undergoing change to dolomite by replacement processes (Adams, et al, 1926, p. 95).

Butts further states that this formation is approximately 1000 feet thick in Cahaba Valley, Alabama (Adams, et al, 1926, p. 97).

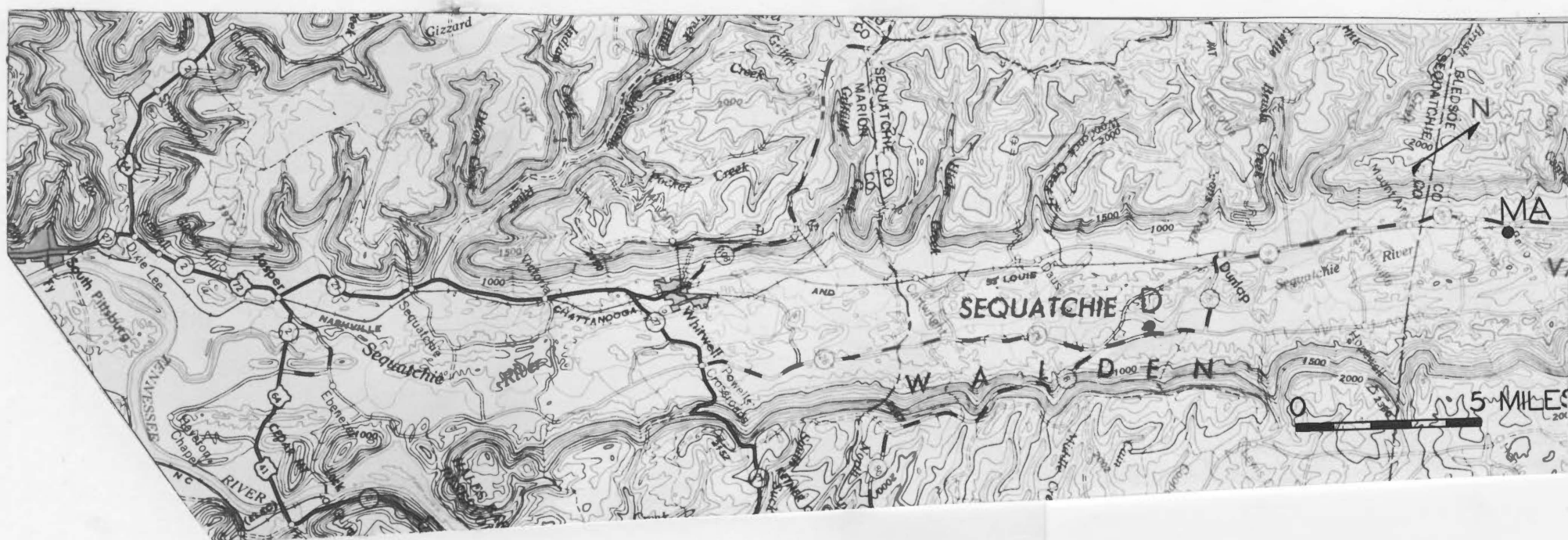
Knox erosion surface.-- Although the erosion surface at the top of the Knox group was not studied in detail, the

writer observed three small occurrences of red and maroon shales and shaly limestones which lithologically resemble stratigraphically similar occurrences in East Tennessee. The East Tennessee occurrences (S. W. Maher and H. A. Tiedemann, 1959, personal communication) are, at least locally, fillings of sinkholes formed in the post-Knox, pre-Stones River interval.

These occurrences are located; (1) on the Daus quadrangle, where Barker Branch enters the Sequatchie River; (2) on the Billingsley Gap quadrangle, where the Knox group plunges beneath the Stones River group, and; (3) on the Mount Airy quadrangle, on the east side of the William Howard Taft highway near Pailo, and near BM Y 39 757. Figure 6 shows these locations.

Stones River Group

Introduction.-- The Stones River group is composed of all of those formations from the top of the Knox group to the base of the Nashville group. It overlies the Knox group unconformably, and is overlain unconformably by the Nashville group (Wilson, 1949, p. 24). The predominant lithology is medium-gray, flaggy to massive, fossiliferous, fucoidal, dense-to fine-grained limestone. Individual formations were physically distinguished chiefly on the basis of thickness of bedding, and, where applicable, the occurrence of key beds.



<u>Quadrangle</u>	<u>Symbol</u>	<u>Tennessee Coordinates</u>
Billingsley Gap	BG	2,258,300E 467,500N
Mount Airy	MA	2,202,100E 392,400N
Daus	D	2,185,100E 344,500N

Figure 6. Location of Ordovician sinkhole occurrences at the top of the Knox group



The Stones River group comprises the Murfreesboro, Pierce, Ridley, Lebanon, and Carters limestones, in ascending order. A minor unconformity occurs between the Lebanon and Carters limestones (Wilson, 1949, p. 54). The other formational contacts within the group are conformable.

Murfreesboro and Pierce limestones.-- The Murfreesboro limestone is defined as that group of rocks above the top of the Knox group, or the top of sink-hole fillings in the Knox group, and below the massively bedded Ridley limestone, or the shaly limestones of Pierce limestone where present.

The lateral relationship of the thin-bedded, olive-weathering shaly limestone of the Pierce formation to the Murfreesboro and Ridley limestones is unknown. The writer believes that the shaly limestone of the Pierce is more probably a facies of the upper portion of the Murfreesboro limestone than of the basal beds of the Ridley limestone, although this has not been conclusively demonstrated in the field.

The Murfreesboro limestone may be divided into two gross lithologic units in the Sequatchie Valley. The basal unit, the "white" Murfreesboro, is exceedingly fine-grained, very light-gray, massively bedded, relatively pure limestone. The rock breaks with a conchoidal fracture.

The overlying unit, the "black" Murfreesboro, is also

fine grained, but medium gray in color. It may crop out in massive or thin beds. It is generally free of clastic impurities, and emits a bituminous odor when freshly broken.

All gradations in color between the very light gray "white" Murfreesboro limestone and the medium-gray "black" Murfreesboro limestone have been noted. In addition to color variations, the amount of clastic impurities in the formation is variable from place to place. The writer has observed outcrops of olive- to light-green, thin-bedded, calcareous shales and shaly limestones similar to those of the Pierce limestone throughout the Murfreesboro limestone.

These lithologies do not occur persistently at any horizon, but appear to be scattered intermittently in the stratigraphic column. Generally only one such zone was found in a given section. It appears, therefore, that the Pierce is merely a locally occurring shaly limestone unit at the top of the Murfreesboro limestone, and the lateral equivalent of the upper part of the "black" Murfreesboro.

The Murfreesboro formation ranges greatly in thickness. Complete sections which could be measured were not found in the course of the present investigation primarily because the outcrop belt of this formation generally coincides with colluvial and alluvial accumulations in the bottom of the valley. Thickness values calculated by measuring angle of dip and width of outcrop belts in the southern part of the

Sequatchie Valley from the latitude of Jasper to the latitude of Sequatchie are between 40 and 175 feet. These values include the Pierce limestone.

Near Caroline Chapel, Sequatchie quadrangle, 95 to 100 feet of Pierce limestone and 50 feet of Murfreesboro limestone were taped. Inasmuch as the basal beds of the Murfreesboro limestone are not exposed here the total thickness of the Murfreesboro-Pierce was estimated to be 175 feet. This estimate was calculated from the width of the outcrop belt, as determined by mapping residuum, and from the angle of dip.

Wilson (1949, pp. 321-322) measured a total of 545 feet of Murfreesboro limestone in the Sequatchie Valley. The range in thickness of this formation probably reflects irregular Ordovician topography of the post-Knox erosion surface.

Ridley limestone.-- The Ridley limestone was divided into three units by the writer. Upper and lower massively bedded, medium-to dark-gray, fucoidal, fine- to medium-crystalline limestone units are separated by a prominent shaly limestone member.

At the Henson Creek section, Henson Gap quadrangle, the writer and C. P. Finlayson measured a total thickness of 275 feet of Ridley limestone. The basal limestone, 105 feet thick, is overlain by 48 feet of shaly limestones, which in turn, are overlain by 122 feet of massive, dark-gray, fucoidal limestones of the upper unit.

The shaly limestone unit of the formation is persistent throughout the length of Sequatchie Valley, Tennessee. Lithologically it is typical of most shaly limestones of the Stones River group; thin-bedded, greenish-gray, olive-weathering, shaly limestones and calcareous shales predominate.

Where Pierce lithology is absent, as it generally is, the Ridley grades into the underlying Murfreesboro limestone with a decrease in the number of dolomitic furoids. Medium- to dark-gray, dense or very fine-grained Murfreesboro limestone may be regarded as Ridley lithology without furoids. It should be noted, however, that furoidal rocks occur locally within the Murfreesboro limestone.

The criterion used to distinguish the Ridley limestone from the overlying Lebanon limestone is the thickness of bedding; the Ridley is massive in comparison to the thin- to medium-bedded strata of the Lebanon limestone.

Lebanon limestone.-- The Lebanon limestone consists of thin- to medium-bedded, medium-gray, impure limestone. This formation weathers to a lighter gray color, as do the other Middle and Upper Ordovician limestones. Some of the beds of the Lebanon limestone are furoidal, some are fossiliferous. Weathered outcrops are characterized by saucer-sized platy fragments scattered over the surface of the ground. Eighty-five feet of Lebanon limestone were logged in TVA drill holes at the Widows Creek steam plant site, near Bridgeport,

Alabama. This represents only a partial thickness of the formation as the hole bottomed in the Lebanon. The writer measured 120 feet of Lebanon limestone at Henson Creek, and 103 feet at the Litton section, on the eastern flank of the anticline.

Carters limestone.-- The Carters limestone may be divided into two recognizable units, designated as the Upper and Lower Carters (Wilson, 1949, p. 321). Two prominent three foot thick bentonite layers and their underlying cherts, T-3 and T-4, are near the middle and top of the formation respectively. T-3 separates the upper and lower members of the formation; T-4 is approximately four feet below the upper contact of the formation (Wilson, 1949, pp. 63-64). Total thickness of the Carters limestone ranges between 115 and 200 feet.

The lower Carters member consists of fucoidal, massively bedded, fine- to medium-crystalline, medium-gray limestone. Ninety feet of the Lower Carters member were measured in drill holes at the Widows Creek steam plant site, 84 feet at Henson Creek, 108 feet at Parham Chapel, Vandever quadrangle, and 160 feet at the Litton section.

The Upper Carters member consists of thin-bedded, light green- to olive-weathering shaly limestone. The freshly broken rock is greenish gray. Twenty-five feet of the Upper Carters member was logged in the Widows Creek drill holes.

This thickness was measured from the top of the formation down to T-3. T-4 was logged 5 feet below the upper contact of the Carters limestone. Twenty-five feet of section were measured between basal cherts of the bentonites at Stephen Chapel, Mount Airy quadrangle. An additional four feet of section above T-4 results in a total thickness of 29 feet of the Upper Carters member here. At the Parham Chapel and Litton sections at the northern end of Sequatchie Valley the Upper Carters member is considerably thicker. Total thickness measured at Parham Chapel was computed to be between 49 and 54 feet, depending upon the value of the dip used in the calculation. The total thickness at the Litton section was measured to be 38 feet. In both the last named sections T-4 was approximately four feet below the top of the Upper Carters member.

Nashville Group

Introduction.-- The formations of the Nashville group, the Hermitage formation, Cannon limestone, and Catheys formations, in ascending order, contain greater quantities of shale than the underlying formations of the Stones River group. They are distinguished from the overlying calcareous shales and limestones of the Eden group only with difficulty. The writer mapped the Eden group (Inman formation) with the Catheys formation of the Nashville group in this investigation.

The base of the Nashville group is readily mapped by locating outcrops of the basal cherts of the bentonites, T-3 and T-4. T-4 is four feet below the contact; T-3 is 25 to 54 feet below the contact of the two groups.

The upper contact of the Nashville group is very difficult to recognize lithologically. Throughout most of its outcrop in the Sequatchie Valley this contact must be established on the basis of faunal studies; it is a sequence of irregular thin- to medium-bedded, fossiliferous limestones and thin shales. Locally, where the Eden shales are present in quantity or where they are reddish in color, the contact between the Eden and Nashville groups may be readily mapped.

Unconformities occur between all the formations of the Nashville group and between the Nashville and Eden groups (Wilson, 1949, pp. 23-24, 87, 90, 156, 177-179).

Hermitage formation.-- Silty or shaly limestone is the predominant lithology of the Hermitage formation, although impure granular rock is common in fresh outcrop. Outcrops of this formation are scarce because the formation decays readily.

The impure limestone is medium- to dark-gray, thin- to massively bedded rock; fossil fragments are generally abundant. Weathered outcrops are rounded in appearance, and contain numerous thin, irregular shale partings.

This unit is less than 100 feet thick throughout the length of its outcrop in Sequatchie Valley, Tennessee. Eighty

feet were measured in drill cores at the Widows Creek steam plant site; 61 feet were measured near Stephen's Chapel, Mount Airy quadrangle; approximately 90 feet were measured at Parham Chapel, and 64 feet at the Litton section.

Cannon limestone.-- The Cannon limestone is predominantly a medium- to dark-gray, thick-bedded, dense or fine-grained limestone. Freshly broken rock yields a bituminous odor. Medium- to coarse-grained granular limestone, similar to the rock of the Hermitage formation is commonly interbedded with the fine-grained limestone. The Cannon contains little shale or siltstone. The formation is 60 feet thick at the Widows Creek steam plant site, 82 feet at Henson Creek, 165 feet at Swafford Pond, and 145 feet near Litton.

Catheys limestone.-- The Catheys limestone, composed of irregularly bedded, impure limestone with thin partings of calcareous shale, is the thickest formation in the Middle and Upper Ordovician limestone section. This formation is very fossiliferous, containing many brachiopods, bryozoans, cephalopods and other fossils. The limestone is usually medium gray where fresh, but weathers to a light gray color. Calcareous shale interbeds are also medium gray; some have a greenish cast. The basal few feet of the formation consists of thin beds of alternately relatively pure and impure

limestone which weather to banded, rounded outcrops, the so-called "contour-rock" mentioned previously. This unique weathering feature enables one to readily map the Catheys-Cannon contact. The writer measured 303 feet of Catheys-Inman at Henson Creek; 387 feet were measured at Swafford Pond.

Eden Group

Inman formation.-- As mentioned above, the rocks of the Eden group, represented by the Inman formation in the Sequatchie Valley, were not mapped separately by the writer. The distinctive interbedded red and green calcareous shales and medium-gray, irregularly bedded limestones were observed at the type locality at Inman, Marion County, and along Shiloh branch a mile northeast of Inman. Outcrops of greenish-gray to olive calcareous shales were observed at the top of the Catheys formation in other localities. These were assumed to be correlative to the Inman formation.

The thickness of the exposure at Inman, in the bluff east of the Inman bridge, is 27 feet. This measurement was taped from the base of the lowest prominent calcareous shale up to the base of the Leipers formation overlying the Inman. C. W. Wilson (1949, Fig. 60) measured 40 feet of Inman formation at this locality. The arbitrary selection by the present writer of the lowest prominent shale bed for the base of the

formation probably accounts for the disparity in the measurements. Dr. Wilson identified the formation by noting characteristic Eden fossils (bryozoans) in the rocks. His location of the Catheys-Inman contact and measurement of the Inman formation were probably more accurately determined than in the present investigation.

Maysville Group

Leipers formation.-- The Leipers formation is a massively bedded, impure, medium-gray limestone 40 to 60 feet thick. A small topographic bench marks its outcrop around the eastern escarpment of Sequatchie Valley, usually at the periphery of the valley floor.

The weathered outcrop is massive, rounded, and has many small, concentric "spalls". The rock looks as if it is exfoliating rather than being dissolved as a primary means of decomposition. This phenomenon may be attributed to the fairly high insoluble content of the rock. The shale particles, which apparently are distributed evenly throughout the limestone, concentrate in small fractures upon solution of the limestone and result in exfoliation of the outcrop.

A prominent zone of Platystrophia ponderosa occurs 5 to 15 feet below the top of the formation.

Richmond Group

Sequatchie formation.-- The following description of

the Sequatchie formation used in this report is largely based on sections measured by H. Wedow of the United States Geological Survey.

The Sequatchie formation ranges in thickness from 150 feet near the Tennessee-Alabama state line to 170 feet at the head of the valley. The formation may be subdivided into two members. The basal unit crops out throughout the length of the area mapped. It is composed of 80 to 146 feet of thin- to medium-bedded, fine-grained, medium-gray to greenish-gray limestone alternating with thin beds of greenish-gray olive or maroon, calcareous shales and siltstones.

From the latitude of Dunlap north, the upper member is composed of 18 to 25 feet of fine-grained, massive, greenish-gray limestone. South of Dunlap the upper limestone becomes increasingly coarse-grained and variegated; it increases in thickness to a maximum of 70 feet near Anderson Hill, Sequatchie quadrangle. Farther to the south, the coarse-grained, variegated unit thins, and at the Widows Creek steam plant site is represented by only a few relatively pure limestone beds 45 feet from the top of the formation.

SILURIAN FORMATIONS

Rockwood Formation

The Rockwood formation, the only one of Silurian age which crops out in the Sequatchie Valley, Tennessee, overlies

the Sequatchie formation with apparent conformity in the area mapped, and is overlain unconformably by the Chattanooga shale.

For the most part the Rockwood formation is composed of thin-bedded, olive, calcareous shales interbedded with greenish-gray, olive-weathering, flaggy limestone beds and calcareous siltstones. In the middle and northern part of the Sequatchie Valley the basal part of the formation is cherty. Wedow (1959, personal communication) has named this unit the Skillern Cove chert member from its exposure in Skillern Cove, east of Pikeville.

The description of the Rockwood formation used in this report is largely based on stratigraphic sections measured and described by Wedow (1959, personal communication). The Rockwood formation is 30 feet thick at Brown Gap in the northern part of Sequatchie Valley. Almost all of the formation exposed at this locality is the Skillern Cove chert member. A few feet of clay-shales crop out at the top of the section.

The Rockwood formation totals 70 feet in thickness at Skillern Cove. A basal 3-foot thick calcareous sandstone is overlain by 42 feet of thin- to medium-bedded, interbedded shale and cherty limestone. The upper 25 feet of the formation is gray-green sandy shale with thin beds of sandstone at the top.

Wedow measured 100 feet of Rockwood formation at Henson

Creek, including 55 feet of the Skillern Cove chert member at the base. The upper part of the formation is composed of shales and sandstone beds with a few beds of impure limestone. In the southern part of Sequatchie Valley, Tennessee, the chert is missing, and the formation consists of thin-bedded, calcareous, olive-weathering shales, impure flaggy limestones, and brown, calcareous siltstones. At Inman red hematite occurs approximately 70 feet above the base of the Rockwood formation. The hematite, which is approximately three feet thick at this locality, was mined from about 1888 to 1903 (Burchard, 1913a, p. 98). The Rockwood formation is 130 feet thick at the Inman locality. Figure 7 summarizes the lithologic relationships of the Rockwood formation in Sequatchie Valley.

DEVONIAN-MISSISSIPPIAN FORMATIONS

Chattanooga Shale

The gray-black to medium-gray fissile shales of the Chattanooga formation overlie the Rockwood formation unconformably. Conant (1954) described in detail the upper, uraniferous member of the Chattanooga shale; seven sections were measured in Sequatchie Valley. Hass (1956, p. 35) described two complete sections of the Chattanooga shale in Sequatchie Valley. Glover (1959, plate 15) has compiled measured sections of the Chattanooga shale in northeastern

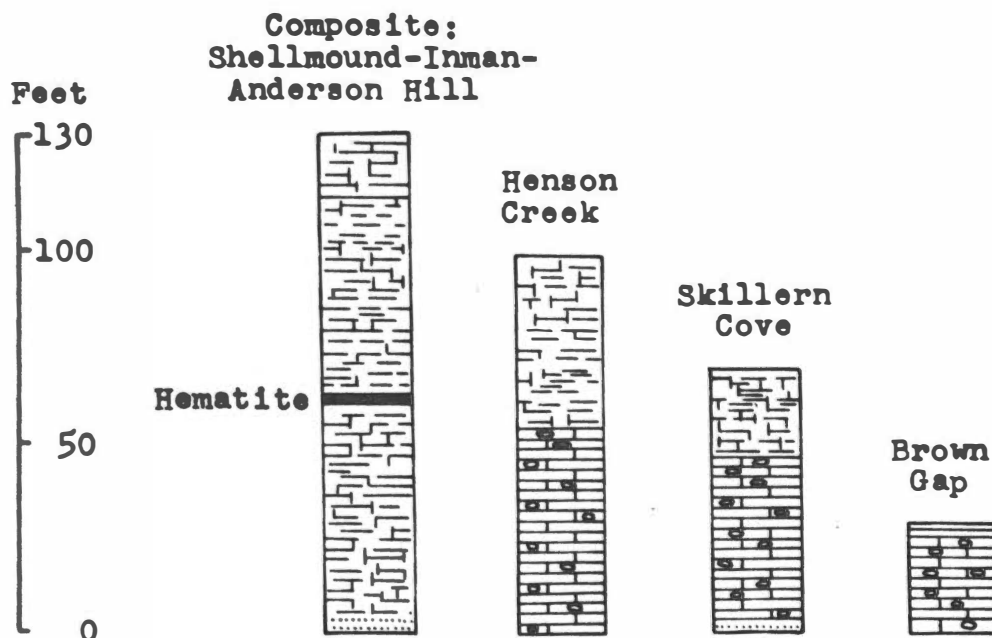


Figure 7. Generalized stratigraphic sections of Silurian rocks in Sequatchie Valley (after Wedow, 1959, personal communication)

Alabama, northwestern Georgia, and eastern Tennessee.

Measurement of seven exposures or drill holes in and adjacent to the Sequatchie Valley, Tennessee shows that the Chattanooga increases regularly in thickness from approximately 9 feet near the Tennessee Alabama state line to approximately 35 feet in Grassy Cove, north of the Sequatchie Valley. Figure 8 summarizes the range in thickness of the Chattanooga shale in the Sequatchie Valley, Tennessee.

MISSISSIPPIAN FORMATIONS

Maury Formation

The Maury formation overlies the Chattanooga shale with apparent conformity. The Maury formation consists of 1.5 to 3 feet of phosphatic, glauconitic, grayish-green to yellow-green claystone. Even though this unit may be traced throughout the Sequatchie Valley, Tennessee, it was not mapped separately by the writer, but was included in the Fort Payne chert.

Fort Payne Chert

Approximately 150 to 200 feet of siliceous carbonate rock above the Maury formation was mapped as Fort Payne chert. The formation is composed of siliceous limestone and dolomite throughout most of its exposure in Sequatchie Valley. In the

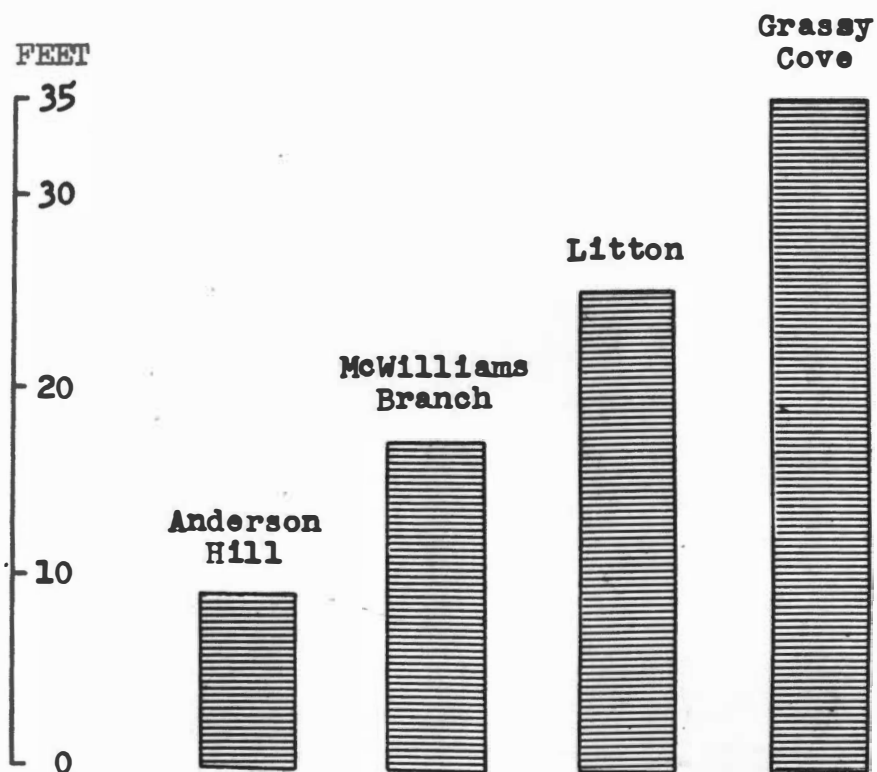


Figure 8. Thickness of the Chattanooga shale in Sequatchie Valley and Grassy Cove, Tennessee (after Glover, 1959, plate 15)

northern part of Sequatchie Valley, however, approximately 20 feet of thin-bedded, medium-gray shale were observed at the base of the Fort Payne chert. Furthermore, several 6 to 8-inch beds of chert were observed near the base of the shale.

Weathered outcrops of the formation are largely composed of fragments of chert rich in fossil remains of corals, bryozoans, or crinoid stems.

Warsaw Limestone

The Warsaw limestone, which overlies the Fort Payne chert, consists principally of medium- to dark-gray, medium- to thick-bedded arenaceous and argillaceous limestone approximately 80 to 100 feet thick. Reddish, calcareous shales occur locally in this formation. The Warsaw limestone, which weathers more rapidly than the overlying and underlying formations, seldom crops out. Weathered outcrops, particularly those containing a relatively high clastic component, commonly exhibit cross-bedding.

St. Louis Limestone

The St. Louis limestone, the formation overlying the Warsaw limestone, consists of 75 to 100 feet of light- to medium-gray, medium- to thick-bedded, very fine-grained, dense, or coarse-grained limestone. Interbeds of medium-grained, light-gray dolomite and red or pink fine-grained limestone occur locally within the formation.

The lower portion of the formation, which is predominantly fine-grained limestone, characteristically contains layers of globular, gray or buff chert nodules. Fossils in the chert are chiefly fragments of corals, bryozoans, or crinoid stems.

The upper portion of the formation is predominantly medium-gray, medium- to coarsely crystalline limestone; patches of chert are locally abundant.

Ste. Genevieve-Gasper Limestones

The Ste. Genevieve limestone overlies the St. Louis limestone and in turn is overlain by the Gasper limestone. The writer did not attempt to map the Ste. Genevieve and Gasper formations separately because of their lithologic similarity.

The Ste. Genevieve-Gasper formations generally consist of 250 to 300 feet of thick-bedded, fine- to coarsely crystalline, oolitic, fragmental, light- to medium-gray limestones. This unit is relatively free from clastic impurities.

Lithologies not generally typical of those found in the Ste. Genevieve-Gasper limestones were noted in several places in Sequatchie Valley. Their development is exceptionally good near Henson Gap, Henson Gap quadrangle, where the formations consist of fine- to coarsely crystalline, pure and impure, gray, tan, pink, and red limestones. Some of the beds

are very fossiliferous, with bryozoan and blastoid remains predominant. Thin zones of oolitic limestone are also present here.

A thin zone of fossiliferous, spongy chert marks the base of the Ste. Genevieve limestone in Sequatchie Valley. This unit contains abundant bryozoan and crinoid remains. It is generally not seen in outcrop, but its "float" is helpful locally in determining the base of the formation. The Ste. Genevieve- St. Louis limestone contact was picked at the base of the lowest oolitic limestone where the fossiliferous chert was not observed.

Big Clifty Formation

The term Big Clifty formation is applied in this report as a field term to all stratigraphic units between the top of the Gasper limestone and the base of the Glen Dean limestone. In the area mapped these units are characterized by a relatively high clastic content. They consist of medium-gray, calcareous shales, which weather to a light-brown color, and fine-grained, arenaceous limestones or siltstones. The formation in the southern part of the area mapped is composed of 20 feet of calcareous shales which grade into fine-grained arenaceous limestones to the northwest, near Whitwell, Tennessee. The sandy limestones persist along strike to the head of the valley.

The 20 to 40 foot thick sandy limestone facies of the Big Clifty formation is more resistant to weathering than the overlying Glen Dean limestone, and, as a result, commonly stands out as a topographic bench several hundred feet above the valley floor. Weathered outcrops are generally very sandy, massive, fluted, and locally show well-developed cross-bedding.

Glen Dean Limestone

The Glen Dean limestone overlies the Big Clifty formation. It consists of 150 to 200 feet of locally petroliferous, medium- to thick-bedded, relatively impure, light- to dark-gray, granular, fossiliferous limestones. The rock is medium or coarse grained, although a few fine-grained beds have been observed by the writer. Locally oolites are abundant. Much of the rock is composed of fragments of bryozoans and remains of echinoderms. Shale partings, several inches to a foot thick, occur intermittently within the formation.

Pennington Formation

The Pennington formation overlies the Glen Dean limestone. It is composed primarily of variegated clay-shales, fine-grained sandstones and siltstones, and a few beds of impure, medium-grained, medium- to dark-gray, sparingly fossiliferous limestones. Dolomitic units which have been noticed

in the Pennington formation are generally lighter colored and more finely crystalline than the limestone.

The Pennington formation crops out poorly because it weathers more rapidly than the overlying and underlying formations. No completely exposed sections were observed in Sequatchie Valley, and the thickness of the Pennington formation was estimated to range between 200 and 400 feet.

PENNSYLVANIAN FORMATIONS

Introduction

The writer mapped four formations of Pennsylvanian age in the Sequatchie Valley, Tennessee. These formations are: the Raccoon Mountain formation, the Warren Point sandstone, the Signal Point shale, and the Sewanee conglomerate. The first three formations are members of the Gizzard group; the latter is the basal formation of the Crab Orchard Mountains group.

Gizzard Group

Introduction.-- Wilson, Jewell, and Luther (1956, p. 1) gave the following description of the Gizzard group.

The Gizzard consists of three formations: Raccoon Mountain formation, Warren Point sandstone, and Signal Point shale. The Gizzard group is so subdivided on the basis of the prominent Warren Point sandstone. All Pennsylvanian beds below the Warren Point are included in the Raccoon Mountain formation, and all beds above

the Warren Point and below the Sewanee conglomerate are included in the Signal Point shale.

Raccoon Mountain formation.-- The Raccoon Mountain formation, which overlies the Pennington formation, consists of olive-green shales and thin-bedded siltstones interbedded with fine-grained, ferruginous, medium- to thick-bedded, cross-bedded sandstones. Locally thin coal seams occur within the shales.

The Raccoon Mountain formation occupies a position immediately below the bluffs of the Warren Point sandstone near the top of the eastern and western escarpments of the Cumberland Plateau in the Sequatchie Valley. The relatively weak shales and siltstones of the formation seldom crop out, and are usually obscured by massive slump blocks of overlying formations. The Raccoon Mountain formation thins northeastward along the strike of the Sequatchie Valley, from approximately 150 feet to 50 feet.

The gradational contact between the Mississippian and Pennsylvanian formations is made more difficult to map as the result of the lack of exposures of the formations involved. Where exposed the contact was selected at the top of the uppermost reddish shales or limestones of the Pennington formation.

Warren Point sandstone.-- The Warren Point sandstone, which overlies the Raccoon Mountain formation, is composed of

50 to 75 feet of medium- to massively bedded, fine- to coarse-grained, locally conglomeratic sandstone. Outcrops of the formation usually exhibit cross-bedding. Iron oxide staining is common.

The Warren Point sandstone usually forms a prominent bluff approximately 50 feet below the massive, cliff-forming Sewanee conglomerate. The Warren Point sandstone bluff is more conspicuous in the southern part of the area mapped where the formation is thickest; to the northeast, the formation becomes thinner and finer grained. In the northern part of Sequatchie Valley, the Warren Point sandstone is difficult to distinguish from the sandstones of the underlying Raccoon Mountain formation, except in areas of good outcrop.

Signal Point shale.-- The Signal Point shale overlies the Warren Point sandstone. The Signal Point shale is composed of approximately 50 feet of olive-green shales and siltstones, interbedded with thick-bedded, fine- to medium-grained sandstones. Two thin coal horizons occur locally in the Signal Point shale; one is at the base and the other is near the middle of the formation.

The Signal Point shale crops out very poorly in the Sequatchie Valley. The formation is best observed in road cuts in the escarpments of the valley walls. Elsewhere, it is generally obscured by massive slump blocks of the overlying Sewanee conglomerate.

Crab Orchard Mountains Group

Introduction.-- The Crab Orchard Mountains group consists of all the formations from the top of the Gizzard group to the top of the Rockcastle conglomerate (Wilson, Jewell, and Luther, 1956, p. 4). Of the five formations in this group, the Sewanee conglomerate, Whitwell shale, Newton sandstone, Vandever formation, and Rockcastle conglomerate, only the base of the Sewanee conglomerate was mapped.

Sewanee conglomerate.-- The Sewanee conglomerate overlies the Signal Point shale and is overlain by the Whitwell shale. The Sewanee conglomerate is a massive, cross-bedded, medium- to coarse-grained conglomeratic sandstone. Weathered outcrops are commonly stained with iron-oxide. The formation forms prominent cliffs at the rim of the eastern valley wall and near the rim of the western escarpment of the valley. Its thickness was estimated to be between 80 and 150 feet. Figure 9 summarizes Mississippian and Pennsylvanian stratigraphy in Sequatchie Valley, Tennessee.

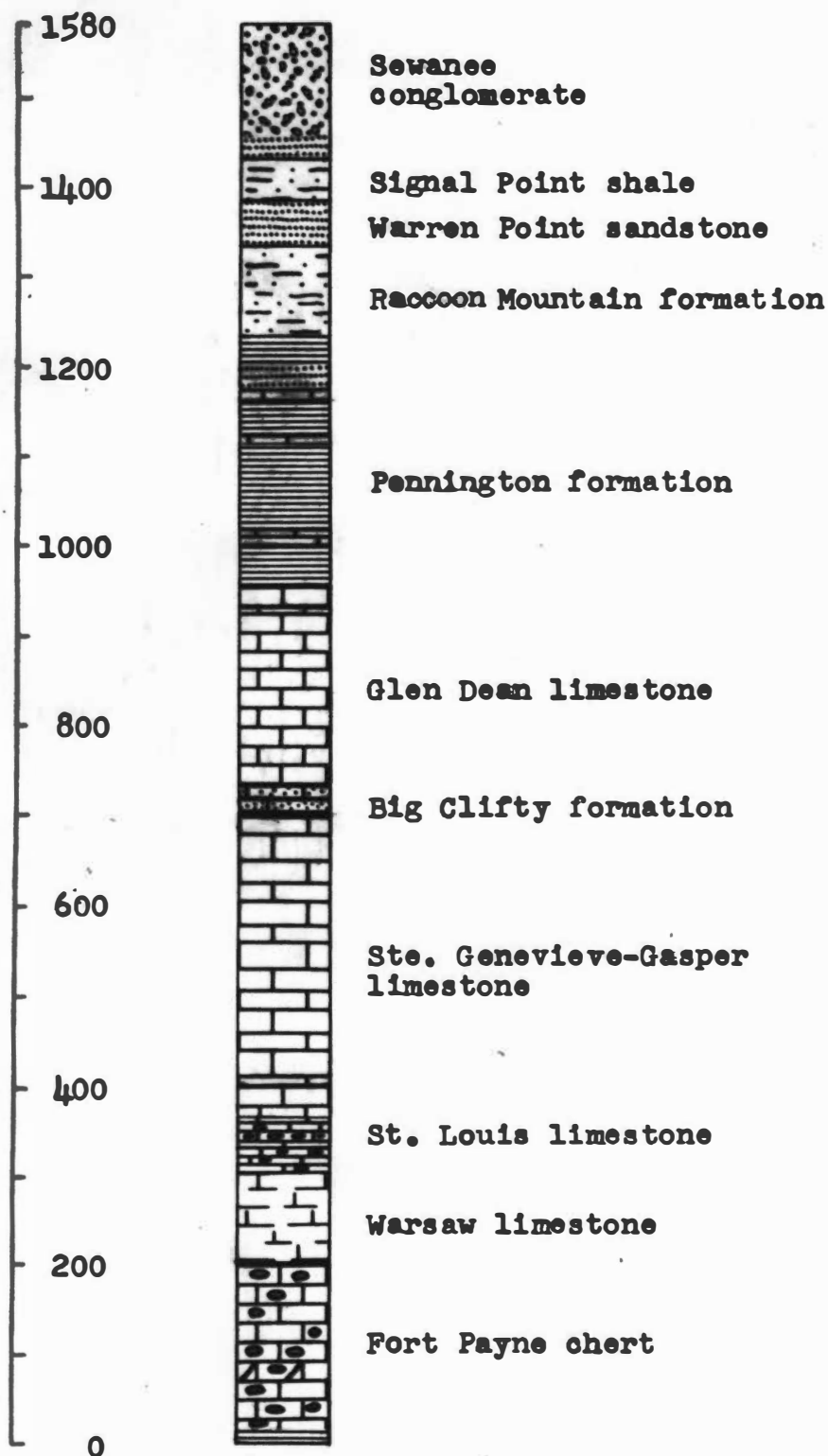


Figure 9. Generalized stratigraphic section of Mississippian and Pennsylvanian formations in Sequatchie Valley, Tennessee

CHAPTER III. STRUCTURAL GEOLOGY

INTRODUCTION

The position of the Sequatchie Valley anticline, fifteen miles to the east of the trace of the Cumberland Plateau overthrust, thirty miles southwest of the Pine Mountain overthrust, and five to ten miles northwest of the imbricate thrust faulting of the Valley and Ridge province has stimulated geological speculation concerning the mechanics of its formation. Both the Cumberland Plateau overthrust (Wilson and Stearns, 1958) and the Pine Mountain overthrust (Rich, 1934) are believed to be "thin-skinned" structures. Ver Wiebe (1936), however, maintained that isolated structures such as the Sequatchie Valley are indicative of "thick-skinned" deformation, involving the basement.

Therefore, important considerations from the point of view of structural geology include: (1) the relationship of the Sequatchie Valley structure to the Cumberland Plateau and Pine Mountain overthrusts; (2) the relationship of the Sequatchie Valley structure to the folding and imbricate thrust faulting of the Valley and Ridge Province to the east; and (3) the mechanism of formation of the Sequatchie Valley structure, which involves considering the relative merits of the "thin-skinned" and "thick-skinned" hypotheses of over-

thrust faulting. Plates 1 to 4, the geologic maps and cross-sections of the Sequatchie Valley, illustrate the geology of that portion of the overthrust block mapped by the writer.

THE SEQUATCHIE ANTICLINE

The Sequatchie anticline is asymmetrical throughout most of its length (Pl. 4). In Tennessee, the axial plane of the fold strikes N 20° to 30° E and dips 60° to 70° to the southeast. The axis plunges 5° to 10° to the northeast at the northern end of the structure, and at a low angle to the southwest at the southern end of the structure in Alabama (Adams, et al, 1926, Geologic Map of Alabama). The rocks of the eastern limb of the fold strike N 20° to 30° E and dip 10° to 35° to the southeast. In contrast, the formations of the more intensely deformed western limb generally dip steeply to the northwest immediately adjacent to the trace of the overthrust; in places they are overturned or complexly folded as the result of drag along the fault surface. Within a half-mile to the northwest of the fault trace the beds flatten and dip but gently to the northwest.

THE SEQUATCHIE VALLEY FAULT

Introduction

The western flank of the anticline is faulted through-

out most of its length by a southeastwardly dipping overthrust. The writer has traced the fault for approximately 80 miles from Devilstep Hollow, Grassy Cove quadrangle, Tennessee, southwestward to the Tennessee-Alabama state line. The fault may persist northeast of Devilstep Hollow, along the western flank of the anticline, to the Emory River fault system. It was observed in an oil test well drilled by the Shell Oil Company in the Sequatchie anticline north of the Sequatchie Valley (Milhous 1959, pp. 80-82), but was not mapped at the surface (Wilson and Stearns, 1958, p. 1294). Charles Butts mapped the Sequatchie Valley fault southwestward from the Tennessee-Alabama state line to a point near Scottsboro, Jackson County, Alabama. He mapped another fault near the southern terminus of the anticline in Blount and Marshall Counties, Alabama (Adams, et al, 1926, Geologic Map of Alabama).

Stratigraphic displacement along the fault increases from a few hundred feet in the northern part of Sequatchie Valley to approximately 2500 feet near Dunlap, Sequatchie County, Tennessee. This displacement persists southward to the Tennessee-Alabama state line. In Alabama, the displacement of the fault decreases from approximately 2200 feet near Stevenson, Jackson County, to nil at the southwestern terminus of the fault (Adams, et al, 1926, Geologic Map of Alabama).

Structural Units

The Sequatchie Valley structure, based on the nature

of the fault trace, may be divided into three units in Tennessee: the northeastern, central, and southwestern sections (Fig. 10). The northeastern section extends from Devilstep Hollow, Grassy Cove quadrangle, to the vicinity of the Bledsoe-Sequatchie county line. The central section extends from the latter location to slightly south of the town of Whitwell, Marion County. The southwestern section extends from Whitwell, southward to the Tennessee-Alabama state line.

In the northeastern section of the area mapped the fault trace is irregular, and klippen of the overthrust block are present in front of the main fault trace. In the central section the fault trace is comparatively straight, and klippen were not observed. In the southwestern section of the Sequatchie Valley, Tennessee, the fault trace is again irregular, and several klippen were mapped. Thus, the fault surface is flat or only slightly dipping in the northeastern and southwestern sections, and moderately dipping in the central section.

The formations exposed in the foot wall become progressively older from Devilstep Hollow, Cumberland County, Tennessee, southwestward to the Alabama state line. The formations of the overthrust block are in contact with fine-grained clastics of the Pennington formation in the northeastern section, with the massive beds of the Glen Dean limestone in the central section, and with the shales of the Big Clifty formation and limestones of the Ste. Genevieve-Gasper limestones

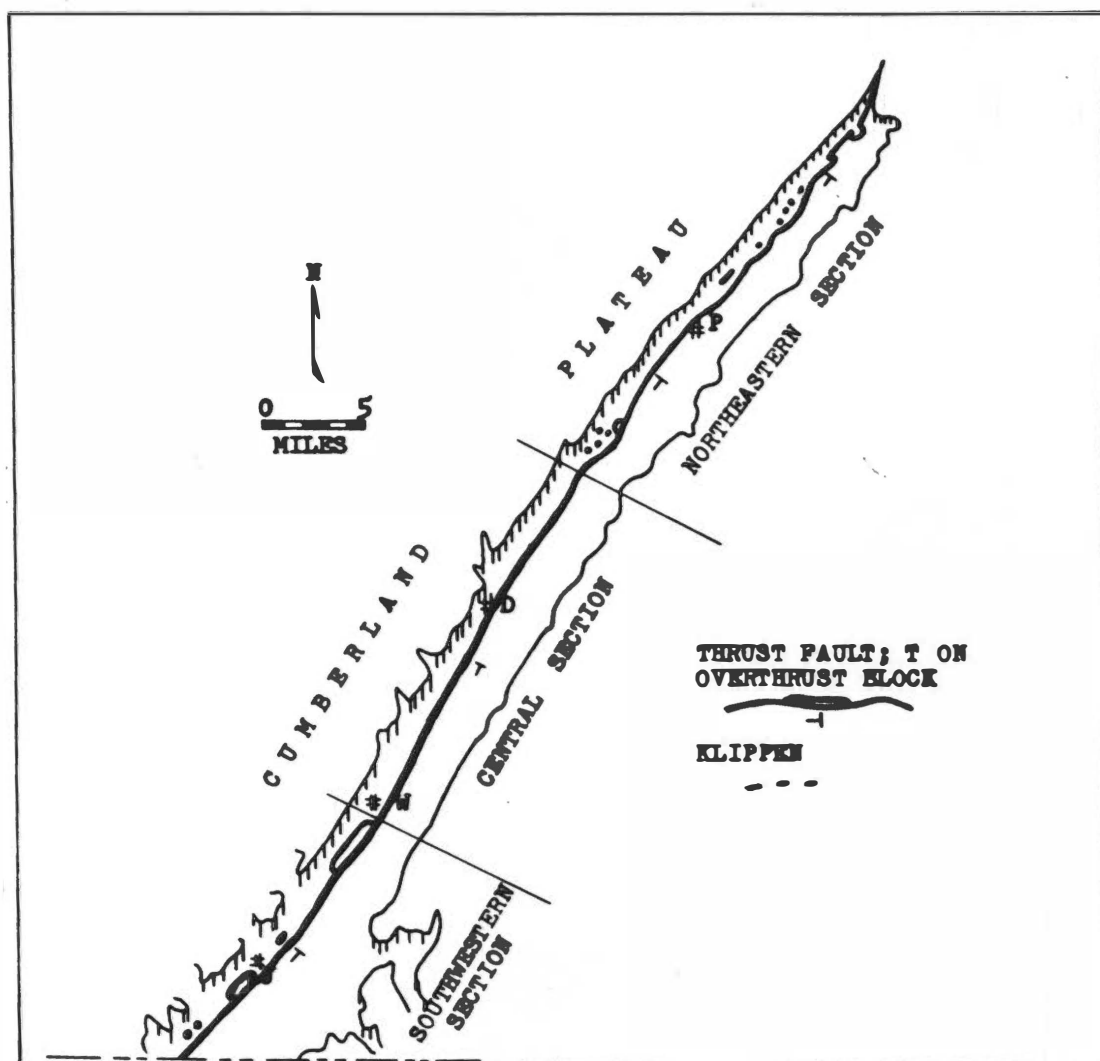


Figure 10. Illustration of the Sequatchie Valley fault trace

in the southwestern section.

The Northeastern Section

Introduction.-- The northeastern section of the structure was mapped on portions of the Grassy Cove, Vandever, Melvine, Billingsley Gap, Pikeville, Brockdell, and Mount Airy quadrangles (Pl. 1).

Stratigraphic displacement.-- The northern part of the fault mapped is exposed in Devilstep Hollow, Grassy Cove quadrangle. Two branches of the fault are present here. The minimum stratigraphic displacement of both the northwestern and southeastern branches is approximately 200 to 300 feet in the northern part of the area mapped. Four miles to the south, at the Head of the Sequatchie and Brown Ridge, Vandever quadrangle, massive Mississippian limestones ranging from the St. Louis limestone to the Glen Dean limestone are thrust over the Pennington formation. Farther to the south, on the Melvine, Billingsley Gap, Pikeville, and Brockdell quadrangles, Upper Ordovician limestone units of the hanging wall are thrust over the Pennington formation of the foot wall. On the latter quadrangles, klippen and fault slices of Fort Payne chert are preserved to the west of the main overthrust block. Northeast of Pailo, Mount Airy quadrangle, the upper portion of the

Knox group is thrust over the Pennington formation, representing a stratigraphic displacement of 2100 to 2200 feet, the greatest attained in the northeastern section.

The fault trace.-- The irregularity of the fault trace and klippen of the overthrust block attest to the flatness of the fault plane in this section (Pl. 1). Pronounced re-entrants into the fault trace occur in three places in this section. Two were mapped on the Vandever quadrangle, near Burke, and in Stephens Branch southwest of Brown Ridge; the third re-entrant was mapped in and near Worthington Cove, Melvine and Billingsley Gap quadrangles (Pl. 1).

Near Burke, Upper Ordovician to Lower Mississippian rocks of the overthrust block have been removed exposing Mississippian limestones and sandstones of the Ste. Genevieve-Gasper limestones, Big Clifty formation, and Glen Dean limestone to form the re-entrant. In the case of the Stephens Branch re-entrant, erosion of Lower Mississippian formations of the overthrust block has exposed clastics of the Pennington formation of the foot wall. The trace of the fault, which crosses contours at a low angle, indicates that the fault surface dips 2° or 3° to the south here. In Worthington Cove, erosion has removed Middle Ordovician to Mississippian formations exposing steeply dipping, variegated shales of the Pennington formation in Rocky Branch.

Fifteen distinct klippen of the overthrust block were mapped to the west of the main overthrust block in this section (Pl. 1). Three of these, one at the Burke re-entrant, Vandever quadrangle, and two west of Melvine, Melvine quadrangle, are of Upper Mississippian limestone. The remainder of the klippen, of Fort Payne chert, were noted on the Billingsley Gap and Brockdell quadrangles.

Structures of the hanging wall.-- The hanging wall exhibits numerous minor structures which were developed during the formation of the major structure. These include drag folds and fault slices associated with the formation of the Sequatchie Valley fault, and drag folds associated with anticlinal folding. The former were developed along the northwestern flank of the anticline near the fault, and the latter are best developed in the formations on the unfaulted southeastern flank of the Sequatchie anticline.

Generally the rocks of the hanging wall are steeply dipping, overturned, and tightly folded along the fault trace. Axes of drag folds associated with the Sequatchie Valley fault parallel the regional strike in general. Formations nearest the fault are most severely deformed, and conversely, folding decreases progressively with distance from the fault surface.

Several drag folds were large enough to be mapped on

the scale used in this investigation. Two tightly folded "knots" were mapped at the leading edge of the overthrust northwest of Melvine, Melvine quadrangle. The two "knots" are approximately three-fourths of a mile long and one-half mile wide, with their long axes parallel to the regional strike. Both are synclinal structures and topographic highs. Both are crowned by small outcroppings of Fort Payne chert which is surrounded by older formations. An anticline and a syncline were mapped near Tollett Lake, Melvine quadrangle. Similar structures were located three-quarters of a mile north of Pikeville on the Howard Taft Highway. In the latter structures the northwest limb of the anticlinal drag fold is overturned or steeply dipping to the northwest, whereas the southeastern limb of the anticline dips gently to the southeast. This indicates movement of the hanging wall to the northwest, relative to the rocks of the foot wall. Many other similar but smaller structures were noted along the trace of the overthrust fault both in the hanging wall and foot wall. The asymmetry of those observed indicates a relative movement of the hanging wall to the northwest.

Drag folds are not nearly so well developed on the southeast limb of the Sequatchie Valley anticline. None were large enough to be mapped on the scale employed. However, where observed, the northwest limbs of the small anticlines dip more steeply towards the northwest than the southeast

limbs dip toward the southeast. This asymmetry indicates that younger rocks moved over older ones toward the anticlinal axis during deformation.

Several relatively minor faults were mapped on the overthrust block in this section. A small reverse fault was mapped approximately one-half mile southwest of Melvine. The fault strikes slightly west of north for about one-third of a mile, and apparently has a steep dip. Other faults of the overthrust block, slices or branches off the main thrust, generally strike parallel to the major fault. The southeastern branch of the Sequatchie Valley fault in Devilstep Hollow, Grassy Cove and Vandever quadrangles, may be considered such a slice. As mentioned previously, Lower Mississippian formations are thrust over Upper Mississippian formations along this fault. Three fault slices, in which Middle Ordovician limestones are thrust over the Chattanooga shale and/or Fort Payne chert, were mapped farther to the south. Two of these are located near Worthington Cove, Melvine and Billingsley Gap quadrangles; the third is one-half mile to the west of the town of Cold Spring, Billingsley Gap quadrangle.

A more complicated structure involving three faults was mapped south of Shoemate Gap, Billingsley Gap quadrangle. The Fort Payne chert is thrust over the Pennington formation

along the trace of the main overthrust; formations of the Knox and Stones River groups are thrust over Upper Ordovician limestones of the fault slice; and, the Murfreesboro limestone was faulted out by a relatively insignificant thrust in the hanging wall.

Two small fault slices were mapped on the Mount Airy quadrangle. One of these is a small slice of Fort Payne chert, Maury shale, and Chattanooga shale located one-quarter mile east of Bethel Church. The second is a small, highly contorted slice of Fort Payne chert, Maury shale, and Sequatchie formation located a mile north of Mount Airy Church on the Alvin York highway.

Structures of the foot wall.-- The foot wall was not mapped in detail. The structures observed in reconnaissance mapping were drag folds and fractures associated with rock movement beneath the sole of the Sequatchie Valley fault. The drag folds are of two types: tilting of the massive Pennsylvanian formations of the foot wall to the northwest, and intricate crumpling and fracturing of the less competent rocks of the foot wall. The former may be observed as an almost continuous feature along the Cumberland escarpment; the latter were observed in a number of places to the west of the trace of the Sequatchie Valley fault.

In general, the smaller drag folds are too small to be mapped on the scale used. Their axes trend parallel to the

regional strike and the northwest flanks of the anticlines are oversteepened compared to the southeast flanks. This asymmetry is further evidence of the relative movement of the hanging wall to the northwest.

The Central Section

Introduction.-- The central section of the Sequatchie Valley fault is exposed on the Mount Airy, Savage Point, Daus, Ketner Gap, and Whitwell quadrangles (Pl. 2). The relatively straight trace of the fault in this section is probably indicative of a steeper dip of the fault surface. The steeper attitude of the fault in this section is presumed to be a reflection of the change in lithology of the foot wall from shale to limestone.

Stratigraphic displacement.-- The stratigraphic displacement of the fault ranges from 2200 feet in the vicinity of Mount Airy, Mount Airy quadrangle southwest to 2500 feet in the vicinity of Cartwright, Daus quadrangle. In this region, the Hermitage, Carters, Lebanon, Ridley, and Murfreesboro limestone formations, and the uppermost units of the Knox group are successively in contact with the Glen Dean limestone of the foot wall. This exposure of the Knox group at the fault trace, at and adjacent to the Sequatchie-Marion county line, represents the greatest stratigraphic displacement of the Sequatchie Valley fault in Tennessee (Pl. 2).

The fault trace.-- As mentioned above, the trace of the fault is comparatively straight in this section. No klippen of the overthrust block were mapped to the west of the main overthrust.

Structures of the hanging and foot walls.-- Drag folds were noted in both the hanging wall and foot wall. None were large enough to be mapped on the scale employed. Well-preserved drag folds were observed in Middle Ordovician limestones of the hanging wall on the Mount Airy quadrangle to the north of Mount Airy, and on the Whitwell quadrangle one-half mile southwest of Red Hill. Drag folds were also observed locally in the shales and siltstones of the Pennington and Raccoon Mountain formations of the foot wall.

The Southwestern Section

Introduction.-- The southwestern section of the Sequatchie Valley fault crops out on the Whitwell, Sequatchie, South Pittsburg, and Bridgeport quadrangles (Pl. 3).

Stratigraphic displacement.-- The maximum stratigraphic displacement of the main overthrust approximates 2100 to 2200 feet in this area (Pl. 4, F - F'). Uppermost units of the Knox group and lowermost units of the Stones River group of the hanging wall are thrust over the Big Clifty formation or Ste. Genevieve-Gasper limestones of the foot wall along the

trace of the main overthrust. Fault slices and klippen of Fort Payne chert thrust over the Big Clifty formation west of the main overthrust have a lesser displacement.

The fault trace.-- The fault surface flattens near the leading edge of the overthrust block in this section, as is evidenced by irregularly shaped fault slices adjacent to the major overthrust block, and by small klippen of rocks of the overthrust block a half to three-quarters of a mile to the northwest of the main fault trace. The trace of the main overthrust fault is comparatively straight in this section. This straightness is probably a reflection of the steeper dip of the main overthrust fault. The fault plane dips more steeply because the rocks of the main overthrust block are in contact with the massive Mississippian limestones of the foot wall which are stratigraphically below the Big Clifty formation.

Klippen and fault slices are not nearly so well developed in this section as they are in the northeastern section. Only three small klippen and two fairly extensive fault slices were mapped in the entire section. This comparatively subdued expression of the flat fault surface is presumed to be a reflection of the contrast in thickness of the Big Clifty and Pennington formations. The 20 foot thick Big Clifty formation would not "support" as wide a flat-lying overthrust block as would the much thicker Pennington formation.

An elongated fault slice of Fort Payne chert is preserved less than a mile to the southeast of State Highway 27, Whitwell quadrangle. The slice, thrust over the Big Clifty formation of the foot wall, was in turn overridden by the uppermost units of the Knox group. This slice is nearly two and one-half miles long and three- to four-tenths of a mile wide. Near Pilgrim Church, a thin, half-mile long slice of Ordovician limestone, tentatively identified as Catheys, lies between the Knox and Fort Payne chert.

Another larger fault slice crops out immediately to the southwest of Jasper, South Pittsburg quadrangle. The rocks of the fault slice are thrust over those of the foot wall, and are overridden in turn by the rocks of the main overthrust block. The fault slice, two and one-half miles long and one mile wide, is roughly elliptical in shape. The long axis of the fault slice and the strike of the formations which form it parallel the regional strike. The rocks of the slice are generally steeply dipping and are locally severely contorted. Three formations were mapped in the slice: the Fort Payne chert, Chattanooga shale, and Rockwood formation. The northwestern two-thirds of the slice is underlain by highly deformed rocks of the Fort Payne chert. Outcrops of the Chattanooga shale and Rockwood formation were mapped in the southeastern portion of the slice.

One klippe of Fort Payne chert was mapped between the towns of Sequatchie and Jasper, Sequatchie quadrangle. The klippe, approximately nine-tenths of a mile long and three-tenths of a mile wide, lies a half-mile to the northwest of the trace of the main overthrust fault. It was thrust over the Big Clifty formation of the foot wall. A pair of small klippen crop out at the crest of a hill at the state line a half-mile east of Richard City, Tennessee. Here residual gravels of Fort Payne chert are underlain by massively-bedded, crystalline limestones of the Ste. Genevieve-Gasper limestones.

TECTONIC IMPLICATIONS

Behavior of the Fault at Depth

"Thick-skinned" vs. "thin-skinned" hypotheses.-- No new evidence is presented in this study which unequivocally supports either of these two hypotheses for the deformation of the Southern Appalachians. The fault surface apparently refracts when it crosses different lithologies; however, there is every indication that the flattening of the Sequatchie Valley fault is of limited horizontal extent in thin-bedded lithologies, and that the fault steepened when it intersected thick-bedded units.

Figure 11 summarizes three of the possibilities for the behavior of the fault at depth. In Figure 11a the assumption is made that competent sedimentary rocks extend to the

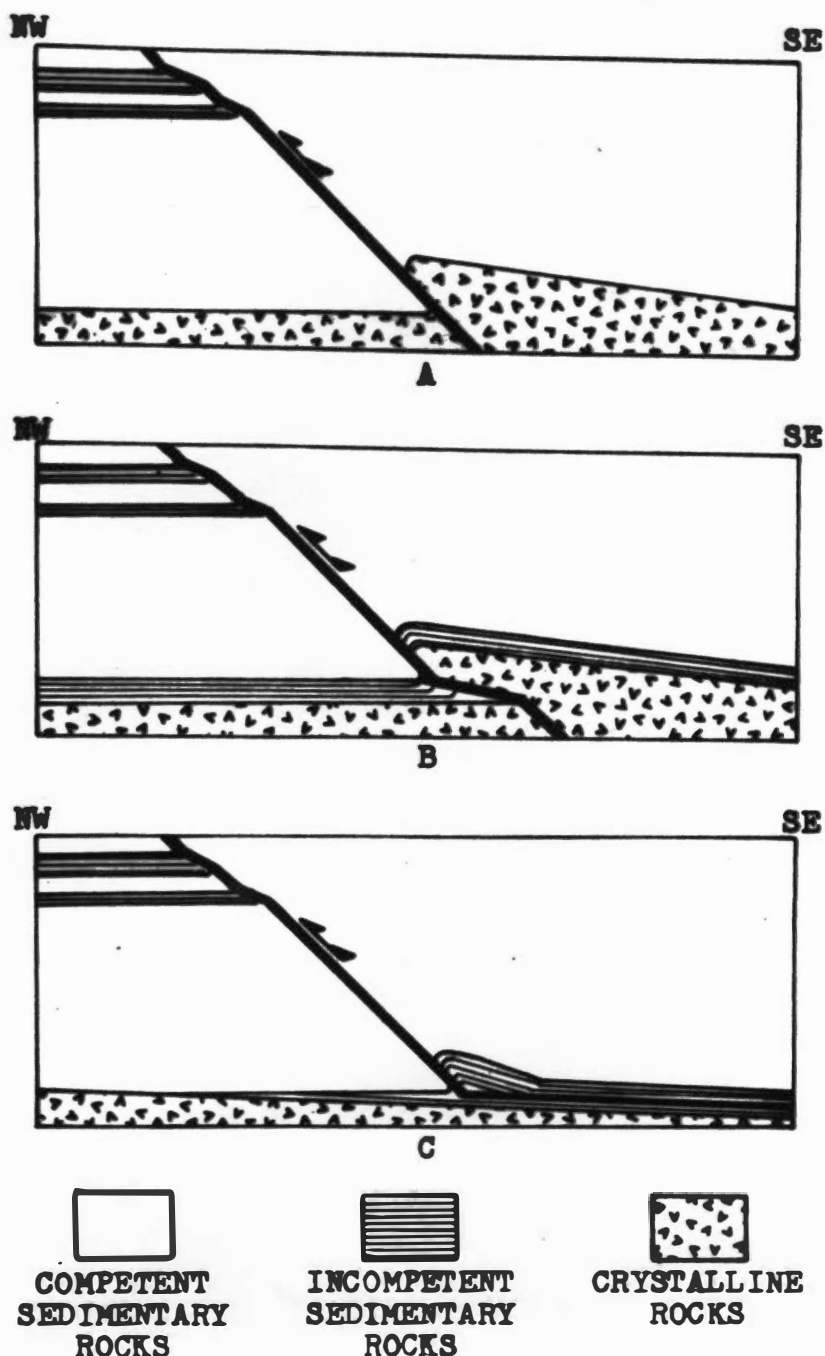


Figure 11. Cross-sections illustrating three possibilities for the behavior of the fault at depth

Basement rocks are shown faulted in A and B. No incompetent sedimentary units are shown at depth in A; the fault refracts in incompetent units postulated to overlie crystalline rocks in B. A sole fault is hypothesized in C; northwestward pinchout of the basal incompetent unit is postulated, causing the fault to refract towards the surface.

"basement", and "basement" rocks are shown as faulted. In Figures 11b and 11c the assumption is made that basal shales, probably of Cambrian age, are present in the Sequatchie Valley region, as is the case in the Valley and Ridge Province approximately 15 miles to the east. Figure 11b illustrates the possibility of the fault flattening in the basal shale, as it does in the upper shales, and then extending into the crystalline rocks below. Figure 11c illustrates the possibility that the fault flattens as a sole fault; subjacent crystalline rocks are not shown as faulted. Wilson and Stearns (1958, p. 1295) suggested that there may be a correlation between the westward pinch-out of these basal shales and the expression of the Sequatchie Valley fault on the surface.

REGIONAL IMPLICATIONS

Introduction

The generally synclinal structure of the Cumberland Plateau of Tennessee is comprised of four major structural elements. These are the Pine Mountain overthrust, the relatively undeformed area of the Cumberland Mountains, the Cumberland Plateau overthrust, and the Sequatchie Valley structure (Fig. 12).

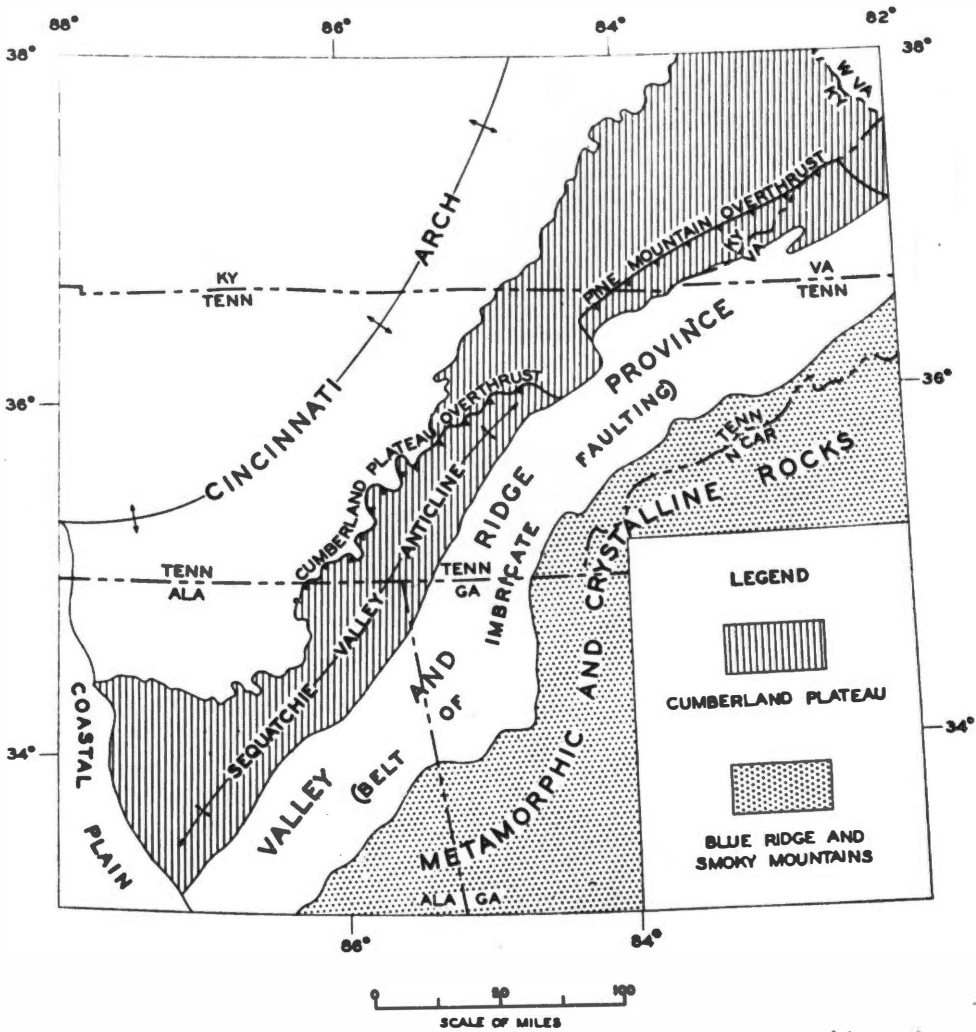


Figure 12. Regional structural features (Wilson and Stearns, 1958, Fig. 1)

The Pine Mountain overthrust (Rich, 1934) and the Cumberland Plateau overthrust (Wilson and Stearns, 1958) are flat-lying overthrust faults which underlie many square miles. The Pine Mountain overthrust block is bounded by the Pine Mountain overthrust fault, and the Jacksboro and Russel Fork cross-faults. The Cumberland Plateau overthrust block is bounded, as far as is known, by the Cumberland Plateau overthrust and by the Emory River cross fault. The area between these two structures is the relatively undisturbed area of the Cumberland Mountains (Fig. 12). One of the problems in this study was to determine if the Sequatchie Valley structure is of a similar nature, i. e., if it too is an overthrust block bounded by an overthrust fault and cross-faults. Other problems involved in regional structural interpretation include the relationship of the Cumberland Plateau overthrust fault system to the Sequatchie Valley structure and the relationship of the structures of the Cumberland Plateau to those of the Valley and Ridge province.

The Sequatchie Valley Structure

The field mapping of the present investigation was not sufficient to determine if the Sequatchie Valley overthrust fault terminates in cross faults. The cross faults, if they exist, would occur at the northeastern end of the fault in Tennessee, and at the southwestern end of the fault

in Alabama. Rodgers (1950, pp. 676-677) summarized the situation thusly:

If the Emory River line at the northeast end of the Sequatchie anticline was formed in the same manner as the Jacksboro fault at the southwest end of the Pine Mountain fault, tear faults like the Russell Fork fault might be expected at the southwest end of the anticline. In the coal basin northwest of Birmingham, Alabama, Butts (1910, 1927b, economic geology maps) found north-northwest-trending and north-trending faults which he described (1910, p. 11) as "short normal faults They vary in throw from 70 to 110 feet. The fault planes are generally inclined 70° or more, but a single one is reported with an inclination of 45°." It is clear from the structure contours on Butts' maps that these faults are downthrown here on one side there on another, and it therefore is possible that they are not normal but strike-slip or tear faults. In position and trend they accord well with what would be expected by analogy with the Russell Fork fault.

Relationship to the Cumberland Plateau Overthrust

Any hypothesis concerning the relationship of the Cumberland Plateau overthrust and the Sequatchie Valley structure must account for a number of observations made by Wilson and Stearns (1958). These authors: (1) maintain that the Emory River cross fault at the northeast end of the anticline is "known to be a part of the superficial older Cumberland Plateau overthrust rather than a part of the Sequatchie Valley structure"; (2) maintain that the Sequatchie Valley fault as a surface feature ends near the head of the main valley, but note that an oil test reveals its presence at depth 14 miles beyond the northeast end of the surface fault;

(3) demonstrate the formation of superficial anticlines by thrusting, anticlines that developed in the hanging wall as the Cumberland Plateau overthrust broke across competent layers; and, (4) demonstrate the Cumberland Plateau overthrust to be descending to lower and lower stratigraphic horizons from northeast to southwest. They hypothesize that the fault is beneath the Sewanee conglomerate in the vicinity of the Sequatchie Valley, i. e., in the shales and siltstones of the Gizzard group or Pennington formation.

The present writer would like to suggest that the Cumberland Plateau overthrust and the Sequatchie Valley structure were originally the same structure. Perhaps the primeval Cumberland Plateau - Sequatchie Valley fault, either riding in Cambrian clastics as a bedding thrust or extending into the "basement", broke through relatively competent Lower and Middle Paleozoic strata in the vicinity of what is now Sequatchie Valley, flattened in the Pennington or Raccoon Mountain formations, and then progressed northwestward in the manner described by Wilson and Stearns (1958). At this stage of development the only expression of the structure at the surface would be the trace of the Cumberland Plateau overthrust, the Emory River cross fault, and superficial anticlinal structures, including the Sequatchie anticline, associated with the fault breaking across competent layers at depth. Continued movement along the fault resulted in the rupture of

Pennsylvanian rocks along the Sequatchie anticline, and the expression of the Sequatchie Valley fault at the surface. No further movement would be expected along the Cumberland Plateau overthrust after the formation of the Sequatchie Valley structure. It should be noted that the magnitude of movement of the Cumberland Plateau overthrust and Sequatchie Valley fault are roughly complementary. Movement along the Cumberland Plateau overthrust is rotational in a horizontal plane, increasing from the latitude of Spencer, Van Buren County, Tennessee, to the northwest (Wilson, Jewell, and Luther, 1956, p. 17). Movement along the Sequatchie Valley fault is rotational but opposite to that of the Cumberland Plateau overthrust. It increases from approximately the latitude of Spencer to the southwest. The present writer suggests that possibly the Cumberland Plateau overthrust may die out as a well defined structural feature south of the latitude of Spencer, although Wilson and Stearns (1958), and Wilson, Jewell, and Luther (1956) have observed evidence that the Cumberland Plateau overthrust extends throughout the Cumberland Plateau of Tennessee as a bedding thrust (Fig. 13). Deformation of Mississippian and Pennsylvanian rocks in "fensters" of Sequatchie Valley, Grassy Cove, and Crab Orchard Cove, previously attributed to movement along the Cumberland Plateau overthrust (Wilson and Stearns, 1958, p. 1291) may be attributed to drag folding resulting from the formation of the

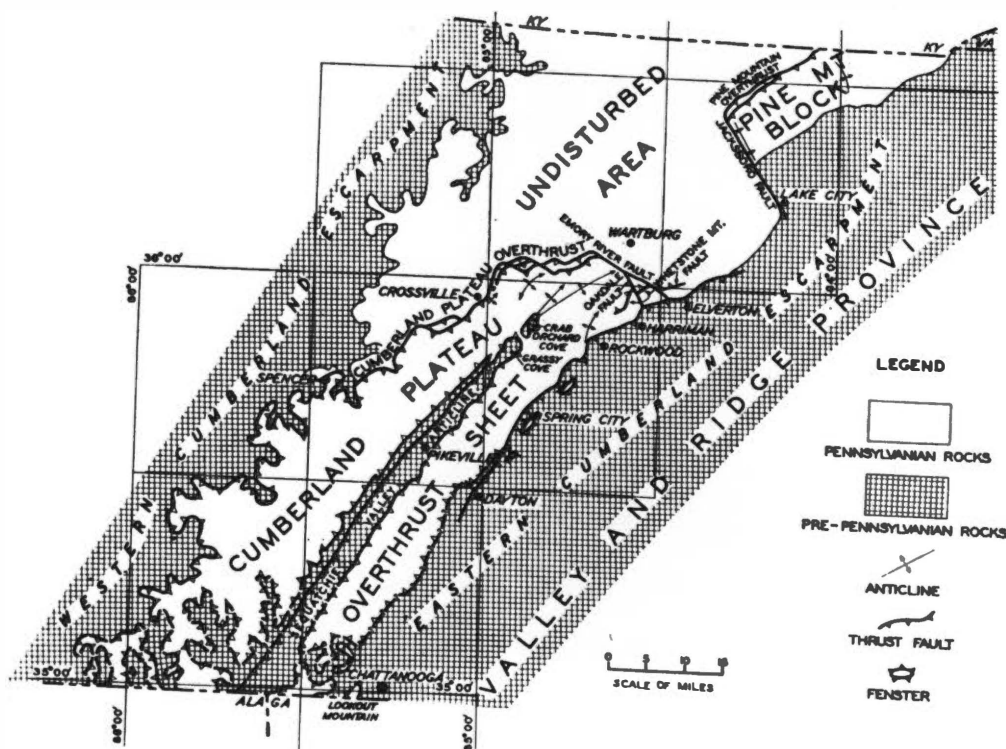


Figure 13. Major faults of the Cumberland Plateau, Tennessee (Wilson and Stearns, 1958, Fig. 2)

Sequatchie Valley structure. Figures 14 and 15 summarize the relationship of the Sequatchie Valley structure to the Cumberland Plateau overthrust.

Relationship of Cumberland Plateau Structures to Structures of the Valley and Ridge Province

At first appearance the tectonic and topographic contrast between the Valley and Ridge province and the Cumberland Plateau is striking. The topographic difference is well defined, but tectonic differences, although significant, appear less and less pronounced as more information is obtained from detailed mapping.

The Valley and Ridge province is underlain, for the most part, by Lower and Middle Paleozoic rocks which are folded and faulted shingle-like, one upon another. The Cumberland Plateau is underlain by Middle and Upper Paleozoic rocks which are known to be locally severely deformed. Perhaps it would be better to consider that the architecture of the Valley and Ridge merges imperceptively with that of the Cumberland Plateau, and that only the material of construction changes, than it would be to consider that both material and style of tectonics change drastically. Thus, both the Valley and Ridge physiographic province and the Cumberland Plateau section are included within the folded and faulted Appalachian structural province.

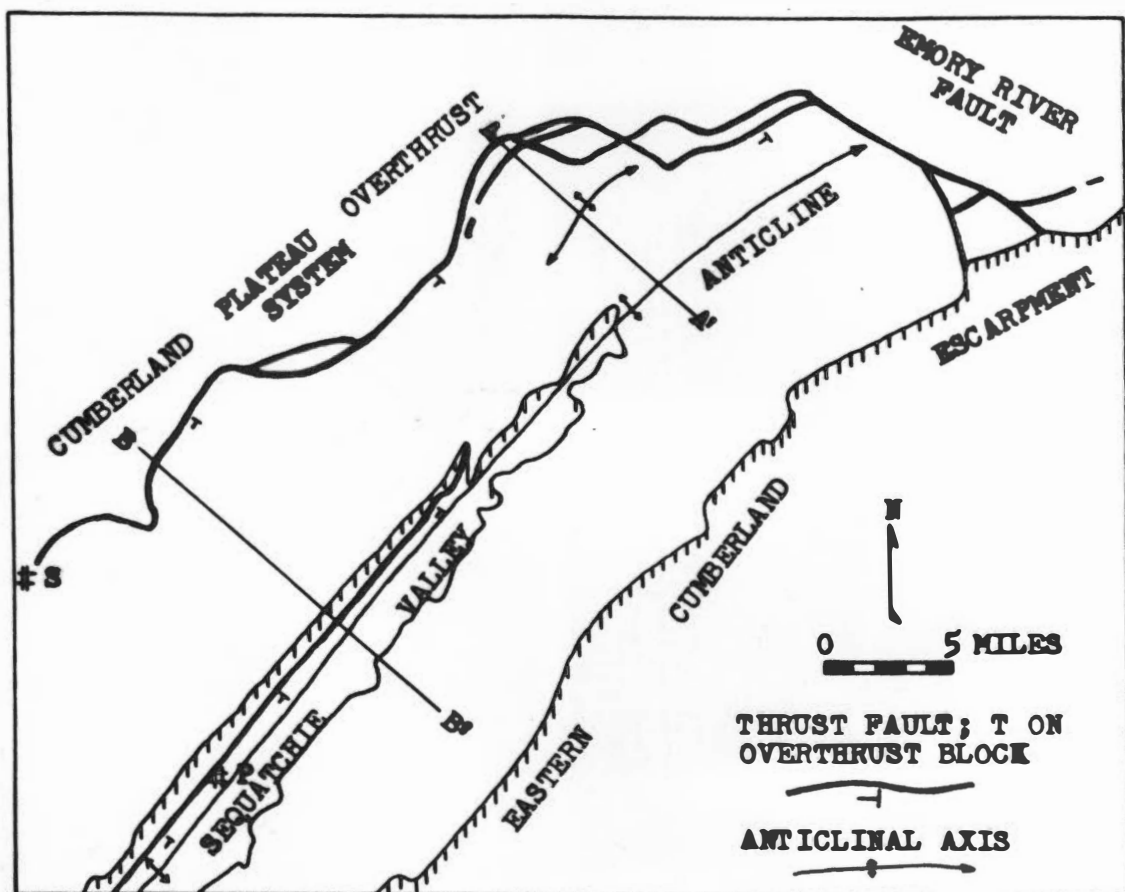


Figure 14. Major structural features at the northern end of Sequatchie Valley, Tennessee (after Wilson, Jewell, and Luther, 1956, Pl. 13)

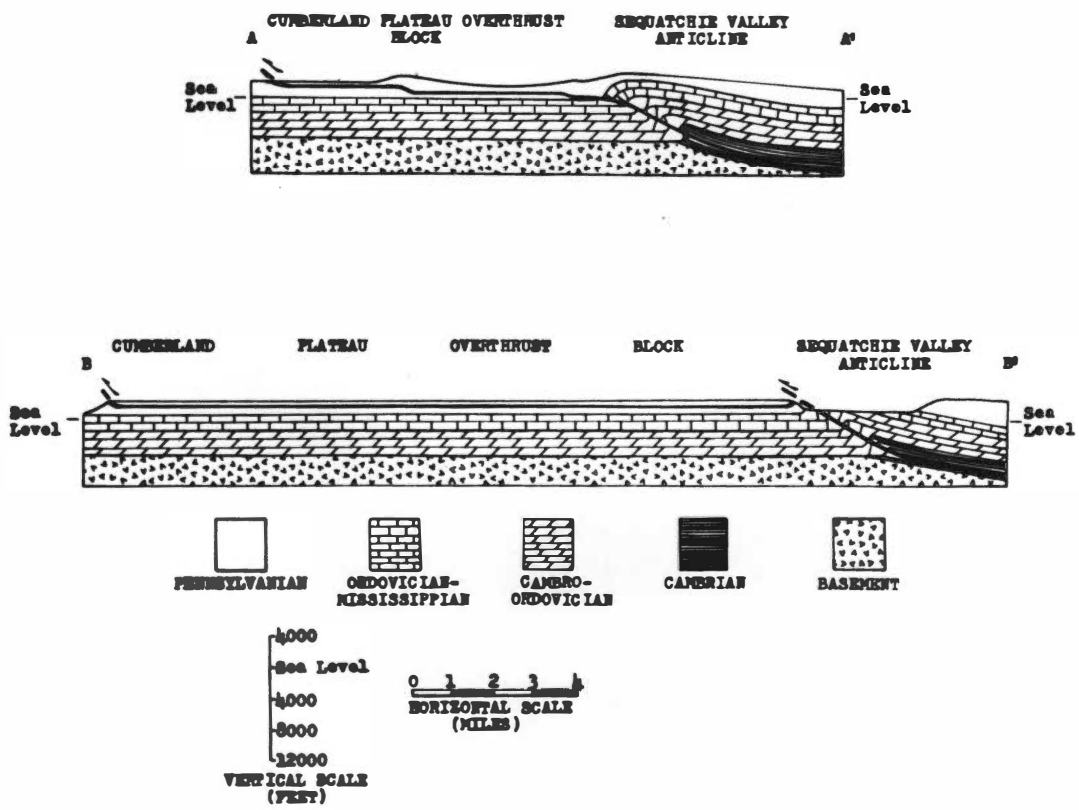


Figure 15. Cross-sections of the Cumberland Plateau and Sequatchie Valley, Tennessee (modified from Wilson and Stearns, 1958, Fig. 6)

See Figure 14 for locations of AA' and BB'.

CHAPTER IV. SUMMARY AND CONCLUSIONS

Summary

Formations of Ordovician to Pennsylvanian age were mapped in the Sequatchie Valley of Tennessee. Lower Ordovician siliceous carbonate rocks of the Knox group, carbonates and clastics of the Middle and Upper Ordovician Stones River, Nashville, Eden, Maysville, and Richmond groups, and of the Rockwood formation of Silurian age were studied in more detail than overlying Devonian-Mississippian black shales, Mississippian carbonates and clastics, and Pennsylvanian clastics. Correlation of pre-Chattanooga formations with those of the Central Basin of Tennessee was effected by Wilson (1949); Glover (1959) has reported on the Devonian-Mississippian Chattanooga shale; Pennsylvanian formations mapped by the writer have been correlated with formations in other parts of the Cumberland Plateau (Wilson, Jewell, and Luther, 1956). Correlation of Mississippian formations with their type sections, as implied by using standard formational names, has not been demonstrated, and should be regarded as speculative.

The trace of the Sequatchie Valley fault was mapped in detail from Devilstep Hollow, Grassy Cove quadrangle, to the Tennessee-Alabama state line. The trace was observed to be irregular in the northeastern and southwestern portions of the area mapped, and comparatively straight in the central

portion. Numerous klippen associated with the irregular trace of the overthrust were mapped; none were found where the fault trace was straighter. It was further noted that the nature of the fault trace was apparently related to the lithology of the foot wall; the surface of the overthrust has a flatter dip where it crosses thin-bedded, shaly lithologies, and a steeper dip where it crosses thick-bedded, coarsely crystalline lithologies.

Structural conclusions

From these observations it can be concluded that the lithology of the foot wall is the governing factor in determining the attitude of the fault surface. The behavior of the fault at depth and the relationship of the Sequatchie Valley structure to other structures of the Cumberland Plateau and Valley and Ridge must still remain speculative. These problems may eventually be solved by geophysical investigations and continued detailed field mapping.

Investigations of the structural geology of the Cumberland Plateau, including the Sequatchie Valley, indicate that the tectonics of the Valley and Ridge province merges imperceptively with that of the Cumberland Plateau, and that both should be included within the folded and faulted Appalachians structural province.

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