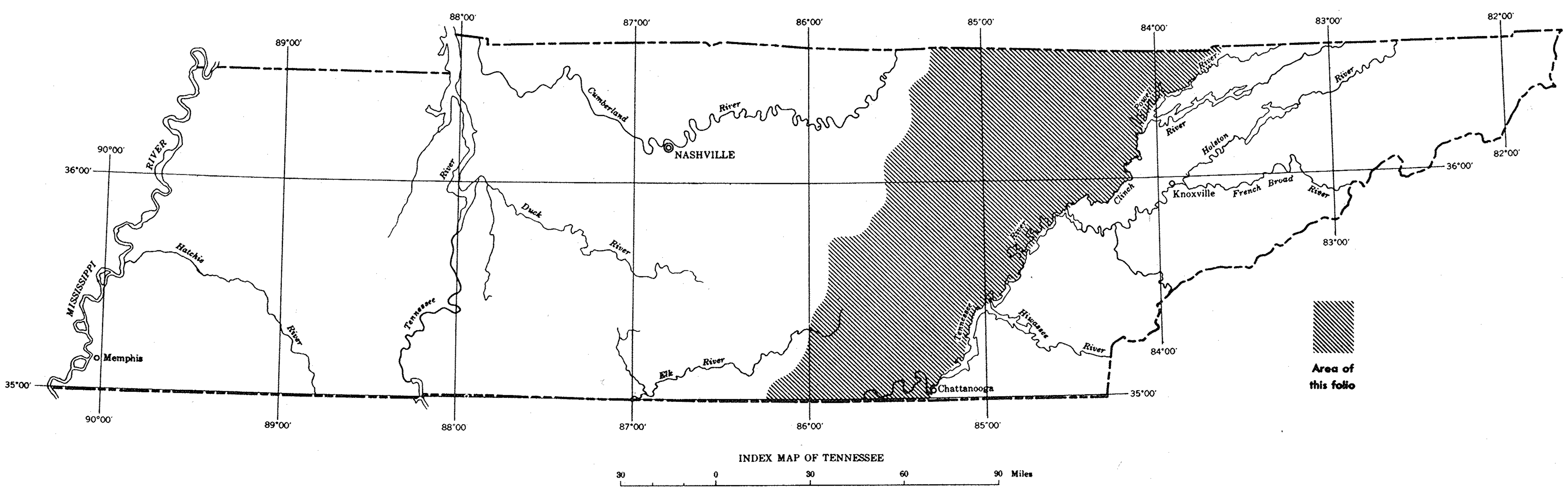
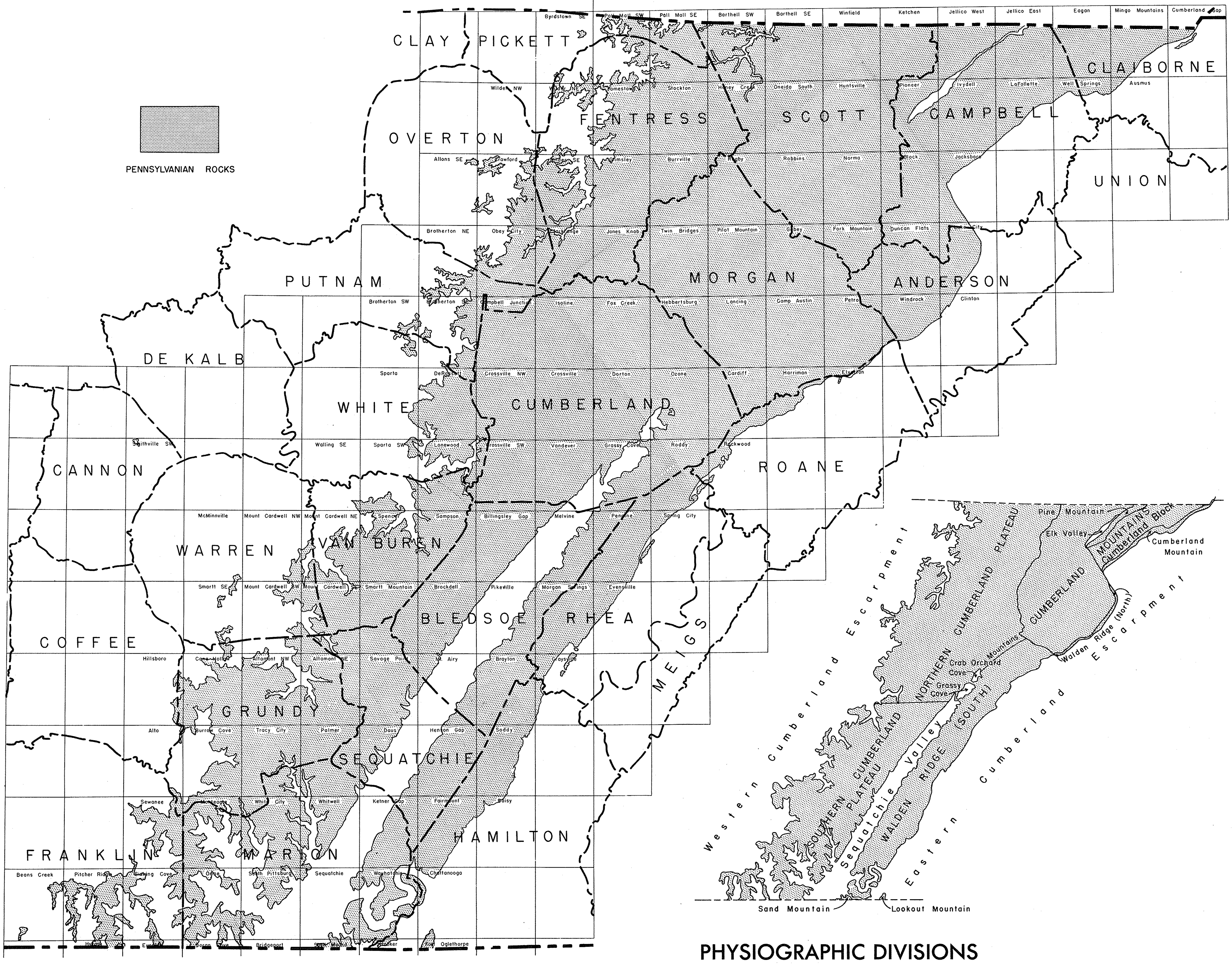
STATE OF TENNESSEE
DEPARTMENT OF CONSERVATION
DIVISION OF GEOLOGY
W. D. Hardeman, State Geologist

PENNSYLVANIAN GEOLOGY
OF THE
CUMBERLAND PLATEAU

By
Charles W. Wilson, Jr., John W. Jewell
and Edward T. Luther



NASHVILLE, TENNESSEE
1956
Richard G. Stearns - Geologic Editor



PHYSIOGRAPHIC DIVISIONS

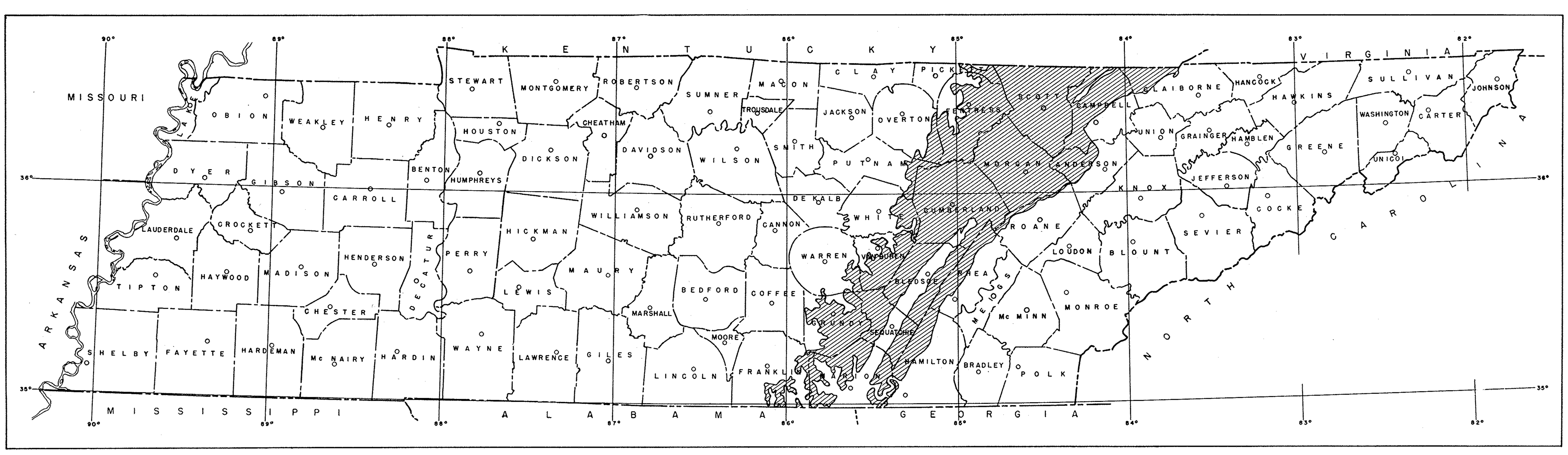


PLATE 1—THE CUMBERLAND PLATEAU

INTRODUCTION

Pennsylvanian rocks in Tennessee underlie the Cumberland Plateau, which is a highland extending across the State from Kentucky and Virginia on the north to Georgia and Alabama on the south. This highland is not a simple plateau but is dissected by prominent valleys and topped by mountains. The general location, specific area, and physiographic divisions of the Plateau are shown on plate 1.

The Cumberland Plateau is an important area of mineral production. Coal, found in Tennessee only in this area, is the most important mineral on the basis of value of annual production. The greatest oil and gas production in the State comes from the Cumberland Plateau. Other mineral products include stone, high-purity sand, and clay.

Distribution of coal and other minerals is primarily related to the occurrence and character of the rock formations. The purpose of this report is to present information about these formations. It is believed that this information will prove helpful in the search for new deposits and will aid in estimating reserves of all minerals, particularly coal.

This folio supersedes all earlier publications on the Pennsylvanian formations in Tennessee. Errors in previous work were discovered and reconciled during the course of this investigation. The resulting new information and revisions are of considerable scientific as well as economic interest, not only in Tennessee but in adjoining states as well.

The general results presented here are primarily based upon geologic mapping, including detailed maps of many key areas. These maps, which will be published at a future date, are available for inspection at the Tennessee Division of Geology office.

Places referred to in the report are found on the topographic quadrangle maps published by the Tennessee Valley Authority and by the United States Geological Survey in cooperation with the Tennessee Division of Geology. These up-to-date topographic maps are at a scale of 1 inch equals 2000 feet, and may be obtained from any of the above agencies at a nominal cost. Names and locations of these quadrangles are shown on the opposite page.

STRATIGRAPHY

INTRODUCTION

The coal-producing rocks of the Cumberland Plateau of Tennessee are early Pennsylvanian in age, representing the Pottsville series of this system. These beds are divisible into two parts: a lower sequence consisting of massive sandstones with approximately equal amounts of shale, and an upper sequence with thinner sandstones and a larger percentage of shale. The lower, sandy sequence crops out over more than three-quarters of the area of the Cumberland Plateau, whereas, the upper, shaly sequence is limited to the northeastern quarter of the Plateau within the Cumberland Mountains.

The lower, sandy beds were previously incorporated into the Lee group, and the upper, shaly beds were divided into four units: the Briceville, Jellico, Scott, and Anderson formations. As a result of recent field work, all of these names are discontinued, and a complete new classification is presented here. A summary of the development of nomenclature is shown in the chart on this page. The general sequence of beds and names now applied is presented on plate 4.

The relatively accessible flats and benches and the cliff-forming character of sand units in the lower part of the Pennsylvanian make it possible to map them by conventional methods. The sandstones that form group boundaries were continuously mapped throughout their extent, thus assuring consistency of groups.

In the upper part of the Pennsylvanian the steepness of the mountains, the variability of the sandstones, and their isolated areas of preservation necessitate the use of different techniques in mapping and correlation. Above the Crooked Fork group the slopes steepen, and ascent anywhere except along roads and trails is somewhat futile because of physical difficulty, as well as the scarcity of natural exposures. In these beds no horizon can be recognized with certainty on the basis of lithology, except the Windrock coal with its underlying flint clay and the associated Big Mary coal that is overlain by a zone containing marine fossils. With this exception, therefore, correlation and mapping above the Crooked Fork group were based largely on *sequence* and *interval.* The areal distribution of the major units is shown on the geologic maps (pls. 5-8).

The lower, sandy sequence of the Pennsylvanian of Tennessee is here divided into three new groups: Gizzard, Crab Orchard Mountains, and Crooked Fork. This is preferable because these groups comprise a great thickness of beds that can easily be subdivided. The most prominent, easily recognizable sandstones in this thick sequence of sediments serve as group boundaries.

The equally thick upper, shaly sequence is here subdivided into six groups to replace the four units of previous reports, because the old units are not traceable over the entire area and specific type sections were not defined. The six new groups, from oldest to youngest are: Slatestone, Indian Bluff, Graves Gap, Redoak Mountain, Vowell Mountain, and Cross Mountain. Because these beds span a great thickness of predominantly shale beds in which sandstones are variable in character, major coal seams are used for all but two group boundaries. Although two sandstones are used as group boundaries, they may be poorly developed locally and at some localities must be recognized by their relation to known coals or by their position in the sequence of beds.

Each group shows considerable range in total thickness. Isopach maps (pls. 9 and 10) showing these variations are presented for each of the groups, except the Vowell Mountain and Cross Mountain groups, which are restricted to relatively small areas of preservation.

There are many striking facies changes in the Pennsylvanian of Tennessee, most prominent of which are the lateral changes from massive sandstones to insignificant sandstones and shale (pls. 11 and 12). Even the most widespread sandstones of the lower, sandy part of the section undergo such changes, especially along the Western Escarpment (pl. 1). Less prominent sandstones higher in the section are commonly preserved as narrow fingers or broader belts of sandstone with equivalent lateral belts of shale (pl. 11). In nearly all cases such changes are abrupt.

LITHOLOGY OF PENNSYLVANIAN SEDIMENTS

Pennsylvanian rocks in Tennessee consist almost entirely of water-laid clastics of various kinds. The most common types of sediments are sandstones and shales, but there are also coals, siltstones, and thin limestone and siderite beds of local extent.

Sandstones of the Pennsylvanian range from conglomerates containing rounded quartz pebbles as much as 2 inches long to very fine grained, impure sandstones. In general, however, most Pennsylvanian sandstones may be classified in one of two categories: a massive, coarse-grained type and a less massive, fine-grained type. The coarser type of sandstone is usually very high in silica, well sorted, crossbedded, and frequently conglomeratic. The finer grained, less massive type is not so well sorted, contains a larger proportion of disseminated silt- to clay-sized particles, and contains intercalated shale partings.

The siltstones of the Pennsylvanian are of gradational lithology, from the silty or sandy shales to the fine-grained, shaly sandstones. They consist largely of silica, as do the sandstones, but in particles of silt size. They are not so well bedded, nor laminated, as the shales.

Shale is the most abundant rock type of the Pennsylvanian. There are two easily distinguishable types of Pennsylvanian shale, the silty or sandy shale and the clay shale. Silty shales are much more common. They are generally gray or brownish in color, contain considerable quantities of silt- or sand-sized particles, and are nonfissile though very finely and irregularly laminated. Clay shales are of two types, the white to light-gray, massive, relatively structureless clays usually associated with coal beds, particularly as underclays, and the dark-gray to black, fissile, finely laminated type of shale that is sometimes associated with intercalated limestone or sideritic beds. The limestone or siderite beds are very thin, usually measured in inches, and are of very limited lateral extent.

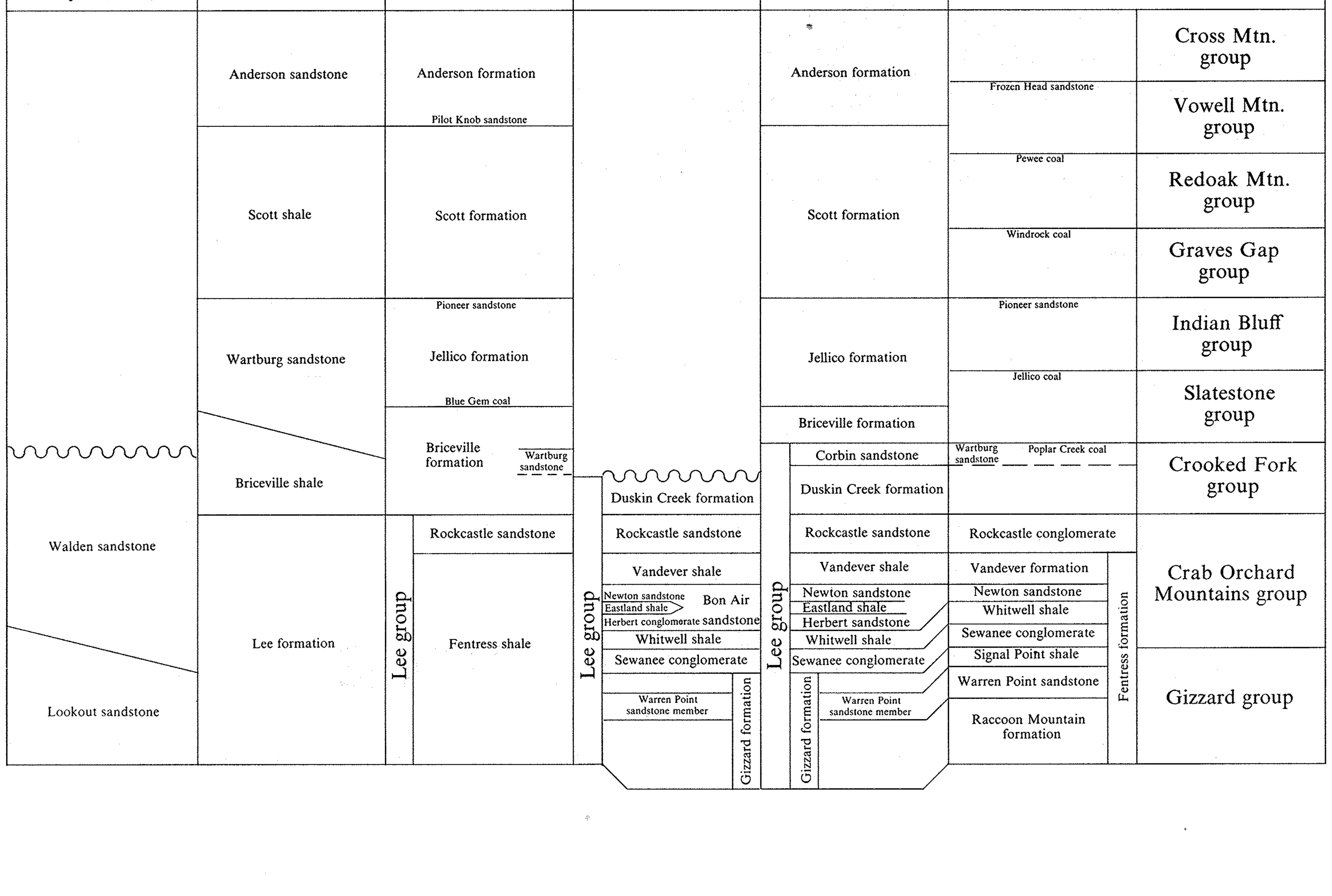
In general, the various types of rocks are distributed throughout the geologic column, but some types are more common in one part of the section than in others. The massive, quartzose sandstones and conglomerates are largely concentrated in the lower part of the section, particularly in the lower three groups. Conversely, the upper groups contain much higher percentages of shale and siltstone, with the sandstones tending to be thin, fine-grained, slabby, and poorly sorted. The upper groups also contain more coals.

DEFINITION OF GROUPS

The classification of Pennsylvanian strata into new groups is presented below, in order from youngest to oldest. Their areal distribution is shown on the geologic maps, plates 5-8, and sections are graphically presented on plates 2-4.

The Pennsylvanian strata are subdivided into nine groups, bounded by the most prominent easily traced or easily recognized units. Cross Mountain is the type locality for the six upper, shaly groups. Because all these upper, shaly groups have a single type locality, possible confusion arising from separated type localities is thus avoided. The type sections of the lower, sandy groups are scattered, but the group boundaries have been mapped together in detail.

For convenience of those who may be working in the upper, shaly beds far from the Cross Mountain type area, three other sections have been chosen for reference (pls. 2 and 3). These occupy similar positions in the regional depositional pattern. Correlation between them is shown on plate 3-E.



The lithologic sequences of all the group type sections are combined in a single generalized stratigraphic column for the Pennsylvanian system in Tennessee (pl. 4).

Pennsylvanian system

Pottsville series

Cross Mountain group, plate 2-B, named and defined on the section between The Wye and Cross Mountain, Lake City quadrangle, Anderson County, and including all strata between the top of the Frozen Head sandstone, elevation 2,980 feet, and the youngest bed on the top of Cross Mountain, elevation 3,534 feet—the youngest Pennsylvanian in Tennessee. Thickness at type section 554 feet.

Vowell Mountain group, plate 2-B, named and defined on the same section, and including all strata between the top of the Pewee coal, elevation 2,610 feet, and the top of the Frozen Head sandstone, elevation 2,980 feet. Thickness about 370 feet.

Redoak Mountain group, plate 2-B, defined on the same section and named from the mountain between Graves Gap and Cross Mountain, and including all strata between the top of the Windrock coal, elevation 2,265 feet, and the top of the Pewee coal, elevation 2,610 feet. Thickness about 345 feet.

Graves Gap group, plate 2-B, defined on the same section and named from Graves Gap crossed by State Highway 116 at the south end of Redoak Mountain, and including all strata between the top of the Pioneer sandstone, elevation 1,900 feet, and the top of the Windrock coal, elevation 2,265 feet. Thickness about 365 feet.

Indian Bluff group, plate 2-B, defined on the same section and named from Indian Bluff on the eastern edge of Braden Flats, only a short distance northeast of Graves Gap, and including all strata between the top of the Jellico coal, elevation 1,445 feet, and the top of the Pioneer sandstone, elevation 1,900 feet. Thickness about 455 feet.

Slatestone group, plate 2-B, defined on the same section and named from the town of Slatestone, 1 mile west-northwest of Briceville, and including all strata between the top of the Poplar Creek coal, elevation 870 feet at The Wye, and the top of the Jellico coal, elevation 1,445 feet. Thickness about 635 feet.

Crooked Fork group, plate 2-B, defined and named from the Crooked Fork section from Wartburg southeastward to Crooked Fork, Camp Austin quadrangle, and including all strata between the top of the Rockcastle conglomerate, exposed downstream from the bridge at elevation of 1,030 feet, and the top of the Poplar Creek coal, exposed at elevation of 1,390 feet two blocks north of the courthouse in Wartburg, Morgan County. Thickness about 360 feet.

Crab Orchard Mountains group, plate 3-C, named from Crab Orchard Mountains, Cumberland County, being exposed along U. S. Highway 70-N. and the tracks of the Tennessee Central Railway Company on the eastern and western flanks of the Sequatchie Valley anticline, Dorton and Ozone quadrangles, and including all strata between the base of the Sewanee conglomerate and the top of the Rockcastle conglomerate. Thickness about 640 feet.

Gizzard group, plate 3-D, named and defined from the gorge of Big Fiery Gizzard Creek (Gizzard Cove), Grundy County, nearly 2 miles south of Tracy City, on the White City quadrangle. The group includes all strata between the base of the Pennsylvanian, elevation 1,525 feet, and the base of the Sewanee conglomerate, elevation 1,755 feet. Pennsylvanian beds in other parts of Tennessee that are older than the bed exposed at elevation of 1,525 feet in this particular section, are also classed in the Gizzard group, even though not represented in the type section. In other words, this group includes all strata in Tennessee above the top of the Mississippian system (Pennington formation) and below the base of the Sewanee conglomerate. Safford first used the name, Gizzard, for a stratigraphic unit when, in 1869 (p. 370), he referred to the "Gizzard Portion" of the "Lower Measures." Thickness at type section about 225 feet.

DETAILED STRATIGRAPHY

Gizzard Group

The Gizzard group includes all strata between the top of the Mississippian and the base of the Sewanee conglomerate. The type section is in the gorge of Big Fiery Gizzard Creek (Gizzard Cove), about 2 miles south of Tracy City, Grundy County (pl. 3-D). The geographic names used here are those used on the White City quadrangle, rather than "Little Fiery Gizzard" of Safford. At this locality the Gizzard group is 224 feet thick.

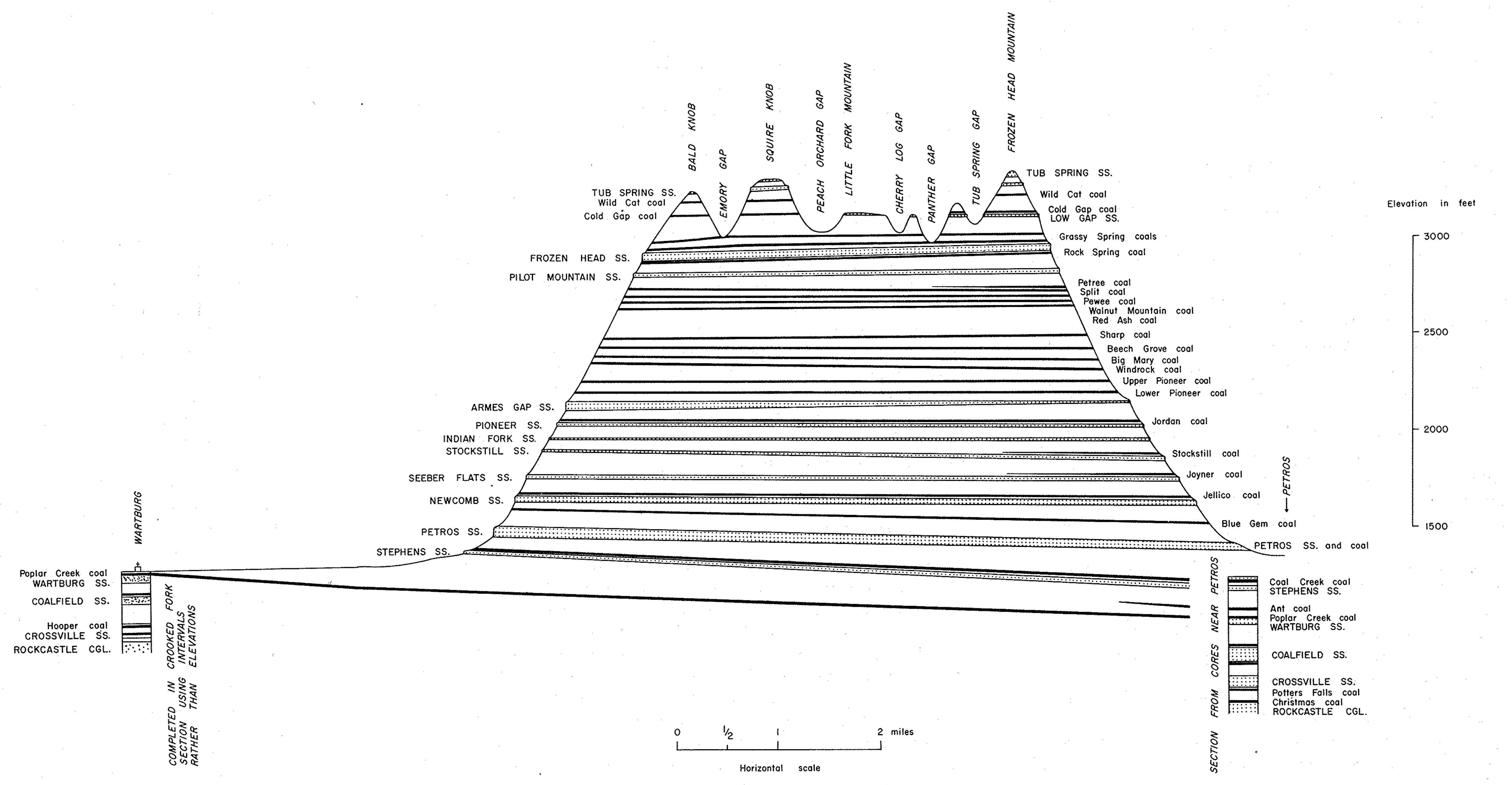
The group has a total range in thickness from 0 to more than 700 feet. In general, the Gizzard group is thickest along the southeastern border of the Cumberland Plateau, along Walden Ridge. This group has a complex thickness pattern that has a marked northwest "grain." An isopach map of the Gizzard group is shown on plate 10-B.

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 wide distribution 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.

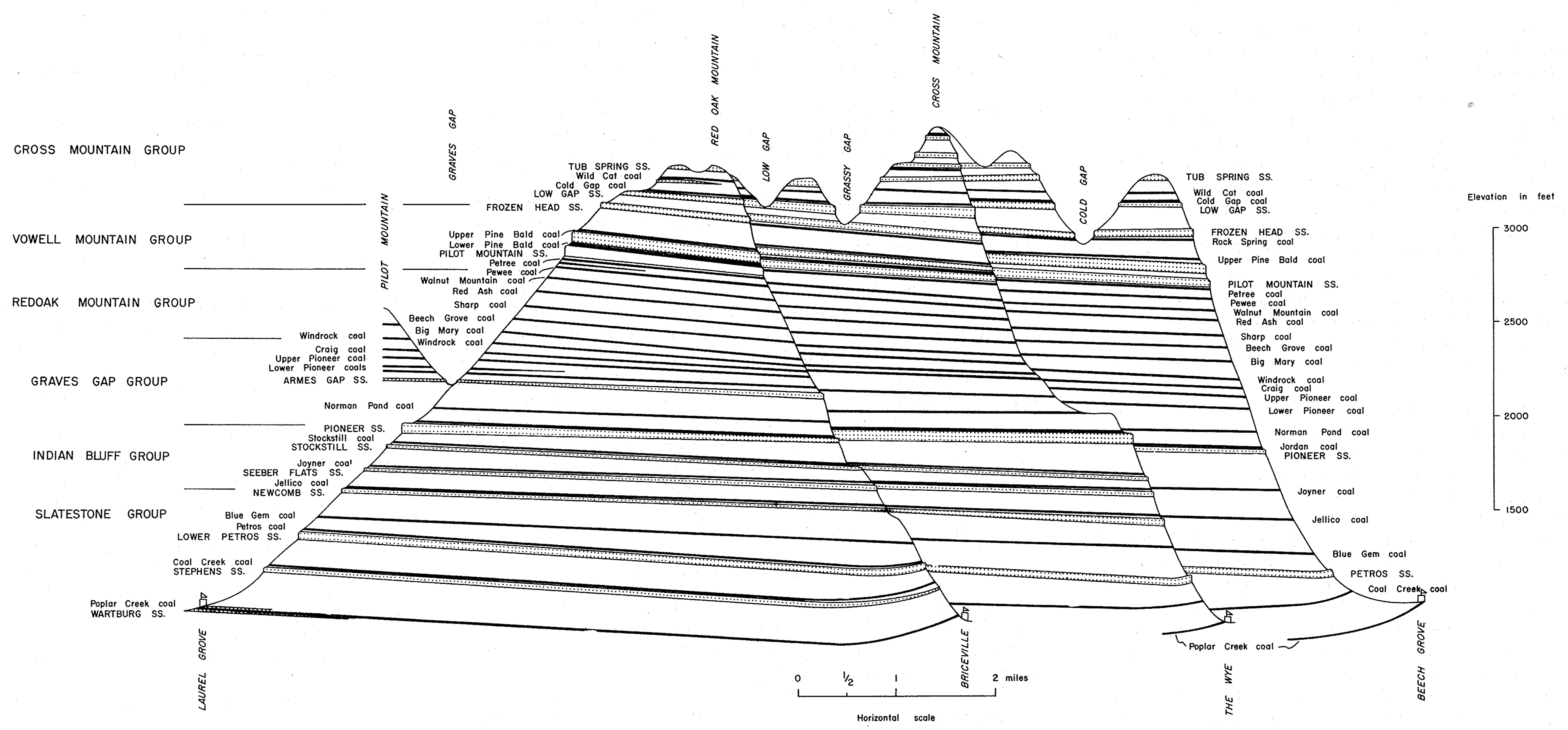
Raccoon Mountain Formation.—The Raccoon Mountain formation consists of an alternation of shales and sandstones with several coals, and includes all beds from the base of the Warren Point sandstone to the base of the Pennsylvanian. The type section of this formation is on a mine road beginning 0.4 mile northwest of Whiteside, Marion County, and leading to strip mines at the head of Scratch Ankle Hollow, Shellmound quadrangle. Here, the thickness of the formation is 353 feet. The Pennsylvanian base is recognized by lithologic contrast between Mississippian limestone and variegated (red, maroon, and green) shale and Pennsylvanian coals and plant-bearing shales. Locally, on the east side of the Cumberland Plateau this contact is difficult to establish, but only a few feet of beds are questionable.

The greatest development of the Raccoon Mountain formation is in the vicinity of its type locality. Elsewhere, its thickness varies, and it is locally absent. This formation is generally thick to the east and thin to the west.

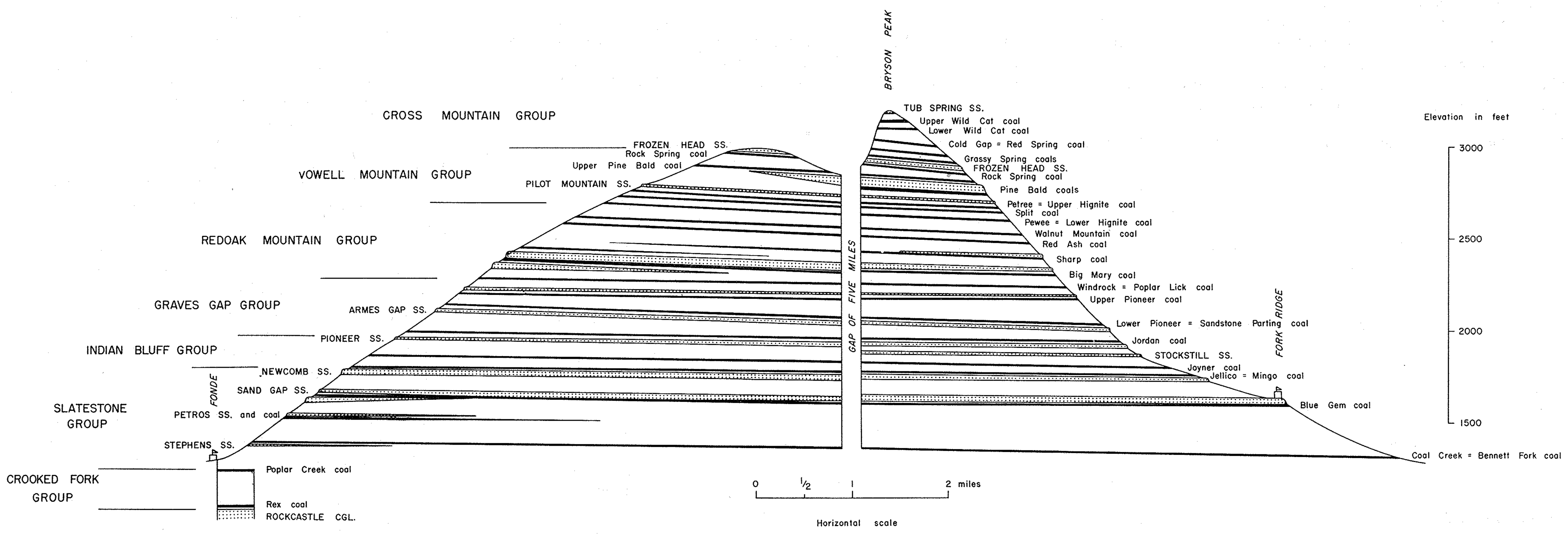
In the areas on the east side of the Plateau where the Raccoon Mountain formation is thick, it commonly contains several mineable



A—FROZEN HEAD MOUNTAIN REFERENCE SECTION

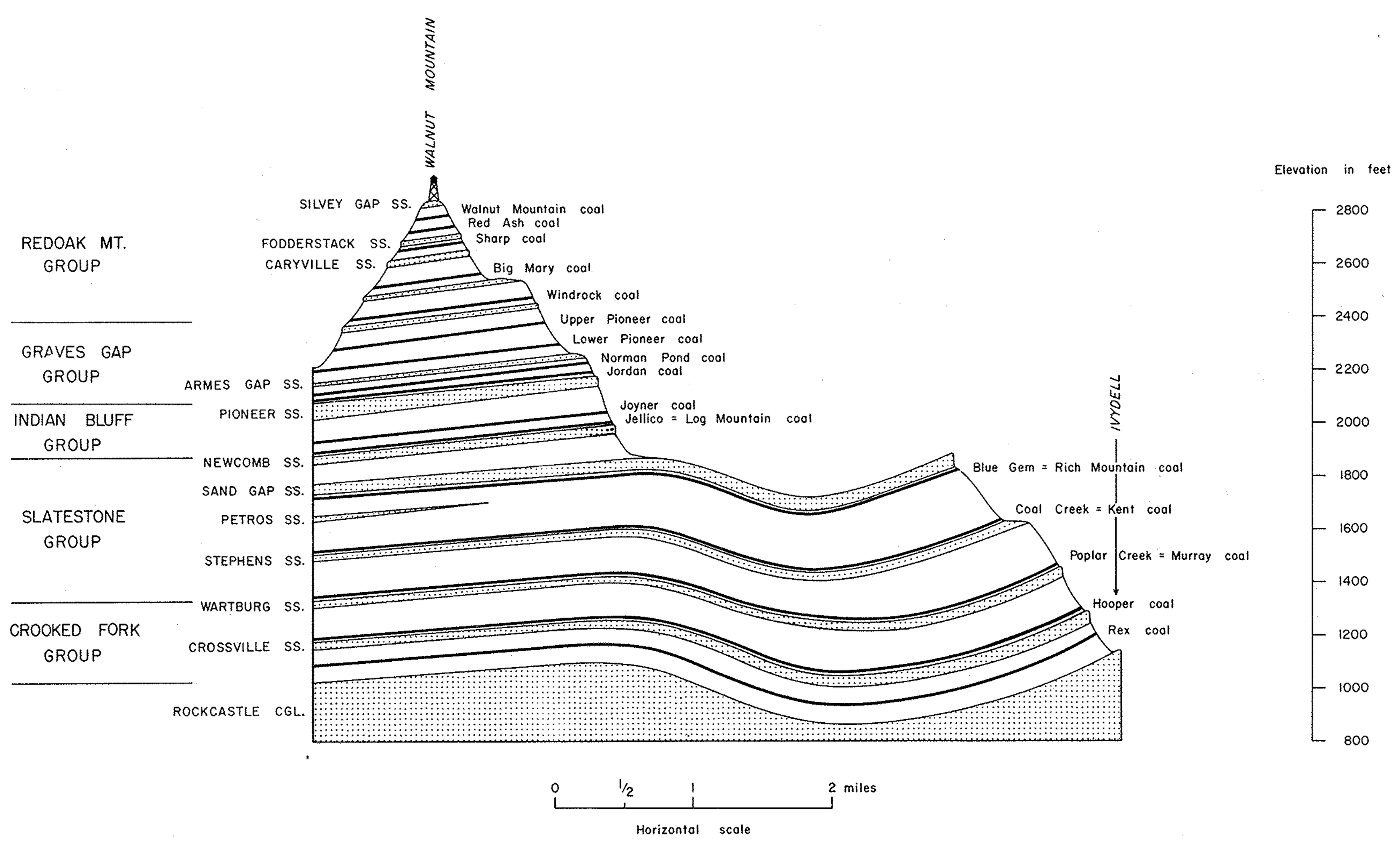


B—CROSS MOUNTAIN TYPE SECTION

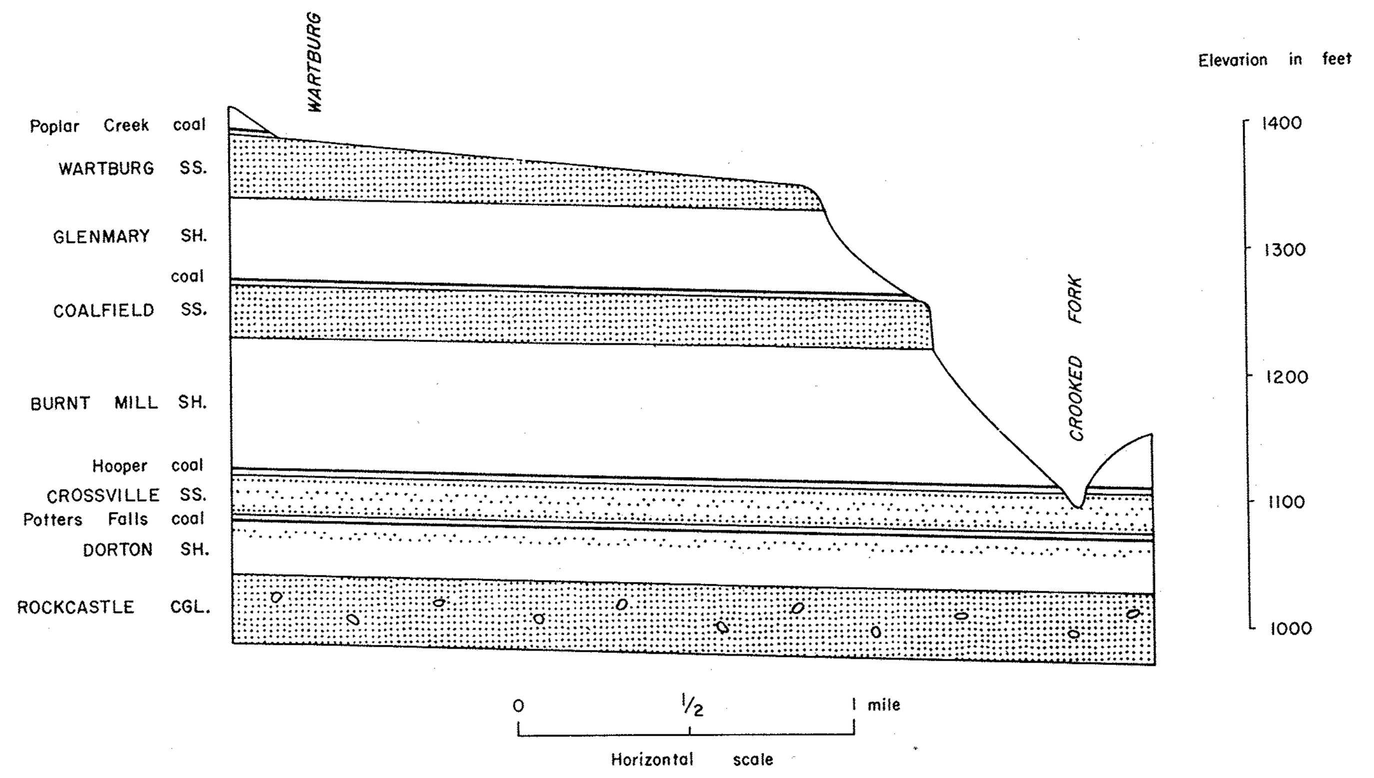


C—BRYSON PEAK REFERENCE SECTION

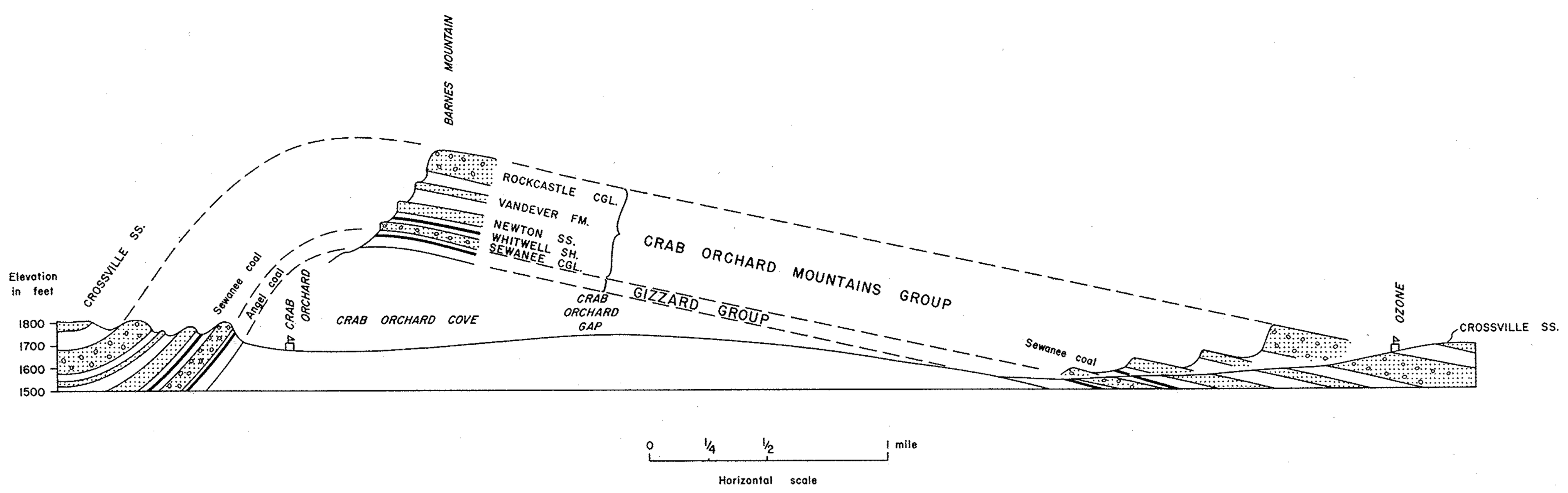
PLATE 2—REFERENCE STRATIGRAPHIC SECTIONS



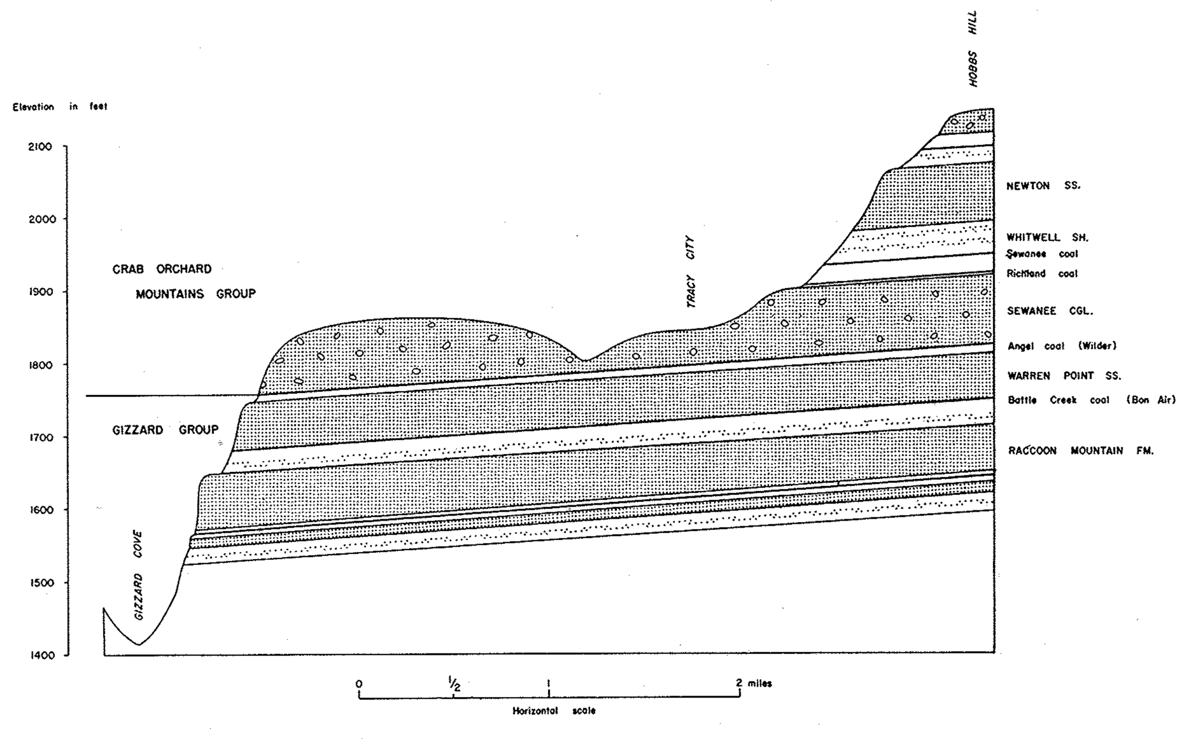
A—WALNUT MOUNTAIN REFERENCE SECTION



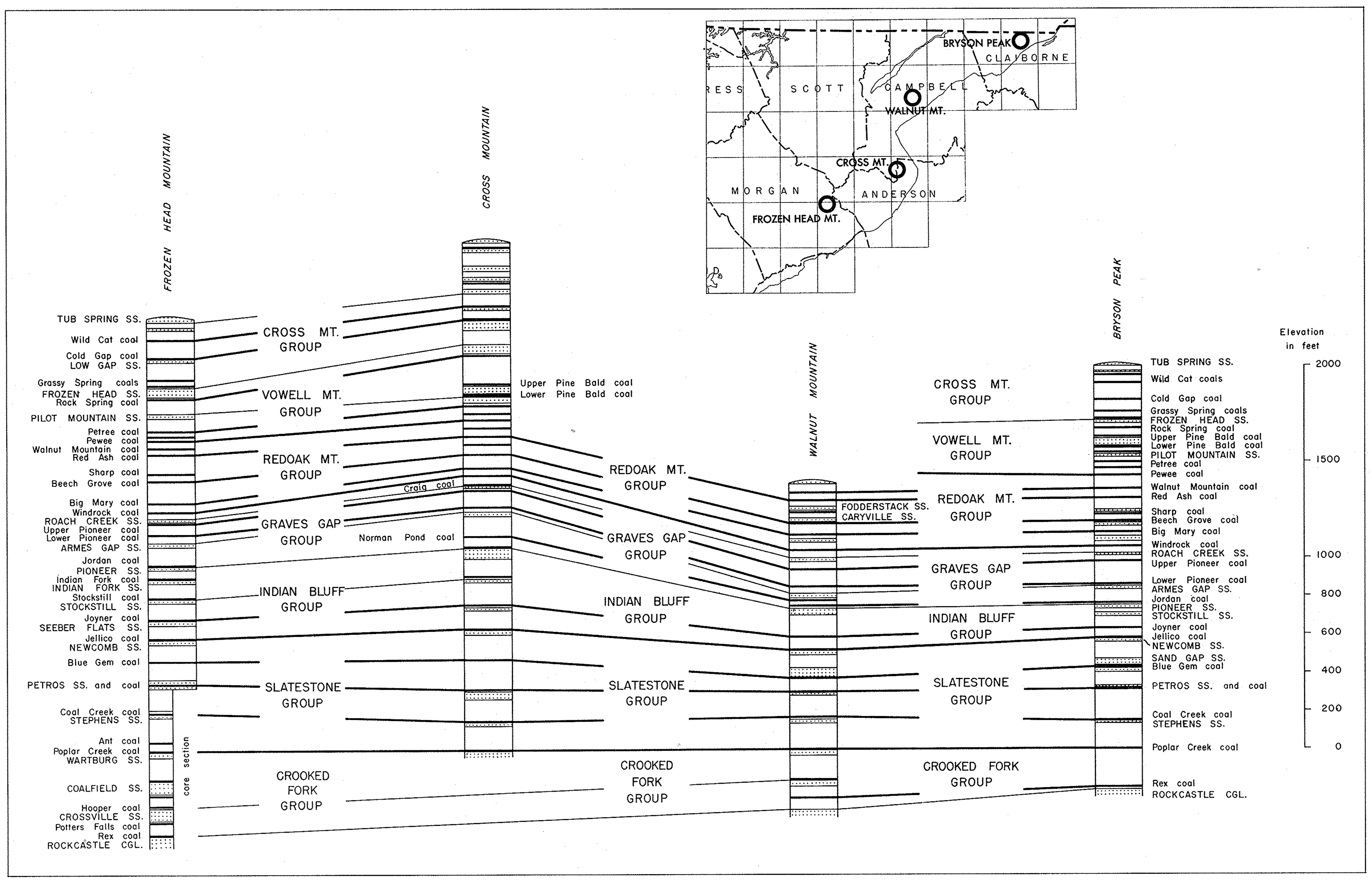
B—TYPE SECTION OF THE CROOKED FORK GROUP



C—TYPE SECTION OF THE CRAB ORCHARD MOUNTAINS GROUP



D—TYPE SECTION OF THE GIZZARD GROUP



E—CORRELATION OF THE CROSS MOUNTAIN TYPE SECTION WITH THE REFERENCE SECTIONS

PLATE 3—REFERENCE STRATIGRAPHIC SECTIONS

coals. The thick depositional basin around Whiteside, Marion County, contains in ascending order, the Mill Creek, Red Ash, Rattlesnake, Dade, and Etna coals. Another basin of thick deposition is in the Sale Creek mining area, northeast of Chattanooga, where this formation contains the Sale Creek, Goodrich, and Nelson coals. On the west side of the Cumberland Plateau this formation is commonly thin, and no commercial coals are known, except along White Oak Creek in Fentress County, east of Jamestown. Here, a considerable thickness is preserved, and the White Oak coal is mined. Near Bon Air, White County, the Bon Air coal has long been mined. The Orme, or Battle Creek, coal, which correlates with the Etna, Nelson, and lower Bon Air coals, has been mined in southwestern Marion County.

The individual sandstones and shales of the Raccoon Mountain formation have not been mapped separately, and these units do not have sufficient continuity to warrant naming them at the present time. In the northwestern part of the Plateau the sandstones of the Raccoon Mountain formation are absent, except for a few local occurrences, and shale occupies the interval between the Warren Point sandstone and the top of the Mississippian.

In the northwest part of the Plateau (pl. 12-D), the Warren Point sandstone thins, and the Raccoon Mountain formation, which cannot be differentiated, is included in the lower part of the Fentress formation. Glenn (1925) used the name, Fentress shale, to include all strata of Pennsylvanian age beneath the Rockcastle conglomerate in Fentress County and vicinity, where these beds are primarily shale and where the Sewanee conglomerate is too thin to be mapped. The name is here changed to Fentress formation because of the local occurrences of sandstone. The definition, however, remains the same.

Warren Point Sandstone.—The Warren Point sandstone, the middle unit of the Gizzard group, has its type section at Warren Point in Grundy County just north of Monteagle, where it is 65 feet thick. This sandstone is well developed over much of the Plateau (pl. 12-D) and serves to divide the Gizzard group into its three formations. Because it forms prominent escarpments along the edge of the Southern Plateau, Safford (1869) referred to it as the Cliff sandstone.

The Warren Point sandstone ranges in thickness from 0 to more than 200 feet and attains its maximum thickness in the vicinity of Signal and Lookout Mountains near Chattanooga, where it is very conglomeratic. However, the Warren Point of this area may be a composite sandstone, with the true Warren Point sandstone resting unconformably on one or more sandstones of the Raccoon Mountain formation. From Chattanooga northeastward to the Sale Creek-Soddy mining district, the Warren Point thins gradually and splits into several nonconglomeratic sandstones. This change and the presence of a number of sandstones in the underlying Raccoon Mountain formation make identification of the Warren Point sandstone difficult in this area. Farther northeast, in the Roddy quadrangle, however, it is again a single, massive, conglomeratic sandstone. Beyond this area, along Walden Ridge, it is easily traceable as far north as Rockwood. Structural disturbances have made reconnaissance identification impossible north of Rockwood, where the lower Pennsylvanian beds have been turned up vertically along the Eastern Escarpment, and the outcrop belts of the various units are therefore so narrowed that reconnaissance mapping does not suffice to separate them.

Along the Western Escarpment the Warren Point sandstone is generally less than 100 feet thick. In the vicinity of its type section at Warren Point this unit is commonly fine-grained, but in some localities it is coarser and contains scattered quartz pebbles. North of Monteagle the overlying Signal Point shale is commonly absent, and the Sewanee conglomerate lies unconformably upon the Warren Point. Near Spencer, Mt. Cardwell S. E. quadrangle, Van Buren County, the Warren Point sandstone is nearly 100 feet thick and is very conglomeratic. In the Fall Creek Falls area, Sampson quadrangle, Van Buren County, the Warren Point sandstone is the lower part of the 260-foot conglomerate that forms the rim of the gorge. North of Fall Creek Falls it is usually separated from the overlying Sewanee conglomerate by the Signal Point shale. The Warren Point maintains a thickness of approximately 70 feet and remains conglomeratic as far north as the Clifty area in White County. At Pilot Falls, near Clifty, the Warren Point sandstone has previously been mistaken for the Sewanee conglomerate because it is extremely conglomeratic. West of Pilot Falls the sandstone is thin and is not conglomeratic. On U. S. Highway 70-S. west of Bon Air the Warren Point is represented by two thin sandstones with an aggregate thickness of less than 5 feet. These sandstones contain marine fossils.

North of Bon Air the Warren Point sandstone again thickens and becomes conglomeratic, though not so thick as to the south. From Bon Air to Monterey, Putnam County, it averages about 40 feet in thickness, with local conglomeratic lenses, and is a mappable unit. North of Monterey along the Western Escarpment, however, it thins and forms a part of the Fentress formation.

Signal Point Shale.—The top unit of the Gizzard group is the Signal Point shale, which has its type locality on State Highway 8 east of Signal Point and just south of the town of Signal Mountain, Chattanooga quadrangle, Hamilton County. The Signal Point shale is bounded below by the top of the Warren Point sandstone and above by the base of the Sewanee conglomerate. At its type section it is 52 feet thick. To the west it thins steadily, until it is only 10 feet thick at the type section for the Gizzard group. Along the eastern edge of Walden Ridge this shale generally averages about 60 feet thick. Along the Western Escarpment it is commonly very thin, often being completely truncated by the overlying Sewanee conglomerate, as at Fall Creek Falls and in the Burrow Cove quadrangle.

This relatively thin shale is important because it contains several widely mined coals. The Angel coal of Bledsoe and Cumberland Counties, the Ravenscroft coal of the Bon Air area, and the Wilder coal of the region around Monterey, Wilder, and Jamestown all occur at the same stratigraphic position in this unit, just beneath the base of the Sewanee conglomerate in the upper part of the Signal Point shale. This coal is locally truncated by the Sewanee conglomerate. The Lower Wilder coal of Fentress and Cumberland Counties occurs near the base of this unit, just above the Warren Point sandstone. This seam has been mined along South Fork in Scott County.

North of Monterey the Signal Point shale is locally not separable from the units above and below, where the Warren Point and Sewanee sandstones, which form its top and bottom elsewhere, are thin or absent. Here, it forms part of the Fentress formation.

Crab Orchard Mountains Group

The Crab Orchard Mountains group includes all strata from the top of the Gizzard group to the top of the Rockcastle conglomerate. This group has a composite type section, along U. S. Highway 70-N. and the tracks of the Tennessee Central Railway Company where they cut across the Crab Orchard Mountains of Cumberland County. Here, good exposures of the group, as typically developed, are to be seen where the beds dip off both flanks of the Sequatchie Valley anticline (pl. 3-C).

At its type section the Crab Orchard Mountains group is approximately 640 feet thick. The group as a whole ranges in thickness, however, from 300 feet in the vicinity of Jamestown to more than 900 feet along the eastern edge of Walden Ridge. The thickness pattern of the Crab Orchard Mountains group is relatively simple, wedging from thick on the east to thin on the west (pl. 10-A). This decrease in thickness is accompanied in part by westward thinning of sandstones.

This group consists of five formations: the Sewanee conglomerate, Whitwell shale, Newton sandstone, Vandever formation, and Rockcastle conglomerate.

Sewanee Conglomerate.—The basal unit of the Crab Orchard Mountains group is the Sewanee conglomerate, which has its type section and typical development in the area around the town of Sewanee in Franklin County. The Sewanee conglomerate is one of the most consistent units on the Cumberland Plateau, except in the northwest part (pl. 12-C), where it merges into the Fentress formation. With the exception of the areas discussed below the Sewanee is consistent in thickness and lithology.

The Sewanee conglomerate is a medium- to coarse-grained, crossbedded, massive, extremely conglomeratic sandstone in most areas, although locally it has few or no quartz pebbles. In thickness it ranges from 0 to more than 160 feet, averaging about 80 feet. The Sewanee attains its maximum thickness in two localities: on the eastern edge of Walden Ridge near Graysville, Hamilton County, and on the western side of Sequatchie Valley near Pikeville, Bledsoe County. In the vicinity of Soddy, Hamilton County, it has no quartz pebbles. Around Clifty, White County, it has locally thinned to 40 feet and is not conglomeratic. West of Clifty, the Sewanee conglomerate thickens rapidly, becomes conglomeratic, and maintains its thickness and characteristic lithology northward to Bon Air. The sandstone that has been called "Bon Air" at Bon Air, White County, is equivalent to the Sewanee conglomerate. Because the name Sewanee has priority, the name, Bon Air, is discontinued. In the northwestern part of the Plateau the Sewanee thins abruptly and is represented by a relatively thin sandstone or sandy shale, or it is locally absent.

Whitwell Shale.—The Whitwell shale was named from exposures west of Whitwell, Marion County. Recognition of this shale is useful in coal prospecting, because it contains the Sewanee coal, the most widely mined coal in the Crab Orchard Mountains group.

It ranges in thickness from 60 to more than 200 feet, being 75 to 100 feet at its type area. A general thickness of about 100 feet is maintained over most of the southeastern part of the Cumberland Plateau. To the northeast along Walden Ridge the Whitwell shale thickens, being more than 200 feet thick near Soddy, Hamilton County. To the west, near Clifty, White County, it is 140 feet thick. West of Clifty, however, the Whitwell shale thins to 60 feet. In the northwestern part of the Cumberland Plateau the Whitwell shale forms part of the Fentress formation.

In many localities, notably in the Southern Plateau, the Whitwell shale contains a sandstone just beneath the Main Sewanee coal. This sandstone is commonly about 30 feet thick and in the vicinity of Tracy City, Grundy County, is locally conglomeratic. On that part of Walden Ridge just west of Suck Creek, Ketner Gap quadrangle, Marion County, almost the whole of the Whitwell shale interval has been replaced by sandstone, leaving only a few feet of coal-bearing shale.

The Whitwell shale commonly contains two or more commercial coals. These are the Sewanee coals, named from mines near Sewanee, Franklin County. In the area around Richland Creek, Rhea County, the lower coal is called Richland, or Lower Sewanee, and the upper, the Main Sewanee. Both of these coals have been widely mined in the Southern Plateau. The lower of the two coals is also called the Coke Oven seam. In the Aetna Mountain area there are three coals in the Whitwell shale: Kelley, Slate, and Oak Hill. The Kelley coal probably correlates with the Richland, or Lower Sewanee, coal, and the Oak Hill coal probably is equivalent to the Upper, or Main Sewanee, coal. In the area just west of Soddy, Hamilton County, there are four coals in the Whitwell, numbered 7, 8, 9, and 10. Of these, Nos. 7, 9, and 10 are thick enough to be mined. In the Eastland-Clifty area of White and Cumberland Counties there are two coals in the Whitwell shale which are locally known as the Clifty coals. North of Bon Air and Crossville there has been very little coal produced from the Whitwell shale. A thin seam prospected in the Clarkrange quadrangle occupies the same stratigraphic position as the Sewanee coal.

The Whitwell grades conformably downward into the Sewanee conglomerate, but in several areas the upper part of the shale is irregularly eroded at the base of the overlying Newton sandstone. In the mines north of Coalmont, Grundy County, the upper, or Main Sewanee, coal is completely truncated by this sandstone. Near Brockdell, Bledsoe County, the Whitwell is absent.

Newton Sandstone.—The Newton sandstone has its type area in the vicinity of Newton, Cumberland County, where it is 110 feet thick. This thickness is the maximum, as it ranges from 0 to 110 feet. In its type area, the Newton sandstone is massive, medium-grained, crossbedded, and locally conglomeratic. Over most of its outcrop area this sandstone is not conglomeratic, but is a fine- to medium-grained, massive, friable sandstone. The conglomeratic phase is localized chiefly in the southern part of Cumberland County and northern Bledsoe County. Locally, there is a marked unconformity at the base of the Newton, but ordinarily this unconformity is not prominent.

The Newton sandstone thins abruptly along a northeast-southwest line (pl. 12-B). Southeast of this line it is a mappable unit, as described above, but to the northwest it is too thin to map.

The conglomeratic phase of the Newton sandstone in southern Cumberland and northern Bledsoe Counties was the type "Herbert conglomerate," erroneously considered by Nelson (1925) to be older than the Newton. The shale thought to be between the sandstones and named "Eastland shale" by Nelson is actually the Whitwell shale. The names "Herbert" and "Eastland," therefore, are here discarded. Nelson (1925) also erroneously considered that the "Bon Air sandstone" (actually the Sewanee conglomerate) represented a combination of the "Herbert" and Newton sandstones, with the "Eastland shale" missing.

Vandever Formation.—The Vandever formation was named from exposures in the vicinity of Vandever, Cumberland County (Nelson, 1925). Here, the Vandever formation, exposed along the axis of an anticline, is about 250 feet thick. This formation was originally named the Vandever shale, but the presence of large amounts of sandstone in this unit along the eastern edge of Walden Ridge make the term formation more applicable.

The total thickness of the Vandever formation ranges from less than 100 to more than 400 feet. Where it is thinnest in the western part of its outcrop belt it is primarily shale, but as it thickens to the east the ratio of sandstone to shale increases. Over most of Walden Ridge the Vandever formation consists of three units: a lower shaly portion, a prominent middle sandstone or conglomerate, and an upper shaly portion. The sandstone member is particularly well developed on the southern part of Walden Ridge in Hamilton County, where it is 100 feet thick and very conglomeratic. It forms the broad flats around Fairmount, Hamilton County, and caps Hobbs Hill, north of Tracy City, Grundy County. Northward and westward the sandstone thins and becomes nonconglomeratic. Even where it forms part of the Fentress formation the tripartite character of the Vandever formation is locally apparent, the middle sandstone member persisting as a thin, usually flaggy sandstone near the top of the Fentress.

There are two important coal horizons in the Vandever formation, the Lantana coal overlying the Newton sandstone near the base of the lower shale unit, and the Morgan Springs coal near the top of the upper shale unit, just beneath the Rockcastle conglomerate. The Lantana coal has been mined chiefly in the vicinity of Lantana, Cumberland County; along the flanks of the Crab Orchard Mountains, Cumberland County; in the Smartt Mountain quadrangle, Van Buren and Bledsoe Counties; and in the vicinity of Soddy, Hamilton County, where it is known as the No. 12 coal. The Morgan Springs coal was named from Morgan Springs, Rhea County. It is a very pockety coal, being locally truncated by the overlying Rockcastle conglomerate. In the Isoline quadrangle, Cumberland County, where it has also been mined, it is called the Isoline coal.

Fentress Formation.—The Fentress formation is widely exposed in Fentress and adjacent counties. Glenn (1925) originally named it the Fentress shale and defined it to include all beds below the Rockcastle conglomerate and above the top of the Mississippian. Glenn's definition is accepted here, but the name is changed to Fentress formation because of the local presence of sandstone members. The Fentress formation includes beds equivalent to parts of two groups: the entire Gizzard group and all of the Crab Orchard Mountains group below the Rockcastle conglomerate. Hence, the Fentress formation is equivalent to the Raccoon Mountain formation, Warren Point sandstone, Signal Point shale, Sewanee conglomerate, Whitwell shale, Newton sandstone, and Vandever formation. In localized areas some of the constituent formations are recognizable. The name, Fentress formation, is used only where the Sewanee conglomerate is not mappable.

Rockcastle Conglomerate.—The Rockcastle conglomerate is the youngest unit of the Crab Orchard Mountains group. The type section of the Rockcastle, as used in this report, is Rockcastle Cove, near Jamestown, Fentress County. In this the writers follow the usage of Wanless (1946). This unit was formerly called the Rockcastle sandstone, but the name, conglomerate, is more appropriate, because it almost invariably contains a few quartz pebbles and is commonly very conglomeratic. At its type area the Rockcastle conglomerate is 160 feet thick.

The thickness of the Rockcastle ranges from 100 to more than 300 feet. In general, the conglomerate is thickest along the Eastern Escarpment. To the south the Rockcastle progressively thins because of removal of the uppermost beds by erosion, the entire formation having been removed south of Sale Creek, Hamilton County, on Walden Ridge, and south of Palmer, Grundy County, on the Southern Plateau.

Along the northeastern edge of the Plateau (pl. 12-A) the Rockcastle conglomerate commonly has several shale splits. Along Piney River in the Spring City area, Rhea County, the massive, conglomeratic sandstone splits eastward to form a sequence of thin sandstones and shales. In the vicinity of Oakdale and Harriman, the Rockcastle conglomerate is similarly represented by an alternation of sandstones, shales, and siltstones.

With the exception of the areas cited above, the Rockcastle conglomerate is uniform in character. It commonly contains a persistent shale split in the upper part or near the middle which in the Spring City area contains the Bumbee coal. This coal probably correlates with the Nemo coal, mined at Nemo, southwest of Wartburg, Morgan County.

Crooked Fork Group

The Crooked Fork group, which includes all strata between the top of the Rockcastle conglomerate and the top of the Poplar Creek coal, is named from the section exposed southeastward from Wartburg and along Crooked Fork, Morgan County (pl. 3-B). The thickness of the group here is 360 feet. This is the uppermost group characterized by prominent sandstones. Its area of preservation is restricted to the Northern Cumberland Plateau, with the exception of a few small outliers.

The group ordinarily ranges from 300 to 400 feet in thickness (pl. 9-E). Along the abandoned Oneida and Western Railroad southwest of Oneida, where it descends into Pine Creek, the thickness is about 250 feet, and in the Barthell S. W. quadrangle the group is locally thinner than this. On the Cumberland Block (pl. 1) its known thickness ranges from 150 to 330 feet.

The group generally consists of an alternating sequence of three sandstones and three shales. Northwest of the type area, however, the upper and lower sandstones converge, so that in the northern part of the Barthell S. W. quadrangle the group is essentially a thick conglomerate overlying the Rockcastle.

Individual units from oldest to youngest are: Dorton shale, Crossville sandstone, Burnt Mill shale, Coalfield sandstone, Glenmary shale, Wartburg sandstone, and the immediately overlying Poplar Creek coal. This coal is used as a boundary, because it is widely mined and prospected and can be traced where the Wartburg sandstone is thin or absent.

Dorton Shale.—The Dorton shale, named from exposures near Dorton, Dorton quadrangle, Cumberland County, is the shale between the top of the Rockcastle conglomerate and the base of the Crossville sandstone. Its usual thickness is from 50 to 80 feet, but at the type locality it is only approximately 35 feet, and in the Crooked Fork section it is 42 feet. A minimum of 10 to 20 feet of shale occurs along the abandoned section of the Oneida and Western Railroad southwest of Oneida in the southeast corner of Barthell S. W. quadrangle, and at Jamestown. The maximum thickness of this unit (115 feet) occurs on Cumberland Block in the Walnut Mountain section, Ivydell quadrangle, Campbell County.

The name, Duskin Creek formation, was previously used for beds presumably overlying the Rockcastle, and including the Dorton shale of this report. The type section of the Duskin Creek, which is along this tributary of Piney River, however, consists of beds of the Vandever formation that actually underlie the Rockcastle. This error is believed to have been due to failure to identify the Rockcastle be-

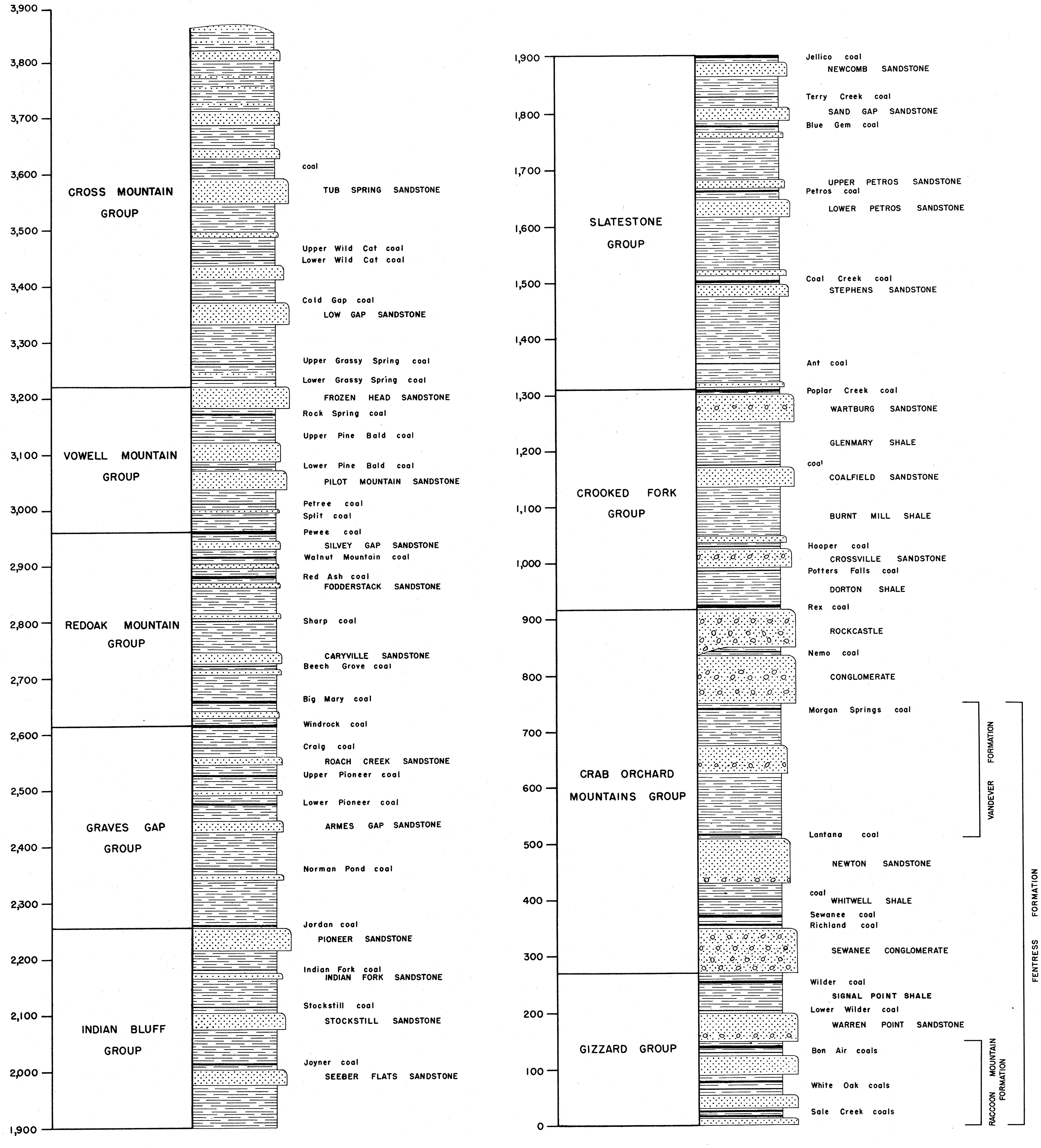


PLATE 4—COMPOSITE STRATIGRAPHIC SECTION

cause of its local shaly character. For this reason the name, Duskin Creek, is no longer used.

The Christmas coal occurs near the base of the Dorton shale, not far above the top of the Rockcastle conglomerate, in Morgan County. On Cumberland Block this is believed to correlate with the Rex coal, although locally the Rex is as much as 70 feet above the Rockcastle. The Christmas coal has been mined in the Wartburg-Harriman-Coalfield area of Morgan County, and the Rex coal in Campbell and Claiborne Counties. A thin coal occurs near the top of the Dorton shale in the Crooked Fork section and in the vicinity of Coalfield, Petros quadrangle, Morgan County. It is here named the Potters Falls coal, from the waterfall of that name where the coal is exposed on Crooked Fork.

Crossville Sandstone.—This sandstone was named by Wanless (1946) from the stone extensively quarried between Crab Orchard and Crossville, Cumberland County. His reported thickness is about 40 feet, but this is not a complete thickness, as the top is not preserved here.

The distribution of massive and thin phases of the Crossville sandstone is presented on plate 11-K. East of a north-south line through Harriman, Wartburg, Sunbright, and Oneida it is usually less than 20 feet thick and may even be locally absent, whereas west of this line it thickens appreciably, ranging from 60 to 130 feet. North of New River, Oneida South quadrangle, it contains quartz pebbles.

In Morgan County, this unit varies from a single thin sandstone to a bipartite or tripartite sandstone. Only the lower bench is believed to represent the Crossville sandstone of the type area. In general, the upper benches thicken to the east and northeast of Crossville.

Burnt Mill Shale.—The Burnt Mill shale is named from exposures near Burnt Mill Bridge in the Robbins and Oneida South quadrangles, Scott County, and includes the beds between the top of the Crossville sandstone and the base of the Coalfield sandstone. The thickness of the shale usually ranges from 35 to 130 feet. In the northern part of Barthell S. W. quadrangle, however, the overlying Coalfield sandstone is missing, and the Burnt Mill and Glenmary shales form a single unit. This composite unit in turn is truncated by the overlying Wartburg sandstone, which locally rests on the Crossville sandstone.

The Hooper coal occurs near the base of the Burnt Mill shale, not far above the Crossville sandstone. This coal has been mined mostly in Morgan County, along Walden Ridge in the vicinity of Harriman, Oakdale, and Oliver Springs.

Coalfield Sandstone.—This sandstone underlies the town of Coalfield, Petros quadrangle, Morgan County. The section at the type locality is incomplete, but the range in thickness nearby is from 30 to 60 feet. In the Crooked Fork section it is 42 feet thick. It is best developed along the north flank of Whetstone Mountain, Petros quadrangle, in the area between Whetstone Branch, which flows westward, and Butler Creek, flowing eastward. The distribution of massive and thin phases of the Coalfield sandstone is presented on plate 11-J.

In Morgan County this sandstone locally splits into two or three benches. Along the abandoned Oneida and Western Railroad southwest of Oneida and in the southeast corner of Barthell S. W. quadrangle, the Coalfield sandstone has thinned to 10 or 15 feet, and in the northern part of the latter quadrangle it is not present.

Glenmary Shale.—The Glenmary shale is named from Glenmary, Robbins quadrangle, Scott County, and includes the beds between the top of the Coalfield sandstone and the base of the Wartburg sandstone. At its type locality it is 50 feet thick, and in the Crooked Fork section it is 64 feet. This shale is usually from 40 to 80 feet thick. In the southeast corner of Barthell S. W. quadrangle, however, it is only 20 feet, and it disappears entirely in the northern part of this quadrangle as the Wartburg sandstone overlaps it.

A thin coal occurs near the base of the Glenmary shale, just above the top of the Coalfield sandstone, at an elevation of 1,265 feet in the Crooked Fork section, and at other localities in Morgan County.

Wartburg Sandstone.—This sandstone was named by Keith (1896) from the flat on which Wartburg, Morgan County, is located. At this locality it is about 50 to 60 feet thick.

The distribution of massive and thin phases of this sandstone is presented in plate 11-I, which shows that east of a line between Petros and Oneida, it is thin and may even be locally absent. An exception to the above, however, is a small area near Lake City and Caryville, where it is thicker than 25 feet. West of the Petros-Oneida line it thickens appreciably, attaining a thickness of more than 100 feet. North of New River, Oneida South quadrangle, it contains quartz pebbles, and from here it has been traced northward into the Corbin conglomerate of Kentucky. The eastern limit of massive Wartburg sandstone may be locally very abrupt, as in the two valleys, head-water tributaries of Paintrock Creek, Oneida South quadrangle, just west of Almy, Huntsville N. W. quadrangle. Here, massive, conglomeratic Wartburg sandstone is replaced by a thin zone of shaly sandstone and sandy shale within a distance of a few hundred feet.

The Wartburg sandstone forms extensive flats in the Camp Austin, Gobey, Pilot Mountain, Robbins, Oneida South, Barthell S. E.; and Winfield quadrangles, marking the uppermost broad topographic bench encircling the Cumberland Mountains on the south, west, and northwest. This sandstone is approximately the horizon separating the Cumberland Plateau from the Cumberland Mountains. The Wartburg sandstone marks the top of the lower, sandy division of the Pennsylvanian rocks in Tennessee, within which the individually named formations are readily mappable by conventional field methods.

Poplar Creek Coal.—This coal, which was named from mines along Poplar Creek, Anderson County, commonly occurs within 5 feet of the top of the Wartburg sandstone. Locally, however, there is as much as 20 feet of shale below the coal. The Poplar Creek is the most widely mined coal in the Northern Cumberland Plateau, having been mined under many local names in Anderson, Campbell, Claiborne, and Scott Counties. It has been traced from the vicinity of Beech Grove, Lake City quadrangle, clockwise around the entire Cumberland Mountains to Kentucky, near Winfield, Scott County, Tennessee.

Slatestone Group

The Slatestone group, which includes all strata between the top of the Poplar Creek coal and the top of the Jellico coal, is defined in the section between The Wye and Cross Mountain, Lake City quadrangle (pl. 2-B). The section begins with the Poplar Creek coal, which is poorly exposed along the tracks and road at The Wye, and ends on Militia Hill, where the Jellico coal occurs at an elevation of 1,445 feet. The town of Slatestone, from which the name is taken, is located about 2½ miles to the south, at the level of the Coal Creek coal. This group includes the Stephens, Petros, Sand Gap, and Newcomb sandstones, and the Jellico coal, which is the uppermost unit. Separating the Poplar Creek coal and the four sandstones of the group, are four shales containing minor sandstones and coals. These and higher shale intervals are not given formal stratigraphic names.

In the type section of the Slatestone group, the Stephens, Sand Gap, and Newcomb sandstones are poorly exposed, the Petros sandstone being the only thick, well exposed sandstone. The thickness of the group here is about 635 feet.

Throughout most of its outcrop area the group ranges from 420 to 720 feet in thickness (pl. 9-D). Northwestward, however, it thins, and in parts of the Gobey, Robbins, and Huntsville quadrangles thickness is only 300 feet. On the Cumberland Block the average thickness is 600 feet, ranging from 500 to 650.

The Slatestone group occupies the foothills and lower slopes of the Cumberland Mountains. Although it lacks the prominent sandstones of lower groups, the widely mined Jellico coal permitted mapping of the top of this group in more detail than most higher contacts.

Lowest Shale Interval.—The shale between the top of the Poplar Creek coal and the base of the Stephens sandstone is about 150 feet thick in the Cross Mountain section. Thicknesses of this interval range from 100 to 240 feet and average approximately 175 feet. In the vicinity of Huntsville it has thinned to about 60 feet, and near Winfield it is as thin as 30 feet. On the Cumberland Block this interval averages about 125 feet. The best exposure of this shale with its constituent units is along State Highway 62, in the gorge of the Middle Fork of the Emory River between Stephens and Coalfield, beneath the type exposure of the Stephens sandstone.

At several localities a sandstone overlies the Poplar Creek coal near the base of this shale. Occurrences of this sandstone are sporadic and difficult to summarize. In parts of Morgan County the thin Ant coal occurs 40 to 50 feet above the Poplar Creek coal. This coal may have a thin sandstone either above or below the seam, or locally both sandstones may be present.

Stephens Sandstone.—This sandstone is named from exposures along State Highway 62 immediately south of Stephens siding, Petros quadrangle. It is well exposed in the vicinity of the bridge over Middle Fork. Here, the sandstone consists of about 40 feet of laminated silty-sandstone with an alternation of dark- and light-colored fine sand and silt. The distribution of massive and thin phases of the Stephens sandstone is shown on plate 11-H.

Shale Interval.—This interval, which includes all beds between the top of the Stephens sandstone and the base of the Petros sandstone, is approximately 130 feet thick in the Cross Mountain section. Elsewhere, including the Cumberland Block, thicknesses range from 130 to 190 feet. It thins northwestward, however, and in the vicinity of Oneida it is only 40 feet thick.

The Coal Creek coal occurs near the base of this interval, ordinarily only a few feet above the Stephens sandstone. Locally, as at Stephens, a sandstone overlies this coal. The coal has been mined in the Windrock, Clinton, and Lake City quadrangles, Anderson County. It is called the Kent coal where mined in the Jacksboro and Ivydell quadrangles, Campbell County, and Eagan quadrangle, Claiborne County.

Petros Sandstones.—These sandstones are named from the town of Petros, Morgan County, where they are well exposed; a shale break between includes the Petros coal. Because it commonly occurs as a bipartite sandstone, the name Petros is applied to both benches, the member below the coal being called lower Petros sandstone, and the overlying one, the upper Petros sandstone. The total thickness is from 50 to 60 feet at the type area, and 45 feet in the Cross Mountain section.

The distribution of massive and thin phases of both benches is shown together on plate 11-G.

Shale Interval.—This interval, which includes the beds between the top of the Petros sandstone and the base of the Sand Gap sandstone, is 170 feet thick in the Cross Mountain section. From this unusual thickness the interval decreases to 100 feet, which is more common. Northwestward, in the vicinity of Oneida, it thins to 40 feet.

The Blue Gem coal occurs in the upper part of this shale, not far below the Sand Gap sandstone. Over a large part of its outcrop area the Blue Gem coal is underlain by a thin sandstone. This coal has been widely mined, probably the largest area being in northeastern Pioneer quadrangle and the Jellico-Newcomb mining district, Campbell County. The Blue Gem, locally known as the Rich Mountain coal, has been mined in the Ivydell and Mingo Mountains quadrangles, Claiborne County.

Sand Gap Sandstone.—This sandstone is named from exposures in Sand Gap, a short distance north of Elk Valley, Pioneer quadrangle, where it is nearly 100 feet thick. The Blue Gem coal has been mined beneath the sandstone at its type section. In the Cross Mountain section this sandstone is only about 5 feet thick. In the area near Oneida and Huntsville, the Sand Gap sandstone caps the higher hills, forming extensive flats above the Wartburg level. The distribution of massive and thin phases of this sandstone is shown on plate 11-F.

Shale Interval.—The shale between the Sand Gap and Newcomb sandstones is about 120 feet thick at Sand Gap, Cross Mountain, and Stephens. This thickness is greater than the average, which is from 80 to 100 feet. Northwestward, it thins to between 40 and 60 feet. Locally, where the Newcomb and Sand Gap sandstones are both thick, practically the entire interval between the Blue Gem and Jellico coals is sandstone.

In northwestern Campbell County and northern Scott County the Terry Creek coal is in the lower part of this shale, overlying the Sand Gap sandstone.

Newcomb Sandstone.—This sandstone is named from Newcomb, Campbell County, where it underlies the widely mined Jellico coal in the Jellico-Newcomb district. Plate 11-E shows the distribution of the massive and thin phases of this sandstone to be very irregular. It is commonly about 20 feet thick, and ranges from 0 to 60 feet.

Jellico Coal.—This coal, named from Jellico, Campbell County, is the top member of the Slatestone group and is found only a few feet above the top of the Newcomb sandstone. The Jellico has been so widely prospected and mined that the top of the Slatestone group can be mapped in much greater detail than would be possible if any other horizon were selected to form the group boundary. Above this horizon tracing of units was of necessity done by correlation of measured sections spaced as close together as separated areas of preservation permitted.

The Jellico has been widely mined in north-central Petros and south-central Fork Mountain quadrangles, Morgan and Anderson Counties; along Ligias Fork and New River, Duncan Flats quadrangle, Anderson County; northeastern Pioneer quadrangle and the Jellico-Newcomb mining district, Jellico East and West quadrangles, Campbell and Scott Counties; and on Cumberland Block, Campbell and Claiborne Counties, where it is known as the Log Mountain, or Mingo, coal.

Indian Bluff Group

The Indian Bluff group, which includes all strata between the top of the Jellico coal and the top of the Pioneer sandstone, is defined in the Cross Mountain section, Lake City quadrangle. The section begins at the top of the Jellico coal on Militia Hill and ends on the top of the Pioneer sandstone, upon which Mountain View Church is located. The name of the group is taken from Indian Bluff in the southwestern part of the same quadrangle. Here, the massive Pioneer sandstone forms Braden Flats, the eastern edge of which is Indian Bluff. This group includes the Seeber Flats sandstone below, Stockstill and Indian Fork sandstones in the middle, and Pioneer sandstone above. Separating the Jellico coal and these four sandstones are four intervals of shale containing minor sandstones and coals. In the type section only the Stockstill and Pioneer sandstones are well exposed. The Seeber Flats sandstone is poorly exposed, and the Indian Fork sandstone was not seen. The thickness of the group here is 455 feet.

In the southeastern part of the Cumberland Mountains the group ranges from 300 to 470 feet in thickness, but northwestward it becomes as thin as 200 to 300 feet. On Cumberland Block known thicknesses range from 150 to 200 feet.

The complete sequence of units is present in the Camp Austin, Petros, Windrock, and parts of adjacent quadrangles. Here, both the Stockstill and Indian Fork sandstones are present. The Indian Fork sandstone is absent in the Gobey, Fork Mountain, Duncan Flats, Lake City, Robbins, Huntsville, Norma, and southwestern Block quadrangles. In the northeastern part of the Cumberland Mountains and the Cumberland Block both the Stockstill and Indian Fork sandstones are absent. The complete sequence is described below.

Lowest Shale Interval.—The shale interval between the top of the Jellico coal and the base of the Seeber Flats sandstone ranges from 40 to 120 feet in thickness, averaging about 75 feet. It contains no important coal.

Seeber Flats Sandstone.—This sandstone is named from exposures in the Briceville-Norman School section, Lake City quadrangle. At an elevation of 1,670 feet a side road leads southward to Seeber Flats, formed on this sandstone. The overlying Joyner coal has been mined along this road. The sandstone is largely covered in the Cross Mountain section. The Seeber Flats thickness varies from 0 to 60 feet. This sandstone is irregular in its thickness, with an average of perhaps 25 feet. Plate 11-D shows the areal distribution of the massive and thin phases of this sandstone.

Shale Interval.—This interval is approximately 50 feet thick in the Cross Mountain section. Elsewhere, including the Cumberland Block, thicknesses range from 40 to 120 feet, averaging about 80 feet.

The Joyner coal occurs near the base of this interval, ordinarily only a few feet above the Seeber Flats sandstone. It has been locally mined on Chimney Top Mountain, east-central Camp Austin quadrangle and Big Mountain, east-central Petros quadrangle, Morgan County; and on Braden and Seeber Flats, southwestern Lake City quadrangle, Anderson County.

Stockstill Sandstone.—The Stockstill sandstone is named for Stockstill Creek from exposures on State Highway 116 between Petros and Armes Gap, where it is a well exposed, massive, 40-foot sandstone. In the Cross Mountain section it consists of 25 feet of poorly cemented sandstone, the top of which is at an elevation of about 1,655 feet. The overlying Stockstill coal, named from the same type section as the sandstone, is present in both of these sections.

The sandstone is well developed in the Camp Austin, Petros, Windrock, Gobey, Fork Mountain, Duncan Flats, Robbins, Huntsville, Norma, and southern Block quadrangles, where it ranges from 20 to 80 feet in thickness. East of this area it is represented by relatively thin shaly sandstone or sandy shale. The distribution of the phases of this sandstone is shown on plate 11-C.

Shale Interval.—This shale averages 40 to 60 feet in thickness. It is 100 feet thick in the Petros and Indian Fork sections and locally is as thin as 25 feet.

The Stockstill coal occurs in the lower part of this shale, not far above the top of the Stockstill sandstone.

Indian Fork Sandstone.—The Indian Fork sandstone is named from exposures along the incline on the north side of Indian Fork, Fork Mountain quadrangle, where it is 15 feet thick. In the Petros section it has about the same thickness.

The Indian Fork sandstone is well developed in eastern Camp Austin, Petros, Windrock, southeastern Gobey, southern Fork Mountain, and southern Duncan Flats quadrangles, where it is as much as 60 feet in thickness. The pattern of development of this sandstone is shown on plate 11-B.

Shale Interval.—This interval is 25 and 45 feet thick in the Indian Fork and Petros sections, respectively. Elsewhere, it ranges to 80 feet in thickness.

The Indian Fork coal, which is well exposed in the type section, is in the basal part of this shale, not far above the Indian Fork sandstone.

Pioneer Sandstone.—The Pioneer sandstone was named by Glenn (1925) from exposures at Old Pioneer, near Poteet Gap, Pioneer quadrangle. The top of the sandstone forms Poteet Gap, where it is about 55 feet thick. In the Cross Mountain section it is 60 feet thick, but in the Petros section it is represented by only 4 feet of sandstone.

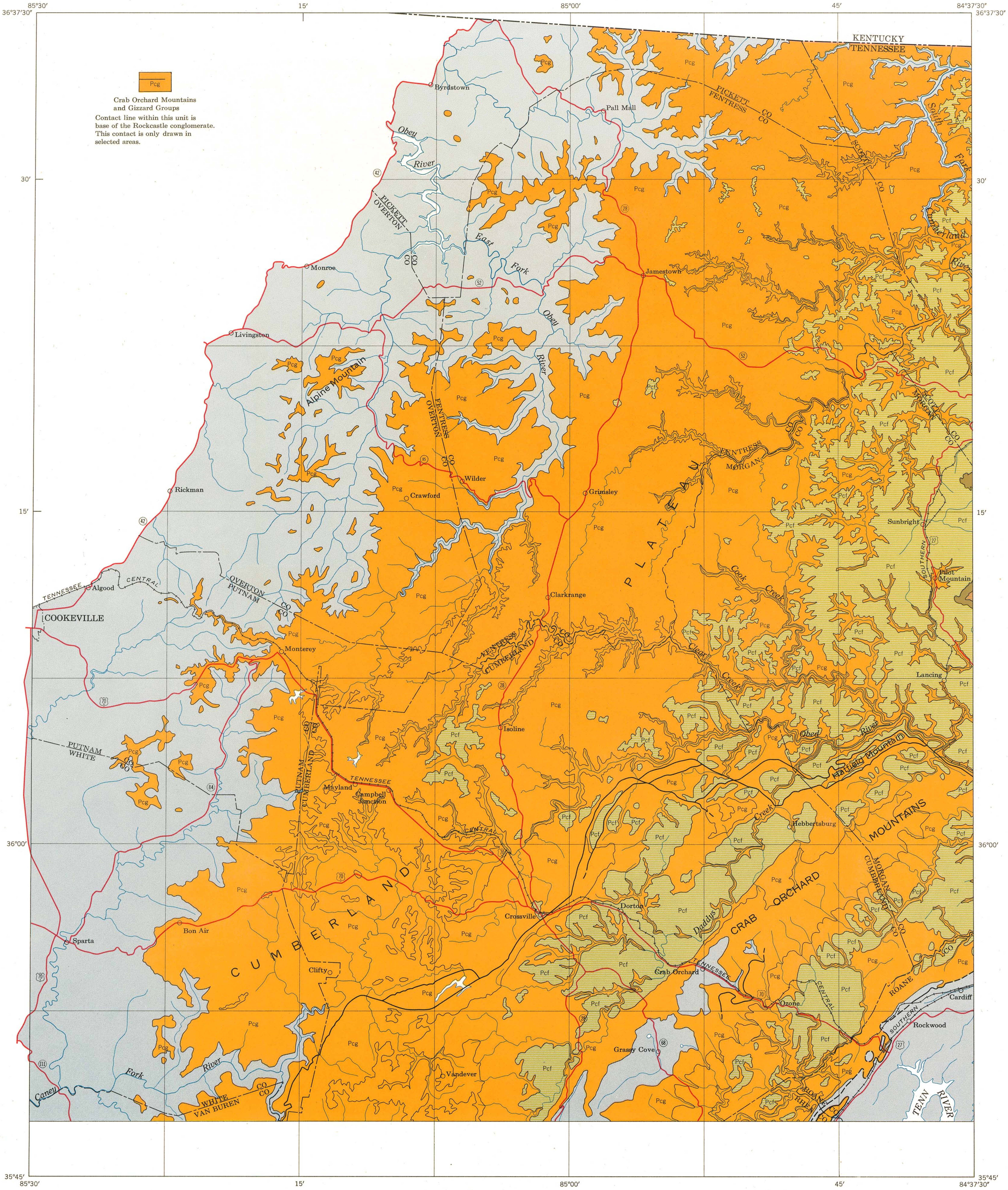
The Pioneer is the most widespread sandstone in the Crooked Fork and Slatestone groups. Except in southwestern Duncan Flats, north-central Petros, central Block, western Norma, Ketchen, and Winfield quadrangles, it is from 20 to 80 feet thick. On the Cumberland Block it averages 30 feet. Plate 11-A shows the distribution of this sandstone.

PLATE 5

STATE OF TENNESSEE
DEPARTMENT OF CONSERVATION
DIVISION OF GEOLOGY

GEOLOGIC MAP

TENNESSEE
CUMBERLAND PLATEAU AREA
NORTHWEST



Base map from TVA-USGS topographic quadrangles
Cartography by Maps and Surveys Branch, TVA

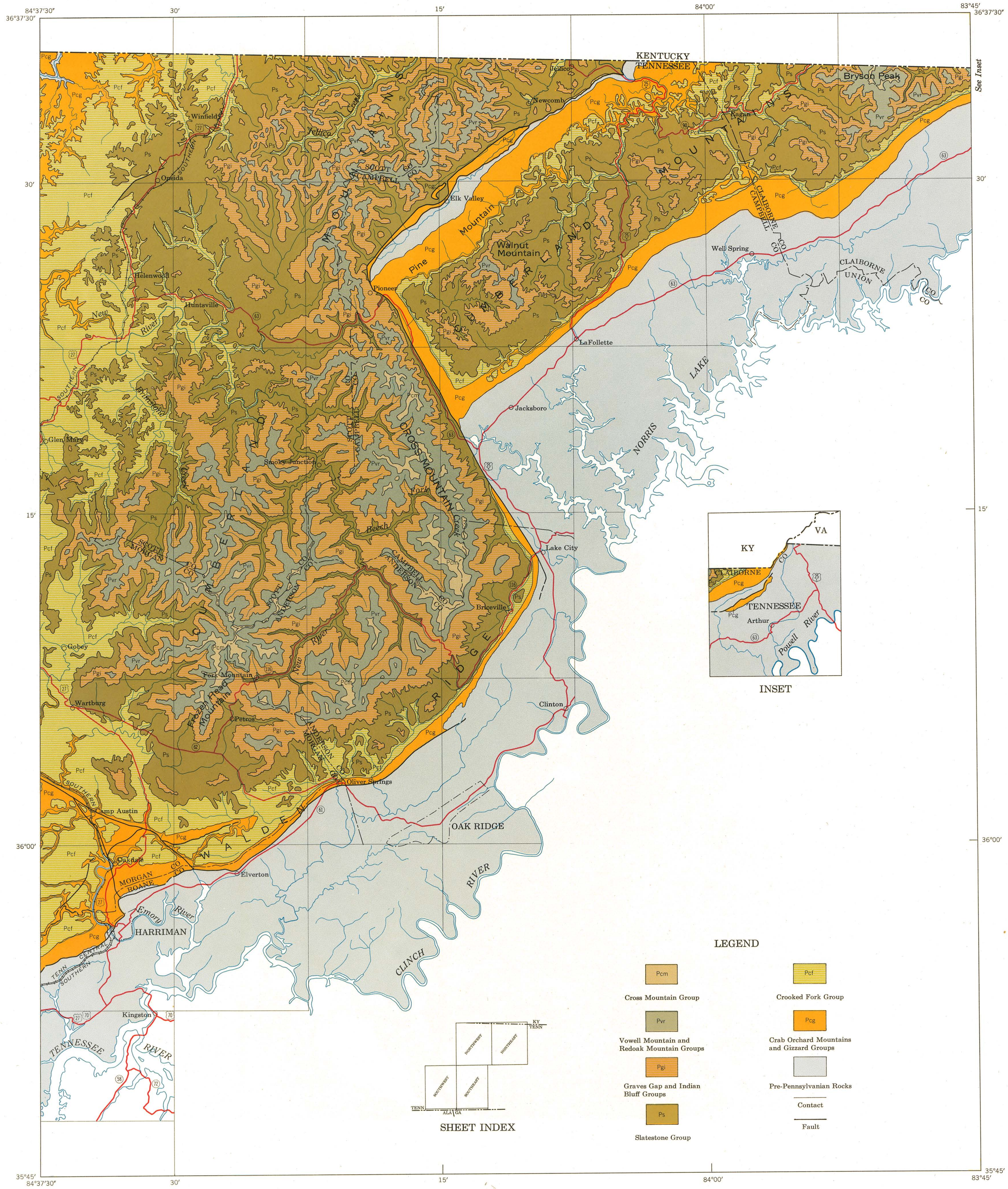
SCALE OF MILES
5 0 5 10 15

CUMBERLAND PLATEAU AREA
NORTHWEST

STATE OF TENNESSEE
DEPARTMENT OF CONSERVATION
DIVISION OF GEOLOGY

GEOLOGIC MAP

TENNESSEE
CUMBERLAND PLATEAU AREA
NORTHEAST



SCALE OF MILES

5 0 5 10 15

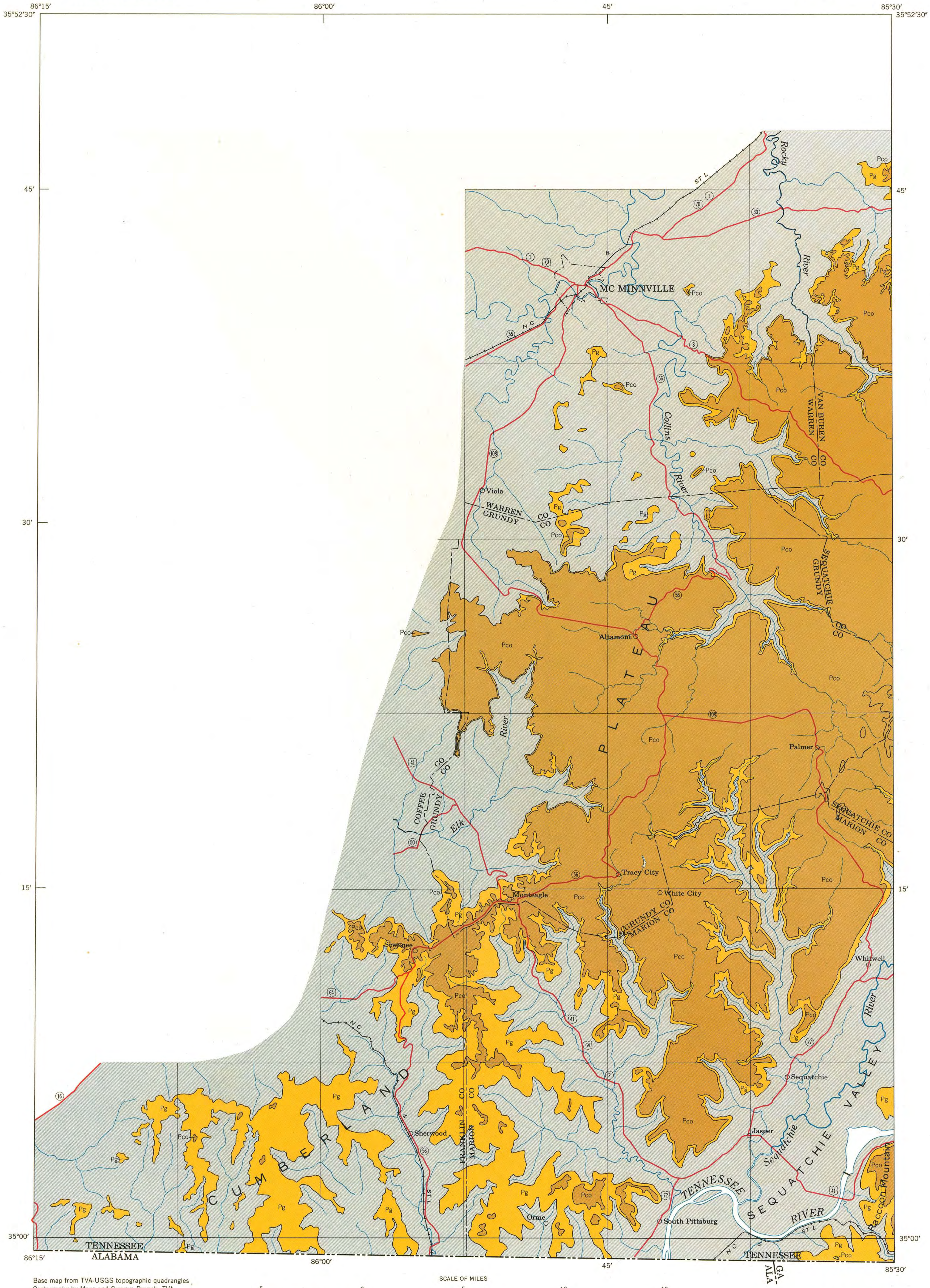
Base map from TVA-USGS topographic quadrangles
Cartography by Maps and Surveys Branch, TVA

PLATE 7

STATE OF TENNESSEE
DEPARTMENT OF CONSERVATION
DIVISION OF GEOLOGY

GEOLOGIC MAP

TENNESSEE
CUMBERLAND PLATEAU AREA
SOUTHWEST



Base map from TVA-USGS topographic quadrangles
Cartography by Maps and Surveys Branch, TVA

SCALE OF MILES

5 0 5 10 15

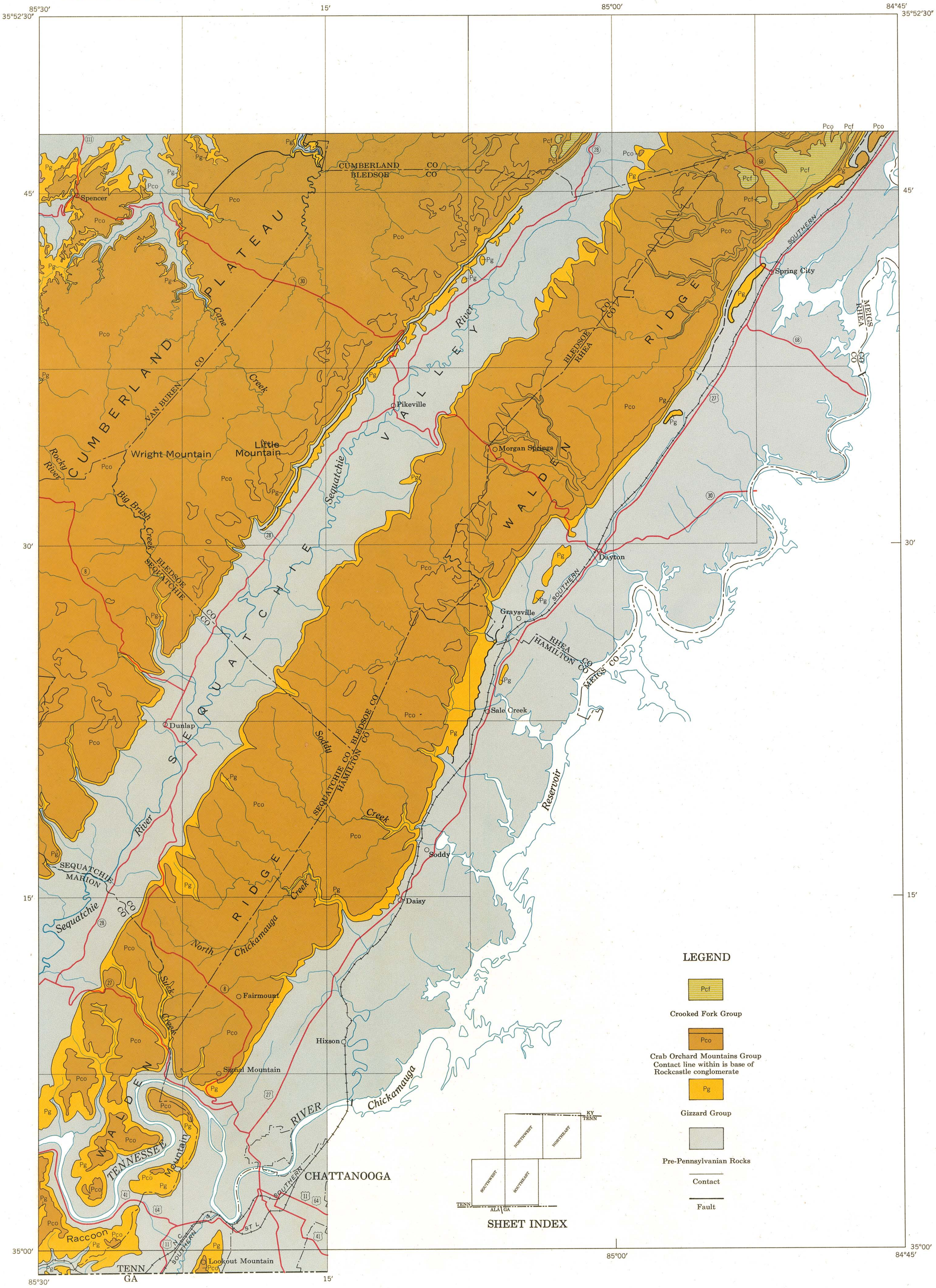
CUMBERLAND PLATEAU AREA
SOUTHWEST

PLATE 8

STATE OF TENNESSEE
DEPARTMENT OF CONSERVATION
DIVISION OF GEOLOGY

GEOLOGIC MAP

TENNESSEE
CUMBERLAND PLATEAU AREA
SOUTHEAST



Base map from TVA-USGS topographic quadrangles
Cartography by Maps and Surveys Branch, TVA

SCALE OF MILES
5 0 5 10 15

Graves Gap Group

The Graves Gap group, which includes all strata between the top of the Pioneer sandstone and the top of the Windrock coal, has its type locality in the Cross Mountain section, Lake City quadrangle. It includes the Armes Gap and Roach Creek sandstones. Separating the top of the Pioneer sandstone, the Windrock coal, and these two sandstones are three intervals of shale containing minor sandstones and coals. The type section begins with the top of the Pioneer sandstone at Mountain View Church and ends at the top of the Windrock coal about 80 feet above Cumberland Mountain Church. Graves Gap, from which the name is taken, is located on State Highway 116 in the southwestern part of the same quadrangle. The gap is slightly below the middle of the group, beneath the Armes Gap sandstone. In the type section, where the Armes Gap sandstone is thin and the Roach Creek sandstone apparently absent, the group is 365 feet thick. In the Graves Gap section the two sandstones are also poorly developed, and the thickness of the group is approximately the same.

In the Cross Mountain-Briceville-Graves Gap area the group averages 360 feet, but elsewhere the range is from 200 to 300 feet. On the Cumberland Block (pl. 1) the average thickness is from 250 to 300 feet.

Lowest Shale Interval.—The shale interval between the top of the Pioneer sandstone and the base of the Armes Gap sandstone is about 200 feet thick in the Cross Mountain section. In the Petros section, however, it is only 105 feet. In the Cross Mountain-Briceville-Graves Gap area the shale ranges from 150 to 200 feet, but elsewhere thicknesses are commonly from 50 to 100 feet. The Jordan coal occurs near the base of this interval, above the Pioneer sandstone. It has been extensively mined in the La Follette quadrangle, Campbell County.

Where the group is from 200 to 300 feet thick, the Norman Pond coal occurs approximately in the middle of the shale. The interval between the top of the Pioneer sandstone and the Norman Pond coal and the interval between the coal and the base of the Armes Gap sandstone are both from 50 to 100 feet. The lower interval remains essentially constant wherever the coal is present, but the upper interval thins northwestward and on the Cumberland Block, so that locally the Armes Gap sandstone immediately overlies the coal. This is illustrated in the Norman Pond Knob section, Fork Mountain quadrangle, where the coal is 55 feet above the Pioneer sandstone and is directly overlain by the Armes Gap sandstone. The Norman Pond coal locally overlies a thin sandstone, which has a maximum exposed thickness of 45 feet at Vowell School in the Cross Mountain section. In several core drill holes in the Block quadrangle this sandstone is as thick as 55 feet. Here, it lies directly over the Jordan coal and is 20 feet beneath the Norman Pond coal.

Armes Gap Sandstone.—This sandstone is named from exposures in Armes Gap north of Petros, where it is less than 10 feet thick. Its thickness ranges from 20 to 40 feet in the east-central Camp Austin, Petros (except near Armes Gap), and south-central Fork Mountain quadrangles. From this area it thins northwestward. East of this area of well developed sandstone there is a northwest-southeast belt of thin sandstone in the Windrock, central Fork Mountain, and southwestern Norma quadrangles.

A northwest-southeast belt of massive Armes Gap sandstone crosses the western Lake City, Duncan Flats, central Block, northeastern Norma, Huntsville, and western Pioneer quadrangles. In this belt the sandstone ranges from 20 to 70 feet thick.

On the Cumberland Block and northwest of this block the thickness commonly is from 20 to 65 feet. Between this area and the belt of massive sandstone described in the preceding paragraph, there is a northwest-southeast belt in which the Armes Gap sandstone is thin.

Shale Interval.—This interval includes the beds between the top of the Armes Gap sandstone and the base of the Roach Creek sandstone. It is approximately 110 feet thick in the Cross Mountain section, and in the Petros section it is 105 feet, but in the Dean section it is only 70 feet thick. Elsewhere, thicknesses range from 60 to 130 feet.

The Lower and Upper Pioneer coals occur in this interval. Their relations to the associated sandstones are:

Roach Creek sandstone
  Interval, 5 to 45 feet; average 30 feet
Upper Pioneer coal
  Interval, 20 to 70 feet; average 45 feet
Lower Pioneer coal
  Interval, 0 to 40 feet; average 15 feet
Armes Gap sandstone

Locally, there is a thin sandstone between the two Pioneer coals. In the Briceville-Norman School section, in the exposures northward from Mountain View Church on Cross Mountain, and in the head of Ligias Fork, Duncan Flats quadrangle, this sandstone is thicker and apparently has truncated the Lower Pioneer coal; it overlies the Armes Gap sandstone. The Pioneer coals have been mined near Poteet Gap and Elk Gap in the Pioneer quadrangle, Campbell and Scott Counties. The Sandstone Parting coal, which is one of the Pioneer coals, has been mined in the Mingo Mountains quadrangle, Claiborne County.

Roach Creek Sandstone.—This sandstone is named from exposures above Roach Creek near Dean, Block quadrangle, where it is 60 feet thick and only about 10 feet below the Windrock coal. It is well developed throughout most of the western part of the Cumberland Mountains, ranging from 20 to 80 feet thick. However, it is thin in the Petros, Windrock, and Lake City quadrangles to the southeast. A northwest-southeast belt of thin Roach Creek sandsone also extends across the Jacksboro, northeastern corner of Block, eastern Pioneer, western Ivydell, and Ketchen quadrangles. In the eastern Ivydell and Jellico West quadrangles, and in the Log Mountain section near Fonde, Kentucky, the sandstone is from 20 to 25 feet thick.

Shale Interval.—The shale interval between the top of the Roach Creek sandstone and the Windrock coal is about 60 feet thick in both the Graves Gap and Petros sections. As the Roach Creek sandstone is not recognized in the Cross Mountain section, the thickness of this interval is unknown there.

Usually, this shale interval is from 50 to 90 feet thick. In the area of this thickness range the Craig coal occurs from 5 to 30 feet above the top of the Roach Creek sandstone. Northwestward, however, the Craig coal disappears and the interval thins, so that the Windrock coal is only 5 to 30 feet above this sandstone.

Locally, where this interval is thick, there is a thin sandstone between the Craig and Windrock coals. At a few localities a thin coal overlies this sandstone.

Windrock Coal.—The top of this seam is selected as the top of the Graves Gap group because of its wide extent and because it can be recognized by a thin flint clay beneath the coal. This clay, even when weathered, is tough, hard, and breaks with conchoidal fracture.

The Windrock coal has been mined in the vicinity of Windrock, Anderson County; in western Lake City quadrangle and Duncan Flats quadrangle, Anderson and Campbell Counties; locally near Newcomb, Campbell County; and in the Robbins and Fork Mountain quadrangles, Scott County. It has been mined as the Poplar Lick coal in Claiborne County.

Redoak Mountain Group

The Redoak Mountain group, which includes all strata between the top of the Windrock coal and the top of the Pewee coal, is defined in the Cross Mountain section. The name is taken from Redoak Mountain in the southwestern part of the Lake City quadrangle, the beds of the group being exposed on the south end of this mountain, above Graves Gap.

This group includes the Caryville, Fodderstack, and Silvey Gap sandstones. Separating the Windrock and Pewee coals and these three sandstones are four intervals of shale containing minor sandstones and coals.

In the Cross Mountain section the group is 345 feet thick, and in the Graves Gap section it is 40 feet thicker. The Caryville, Fodderstack, and Silvey Gap sandstones are poorly developed in the Cross Mountain and Graves Gap sections. The group ranges in thickness from 300 to 440 feet.

Lowest Shale Interval.—The shale interval between the top of the Windrock coal and the base of the Caryville sandstone is 135 feet thick in the Cross Mountain section and 115 feet in the Caryville section. The range in thickness of this interval is 80 to 190 feet.

The Big Mary coal occurs in this shale 20 to 95 feet above the Windrock coal, with the average interval being 40 feet. Between these coals is a thin but persistent sandstone, which has its massive and thin phases arranged in northwest-southeast belts. It is rarely thicker than 30 feet. The Big Mary coal has been widely mined in the Windrock, Petros, Fork Mountain, and Duncan Flats quadrangles, Anderson, Campbell, Scott, and Morgan Counties, mining being largely concentrated in an area centered at their common corners; and at Dean in northwestern Block quadrangle, Scott County. It has also been mined as the Klondike (or Sterling) coal in the Mingo Mountains quadrangle, Claiborne County.

The Beech Grove coal occurs near the top of this interval, only a few feet below the base of the Caryville sandstone. Underlying this coal is an unnamed sandstone that is well developed in three narrow northwest-southeast fingers; one in the north-central Petros and southwestern Fork Mountain quadrangles, one in the northeastern Duncan Flats and south-central Block quadrangles, and the third in the northeastern Block, eastern Pioneer, and Winfield quadrangles. The maximum thickness of this sandstone is 50 feet.

Caryville Sandstone.—This sandstone is named from exposures in the section above Caryville, Jacksboro quadrangle, where it attains its maximum known thickness of about 60 feet. In the Cross Mountain section it is represented by 10 feet of shaly sandstone. The sandstone is thin in the Petros and Gobey quadrangles. A northwest-southeast belt of massive Caryville sandstone crosses the Windrock, Duncan Flats, Fork Mountain, southwestern Block, and west-central Jacksboro quadrangles. Paralleling this on the northeast is a belt of thin Caryville sandstone in the Lake City, northeastern Block, and Pioneer quadrangles. In the Walnut Mountain section, Ivydell quadrangle, the thickness is 20 feet.

Shale Interval.—The shale between the top of the Caryville sandstone and the base of the Fodderstack sandstone is about 85 feet thick in the Cross Mountain section. The known total thickness ranges from 50 to 150 feet. The Sharp coal occurs about midway between these sandstones, and a thin sandstone locally overlies this coal.

Fodderstack Sandstone.—This sandstone is named from Little Fodderstack Mountain, Petros quadrangle, where it forms a bench on which a trail encircles the mountain. This is the "Big Bench" of Glenn (1925). In the Cross Mountain section it is at least 12 feet thick, but in the Petros section it is approximately 5 feet thick. The sandstone is well developed in two northwest-southeast belts, the larger of which crosses the Petros (except in the Armes Gap section), southwestern Duncan Flats, Fork Mountain, and southeastern Gobey quadrangles. The other is in the northwestern Lake City, northeastern Duncan Flats, and central Block quadrangles.

Shale Interval.—This interval, which includes the beds between the top of the Fodderstack sandstone and the base of the Silvey Gap sandstone, is approximately 80 feet thick in the Cross Mountain section. In the Windrock section, where the Silvey Gap sandstone is named, the Fodderstack sandstone is not exposed or not present, and the interval is uncertain; the interval ranges from 45 to 110 feet in thickness.

The Red Ash coal occurs in the lower part of this interval, within 20 feet of the top of the Fodderstack sandstone. This coal has been mined west of the Jacksboro fault in a belt extending across the Jacksboro, Block, Gobey, and Pioneer quadrangles, Campbell, Morgan, and Scott Counties. The Walnut Mountain coal is in the upper part of the interval, from 5 to 45 feet below the Silvey Gap sandstone. The interval between these two coals averages 50 feet and ranges from 25 to 80 feet. Locally, there is a thin sandstone between these coals.

The Walnut Mountain coal averages 60 feet below the Pewee seam, the interval ranging from 20 to 110 feet. It is mined in the Block and Jacksboro quadrangles, Campbell County.

Silvey Gap Sandstone.—This sandstone is named from exposures in Silvey Gap above Windrock, Windrock quadrangle, where it is 60 feet thick. It is thin in the southwestern Fork Mountain quadrangle and in a narrow northwest-southeast belt across the northwestern Lake City and central Block quadrangles. It is well developed in a broad northwest-southeast belt including the Windrock, Duncan Flats, northeastern Fork Mountain, and southwestern and northeastern Block quadrangles. Its maximum known thickness is at the type locality.

Pewee Coal.—The Pewee coal, which is the top member of the Redoak Mountain group, usually occurs within 20 feet of the top of the Silvey Gap sandstone. It is a widely recognized and mined seam. The major mining areas are in the south-central part of Fork Mountain quadrangle, in the vicinity of Windrock, and in an area centered at the common corner of Block, Jacksboro, Lake City, and Duncan Flats quadrangles, Anderson, Campbell, Morgan, and Scott Counties. The Lower Hignite (Pewee) coal has been mined in the Mingo Mountains quadrangle, Claiborne County.

Vowell Mountain Group

The Vowell Mountain group, which includes all strata between the top of the Pewee coal and the top of the Frozen Head sandstone, is defined in the Cross Mountain section. The name is taken from Vowell Mountain, a spur on the east side of Cross Mountain. The group ranges in thickness from 230 to 390 feet, and in this section it is 370 feet thick.

The Pilot Mountain and Frozen Head sandstones, which are thick and well exposed in the type section of the group, are the only named units.

Separating the top of the Pewee coal and the two sandstones are three intervals of shale containing minor sandstones and coals.

This group is preserved only on the higher mountains and hence has a much more restricted outcrop area than the older groups.

Lowest Shale Interval.—The shale between the top of the Pewee coal and the base of the Pilot Mountain sandstone is 100 feet thick in the Cross Mountain section. Elsewhere, this interval ranges from 60 to 160 feet, the average being about 80 feet.

The Split and Petree coals occur in this interval, the Split usually being 30 feet above the Pewee coal, and the Petree 35 feet above the Split coal. Locally, there is a thin sandstone between these two coals. The interval between the Petree coal and the overlying Pilot Mountain sandstone ranges from 5 to 50 feet. Due to truncation, variations in thickness of this magnitude are common in beds lying below massive sandstones.

Pilot Mountain Sandstone.—This sandstone was originally named the Pilot Knob sandstone by Glenn (1925). It is here renamed the Pilot Mountain sandstone because the name, Pilot Knob, had previously been used. Furthermore, the type locality is now called Pilot Mountain on the T. V. A. Duncan Flats quadrangle. Here, the sandstone is 60 feet thick, and in the Cross Mountain section it is 35 feet thick.

This sandstone is well developed in the Petros, Windrock, Fork Mountain, Duncan Flats, Lake City, Norma, and Block quadrangles. It is thin in the northeastern and east-central parts of the Block quadrangle. The maximum thickness is found at the type locality.

Shale Interval.—The shale between the top of the Pilot Mountain sandstone and the base of the Frozen Head sandstone is about 165 feet thick in the Cross Mountain section. In the Petros section, from which the Frozen Head sandstone was named, it is 90 feet thick; in the Pilot Mountain section, where the Pilot Mountain sandstone was named, it is 50 feet thick. These thicknesses indicate a marked variability in this interval.

The Lower and Upper Pine Bald coals occur in this interval, the former only a few feet above the Pilot Mountain sandstone. In the eastern Duncan Flats, Lake City, and part of eastern Block quadrangles a sandstone with a thickness range of 15 to 60 feet is present between these coals. In this area the interval between the Pine Bald coals ranges from 35 to 90 feet, but where the intervening sandstone is absent the coals may be only 20 feet apart. In the Cross Mountain section, where the sandstone is 35 feet thick, these coals are 45 feet apart. The U. S. Bureau of Mines (unpublished manuscript, 1955) cites reserves of "Petree" coal in the east-central part of Block quadrangle, Campbell County. This seam is the Lower Pine Bald coal of this report.

The Rock Spring coal occurs in this shale from 20 to 100 feet above the Upper Pine Bald coal, the greater thickness being in the Cross Mountain section. This coal underlies the Frozen Head sandstone at a variable interval as much as 65 feet. In the Cross Mountain section this interval is 30 feet; in the Petros section, 10 feet; but in the Flat Fork section, in the southwest corner of the Fork Mountain quadrangle, the Frozen Head sandstone rests directly upon the coal. The Rock Spring coal has been mined in the eastern part of Block quadrangle, Campbell County.

Frozen Head Sandstone.—This sandstone was named from Frozen Head Mountain, Petros quadrangle, by Glenn (1925). In its type locality it is 35 feet thick, and in the Cross Mountain section it is 60 feet thick. Wherever this sandstone is preserved it is massive, except in the eastern part of the Block quadrangle, where in drill cores it is represented by shaly sandstone or sandy shale. The sandstone has a maximum thickness of 100 feet. In the Flat Fork section it is coarse-grained and contains quartz granules.

Cross Mountain Group

The Cross Mountain group, which includes all strata between the top of the Frozen Head sandstone and the top of Cross Mountain, is defined and named on the road leading to the top of this mountain. Here, it is 554 feet thick. This group includes the Low Gap and Tub Spring sandstones, which are thick in the type section of the group. Separating the top of the Frozen Head sandstone, the two named sandstones within the group, and the top of Cross Mountain are three intervals of shale containing minor sandstones and coals.

This group includes the youngest Pennsylvanian beds in Tennessee, which are preserved only on the higher peaks and ridges in the Cumberland Mountains; in fact, the upper half of these beds is preserved only on Cross Mountain.

Lowest Shale Interval.—The shale between the top of the Frozen Head sandstone and the base of the Low Gap sandstone is 60 feet thick in the type section of the group. In the Petros section, the type locality of the Frozen Head sandstone, this interval thickens to 140 feet. In the Graves Gap section, the type locality of the Low Gap sandstone, the interval is only 35 feet thick. The maximum range is from 35 to 140 feet.

The Lower and Upper Grassy Spring coals are found near the base of this interval, not far above the Frozen Head sandstone, the lower coal ranging from 0 to 15 feet above this sandstone. The two coals average 30 to 35 feet apart. In the section above Clinchmore, Duncan Flats quadrangle, where the (Upper) Grassy Spring coal was named, it is higher above the Frozen Head sandstone than is characteristic of this seam.

Low Gap Sandstone.—This sandstone is named from exposures in Low Gap on the crest of Redoak Mountain between Graves Gap and Cross Mountain. In the Cross Mountain section the sandstone is about 45 feet thick. The Low Gap sandstone is massive and well developed in the eastern Petros, Windrock, eastern Fork Mountain, Duncan Flats, Lake City, and central Block quadrangles, where it attains a maximum thickness of 70 feet. In the western Petros, western Fork Mountain, and western and northeastern Block quadrangles, and on the Cumberland Block, it is thin.

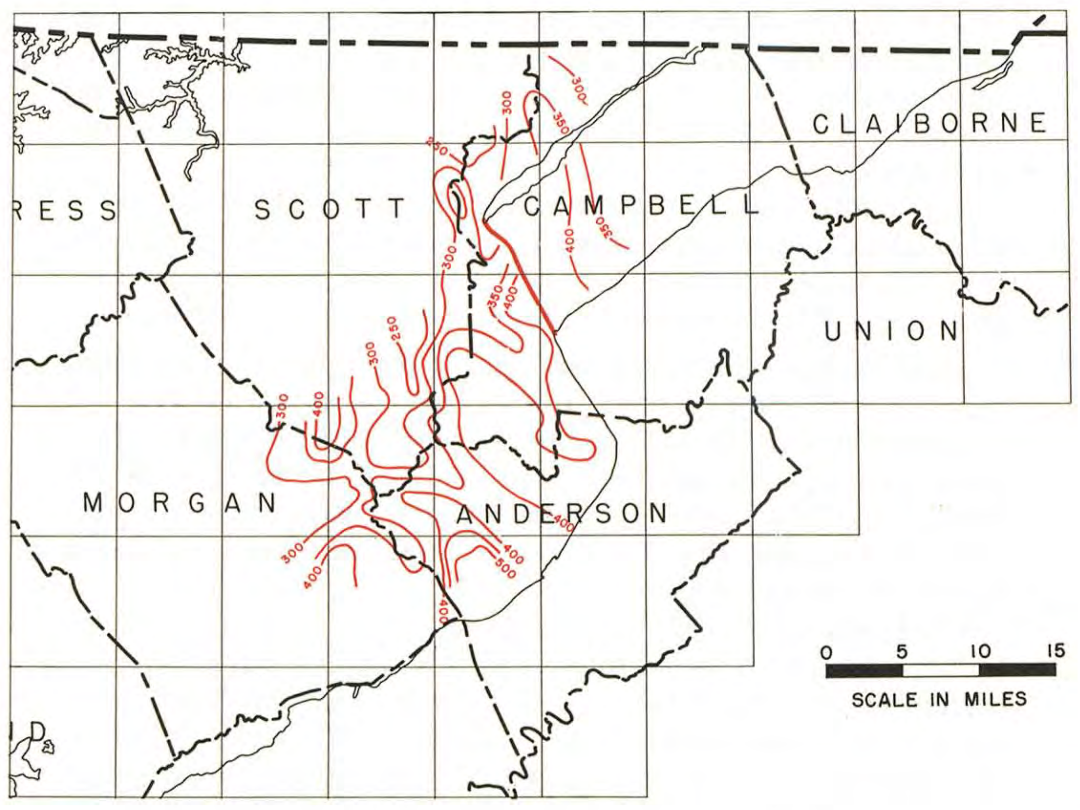
Shale Interval.—The shale between the top of the Low Gap sandstone and the base of the Tub Spring sandstone is 150 feet thick in the Cross Mountain section. In the Petros section, where the Tub Spring sandstone is named, this interval is 200 feet thick. In the Graves Gap section it is 110 feet thick. It contains the Cold Gap and Wild Cat coals.

The Cold Gap coal occurs in this interval not far above the Low Gap sandstone. It has been mined locally in the vicinity of Bald Knob, Fork Mountain quadrangle. The Lower Wild Cat coal ranges from 25 to 90 feet above the Cold Gap coal and 30 to 40 feet below the Upper Wild Cat seam. Locally, in the Windrock, eastern Duncan Flats, and southeastern Block quadrangles, there is a massive sandstone below the Lower Wild Cat coal. A thin sandstone locally overlies the Upper Wild Cat seam.

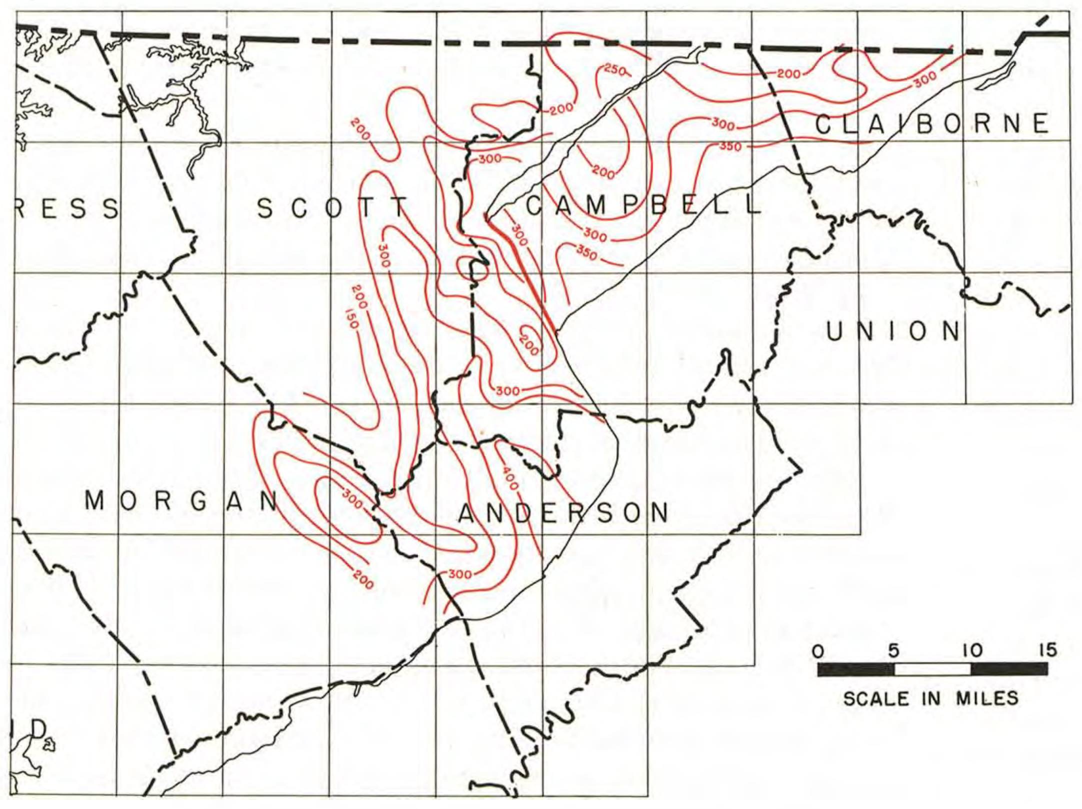
Tub Spring Sandstone.—This sandstone is named from exposures on the top of Frozen Head Mountain above Petros, where 50 feet are preserved. The name is taken from the spring on the north side of this mountain, in the Fork Mountain quadrangle. In the Cross Mountain section it is at least 20 feet thick. This sandstone forms the crests of several prominent mountains in the northern Petros, southern Fork Mountain, Windrock, Lake City, and Block quadrangles, where it is usually a massive, well developed sandstone. It is the uppermost sandstone in several of the higher sections.

It is present, but thin, near the top of the Bryson Peak section on the Cumberland Block.

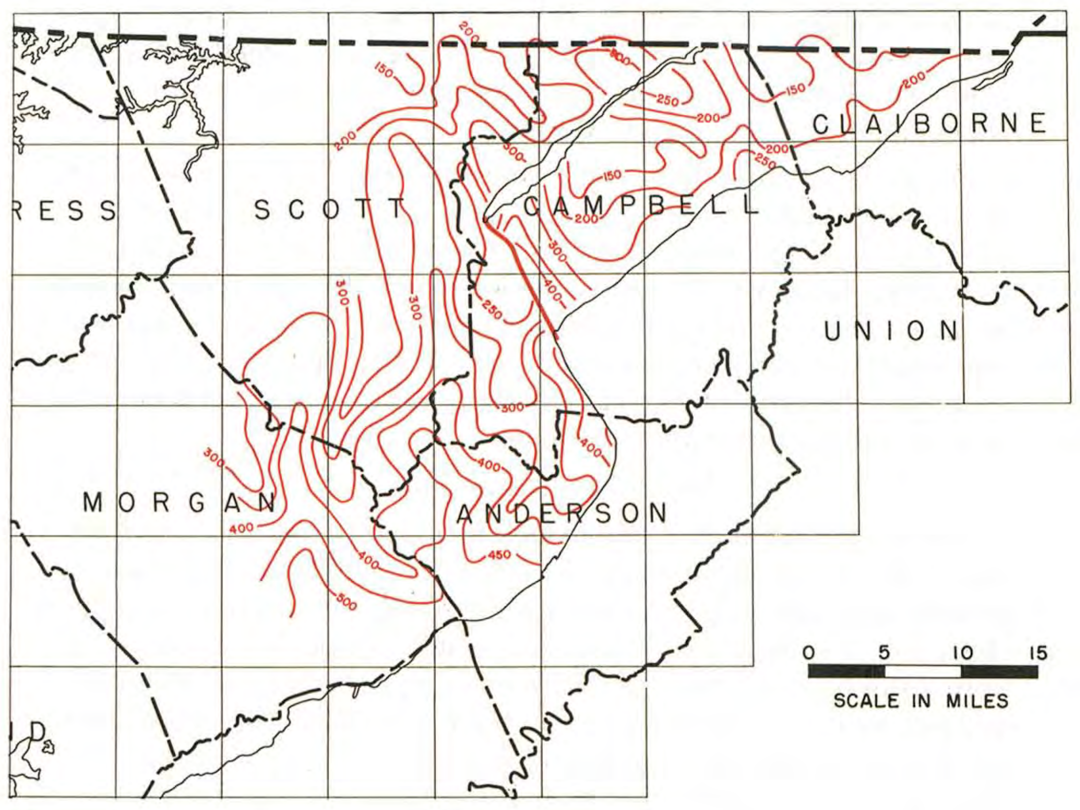
Uppermost Shale Unit on Cross Mountain.—In the Cross Mountain section 270 feet of shale with minor sandstones and several thin coal seams overlies the Tub Spring sandstone. As the preservation of most of these beds is largely restricted to this local area, no member warrants special discussion.



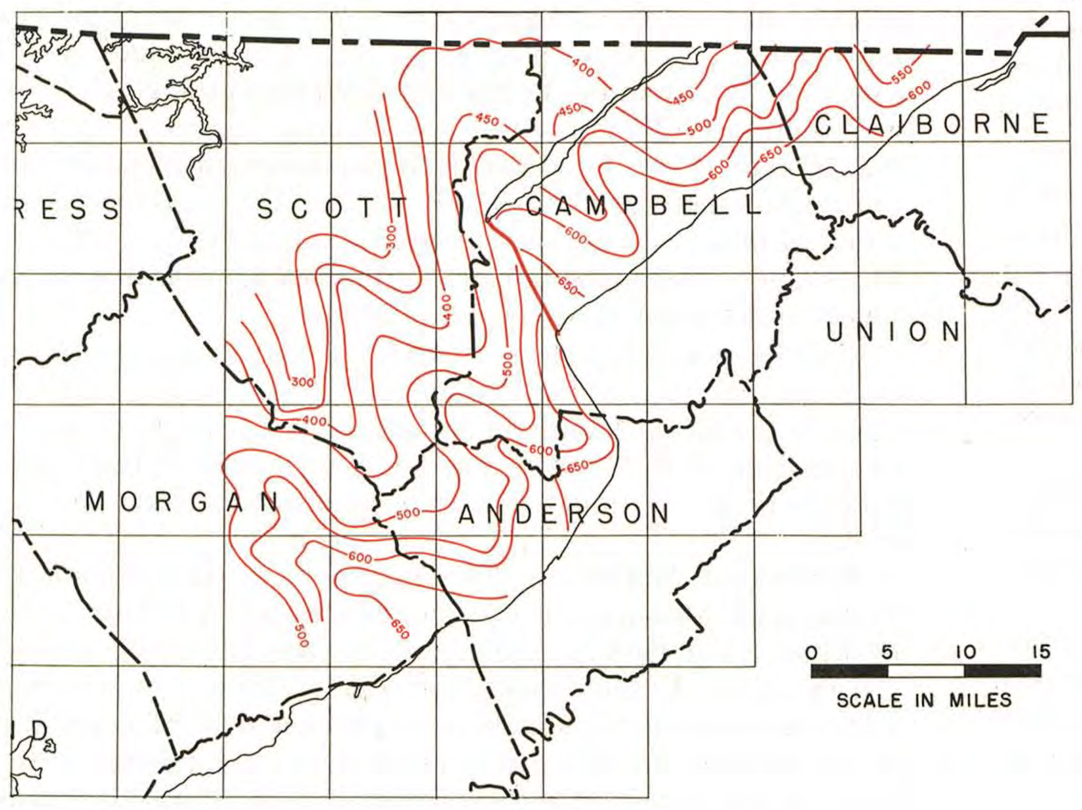
A—REDOAK MOUNTAIN GROUP



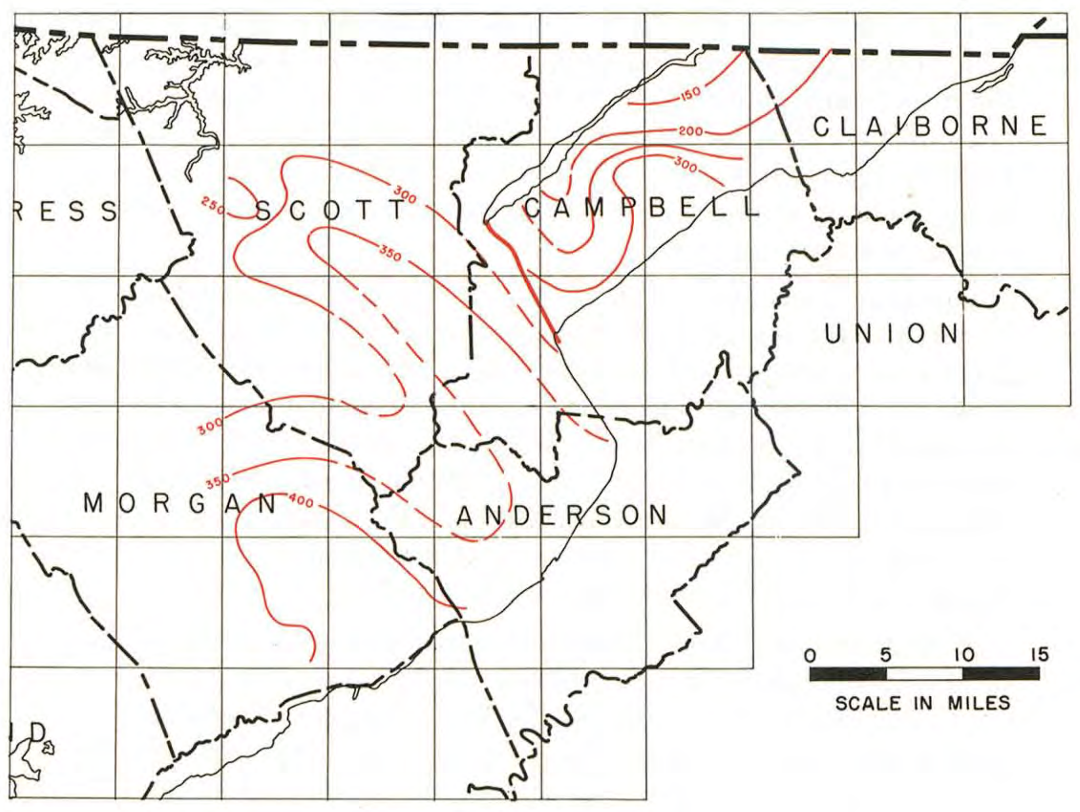
B—GRAVES GAP GROUP



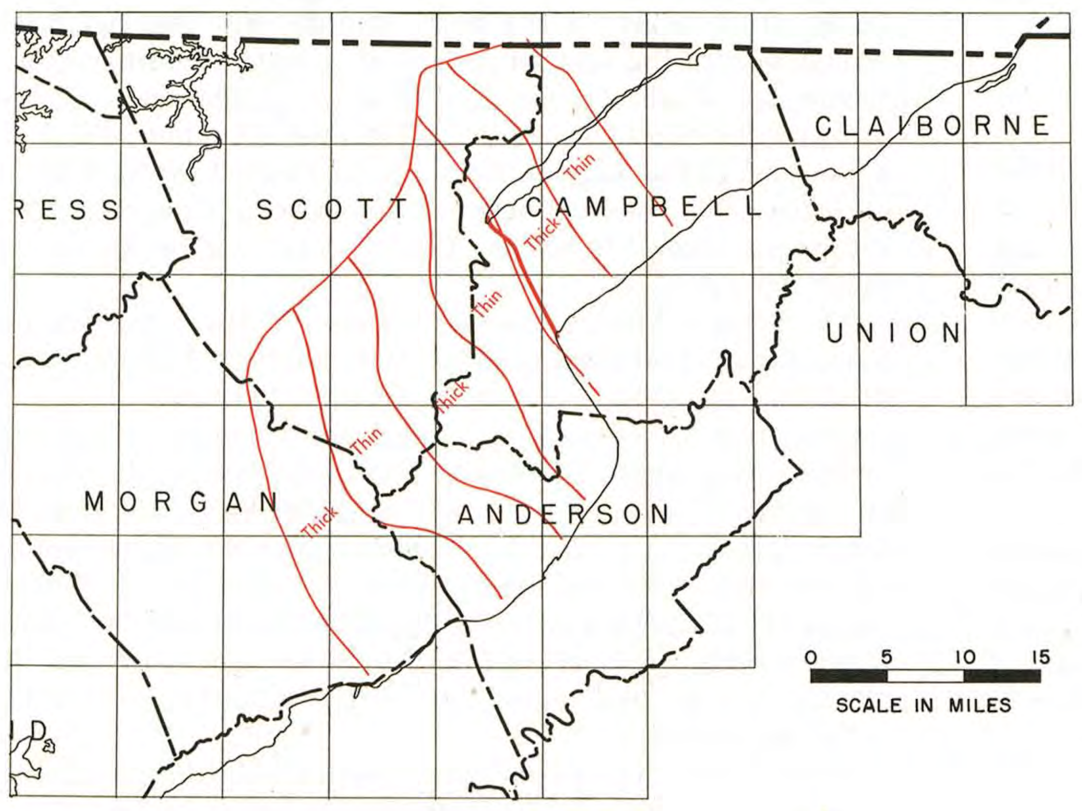
C—INDIAN BLUFF GROUP



D—SLATESTONE GROUP



E—CROOKED FORK GROUP



F—THICK AND THIN BELTS

Thickness variations of the younger Pennsylvanian groups show a consistent pattern. This is a general southeastward thickening with development of pronounced northwest-trending thick and thin belts. This pattern repeats from the Redoak Mountain group through the Crooked Fork group. In older groups this pattern is unknown because of lack of outcrops and scarcity of subsurface data. The isopach map of the Crooked Fork group is not so detailed as the maps of the younger groups (A-D), because the full thickness of this group is rarely exposed in the Wartburg basin. In general, the rate of thinning seems less than that of the younger groups. In groups younger than those shown here, restricted outcrop area (due to erosion) allows only a suggestion of this pattern.

The thick and thin belts in successive groups do not exactly coincide. The axes of these belts vary in geographic location within the bands shown on plate 9-F, and, locally, a thick axis of one group may actually cross a thin axis of another group.

Three possible explanations for these thick and thin belts include: (1) greater concentration of thicker and less compressible sandstones along the thick belts, (2) greater concentration of coal in the thin belts (compaction factor), and (3) differential subsidence of crustal blocks.

The first of these is definitely a contributory factor. As shown on plate 11 the massive phases of several post-Rockcastle sandstones have similar northwest trends. A comparison of these maps with the thick and thin belts shown on plate 9-F demonstrates that there is a greater concentration of massive sandstone within the limits of the thick belts. Although massive sandstones do occur within the thin belts, they are much less abundant.

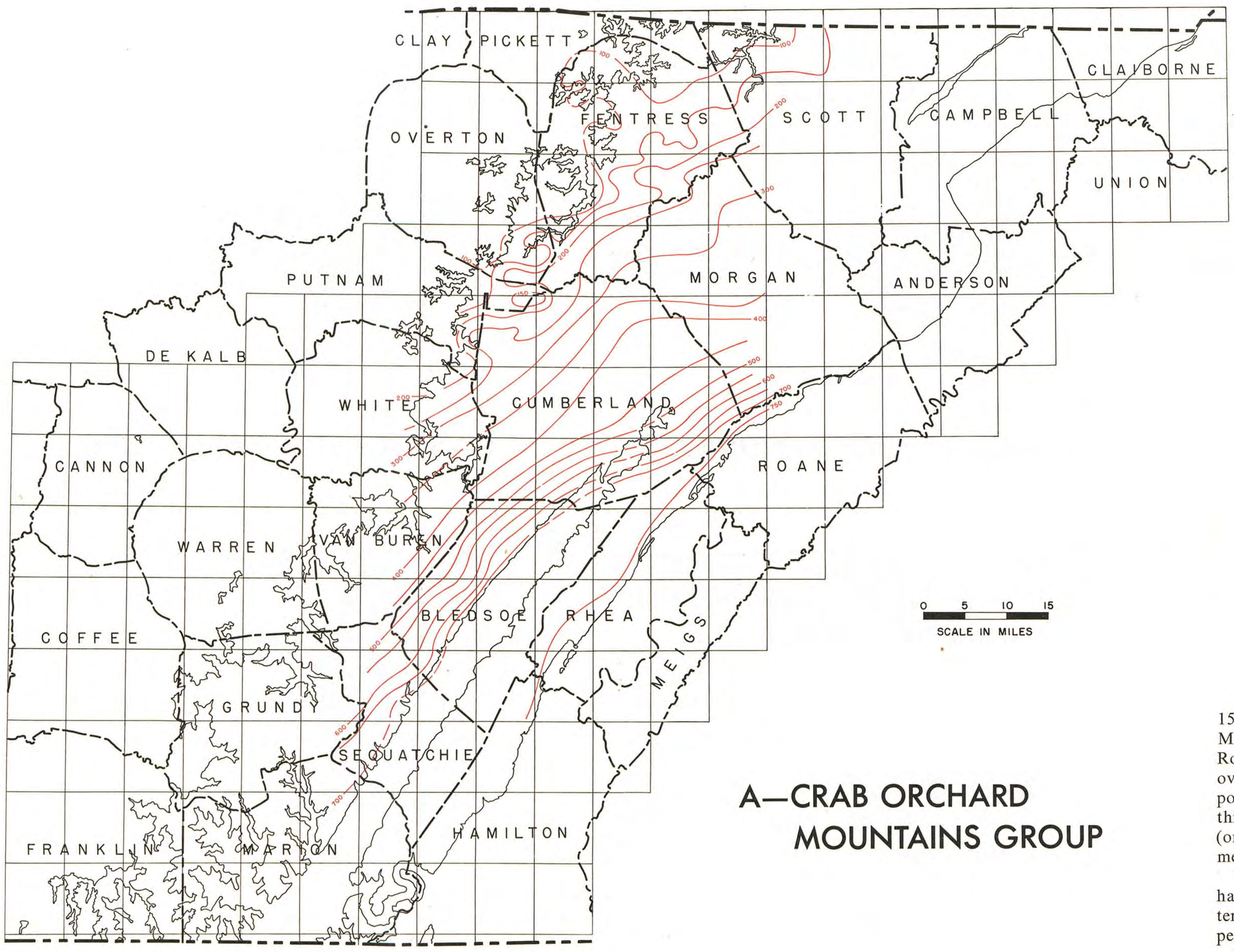
Compaction of coal is another contributory factor, for there is agreement between the thin belts and areas that have been extensively mined. Compaction of shale does not account for the difference in thickness, as a greater thickness of shale is present in the thick belts than in the thin ones. Compaction of shale, therefore, would have decreased, rather than increased, the differential in thickness between the two types of belts.

The combined Slatestone, Indian Bluff, Graves Gap, and Redoak Mountain groups average 475 feet thicker in the thick belts than in the thin ones. It is quantitatively possible for the relative concentration of massive sandstones and the compaction of coal to account for this difference in thickness.

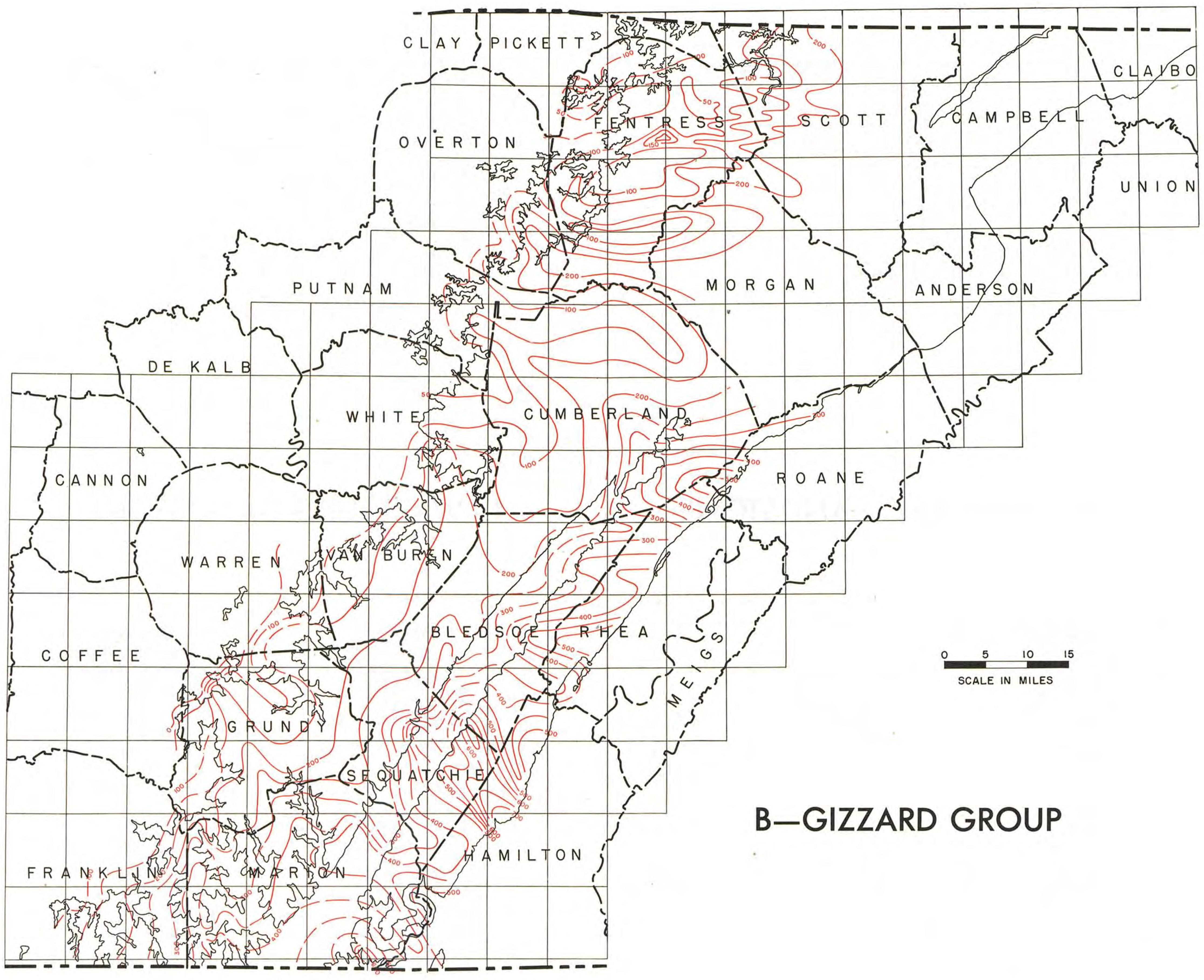
The strike of these belts, however, is so consistent, and the width so equal and uniform, that it is difficult to visualize their initiation and maintenance being due entirely to these two factors. It is possible that a set of deep northwest-southeast fractures may have been a controlling factor. Once northwest-southeast crustal blocks, bordered by these fractures, were formed, their differential subsidence could have initiated differential deposition resulting in the establishment of such belts. It is interesting to note that the Jacksboro fault parallels these belts, and, furthermore, that it forms the boundary between a thick and a thin belt.

The northwest thinning of these groups is largely accomplished by thinning of shales, but also by thinning of some of the sandstones.

PLATE 9—ISOPACH MAPS



A—CRAB ORCHARD MOUNTAINS GROUP



B—GIZZARD GROUP

The thickness of the Rockcastle conglomerate, which averages 150 feet, is excluded from the isopach map of the Crab Orchard Mountains group. This does not affect the pattern, because the Rockcastle does not vary radically from its average thickness. Moreover, using the base of the Rockcastle as an upper datum, it was possible to extend the map over a much larger area, because the full thickness of the Rockcastle is not preserved south of Spring City (on the Eastern Escarpment) or anywhere on the Western Escarpment.

To the south and west contours terminate where the Rockcastle has been removed by erosion. To the north and east the contours terminate where deep burial and lack of subsurface control do not permit contouring.

The Crab Orchard Mountains unit is 750 feet thick along the southeastern part of the map and thins northwestward to 100 feet. The contours are essentially parallel and evenly spaced, indicating an even rate of thinning, except for three features. First, the data available show only 50 feet of thinning across Sequatchie Valley, which is less than anywhere else for the same distance. Second, the rate of thinning is greater between the 450- and 700-foot lines. Finally, the contours in the northwestern part of the map are much more irregular than elsewhere. The greater irregularity shown in this area is, to a large extent, due to the presence of more control points rather than to greater irregularity in the beds themselves.

The line of abrupt thinning of the Sewanee conglomerate (pl. 12-C) parallels the isopach lines (pl. 10-A) and ordinarily lies between the 100- and 200-foot lines.

When the known irregularities of the various sandstones and shales, and the channeling at the base of the Rockcastle and Sewanee conglomerates, are considered, the regularity of the rate of thinning is surprising.

The isopach map of the Gizzard group, plate 10-B, contrasts sharply with that of the Crab Orchard Mountains group. Along the Eastern Escarpment south of the Cardiff quadrangle, the group is characterized by an alternation of thick and thin belts that strike from west to northwest, the thickness ranging from 300 to 700 feet. To the northwest the rate of thinning decreases, and the abrupt variations in thickness are absent. Along the Western Escarpment the thickness is usually from 50 to 100 feet, but in part of the Hillsboro and Cane Hollow quadrangles the group is absent altogether, and the Sewanee conglomerate rests on the Mississippian.

The pattern in the northwest part of the Plateau has more detail, because of a larger number of control points. Here, the group thins northwestward from 200 to 50 feet in a series of east-west belts.

Some of the irregularities of this map are believed to reflect irregular topography cut into the Mississippian strata, upon which the beds of the Raccoon Mountain formation, and locally the Warren Point sandstone, were deposited.

Like the isopach map of the Crab Orchard Mountains group, the Gizzard is not contoured in the northeastern part of the Plateau where data are scarce.

PLATE 10—ISOPACH MAPS

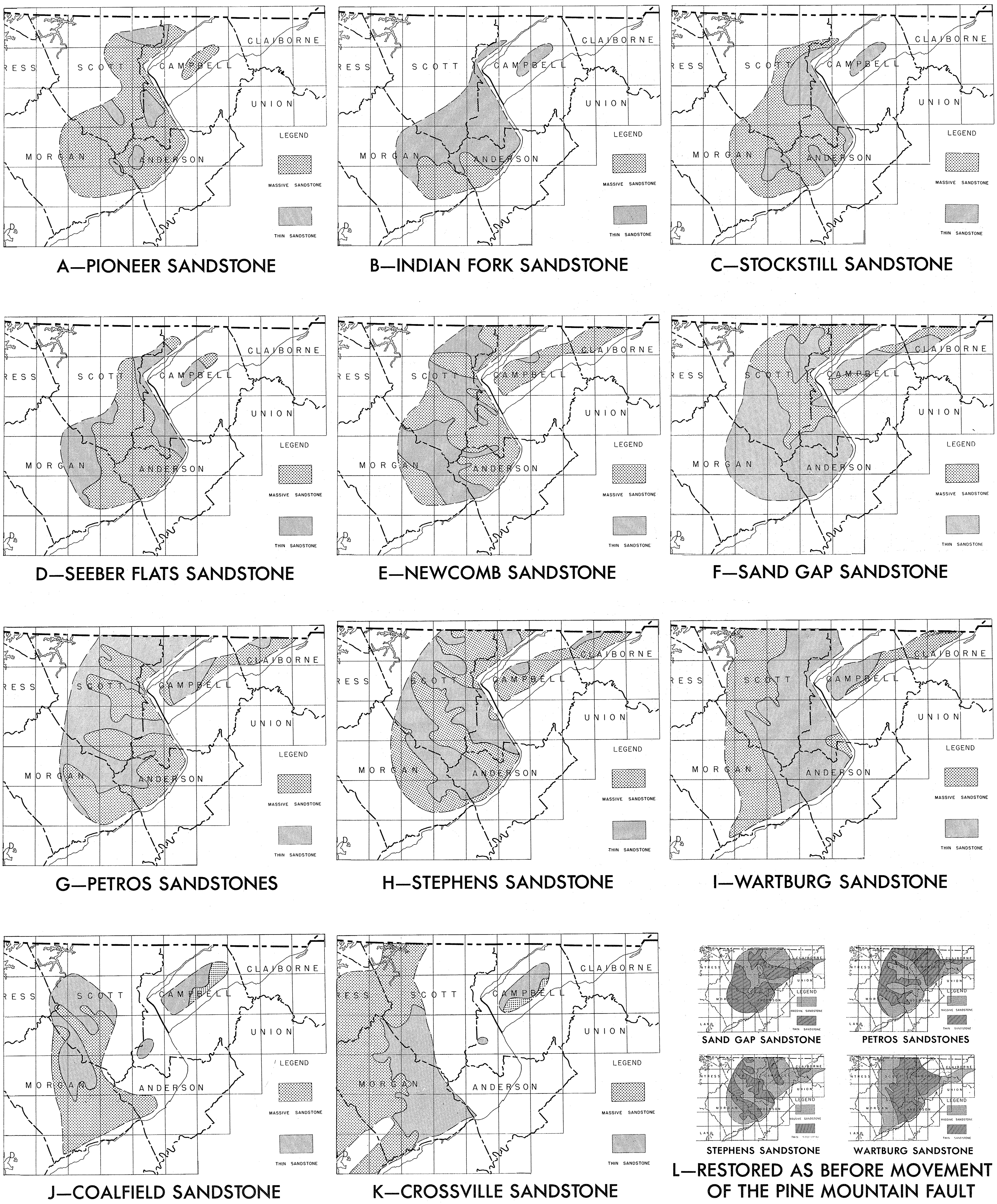
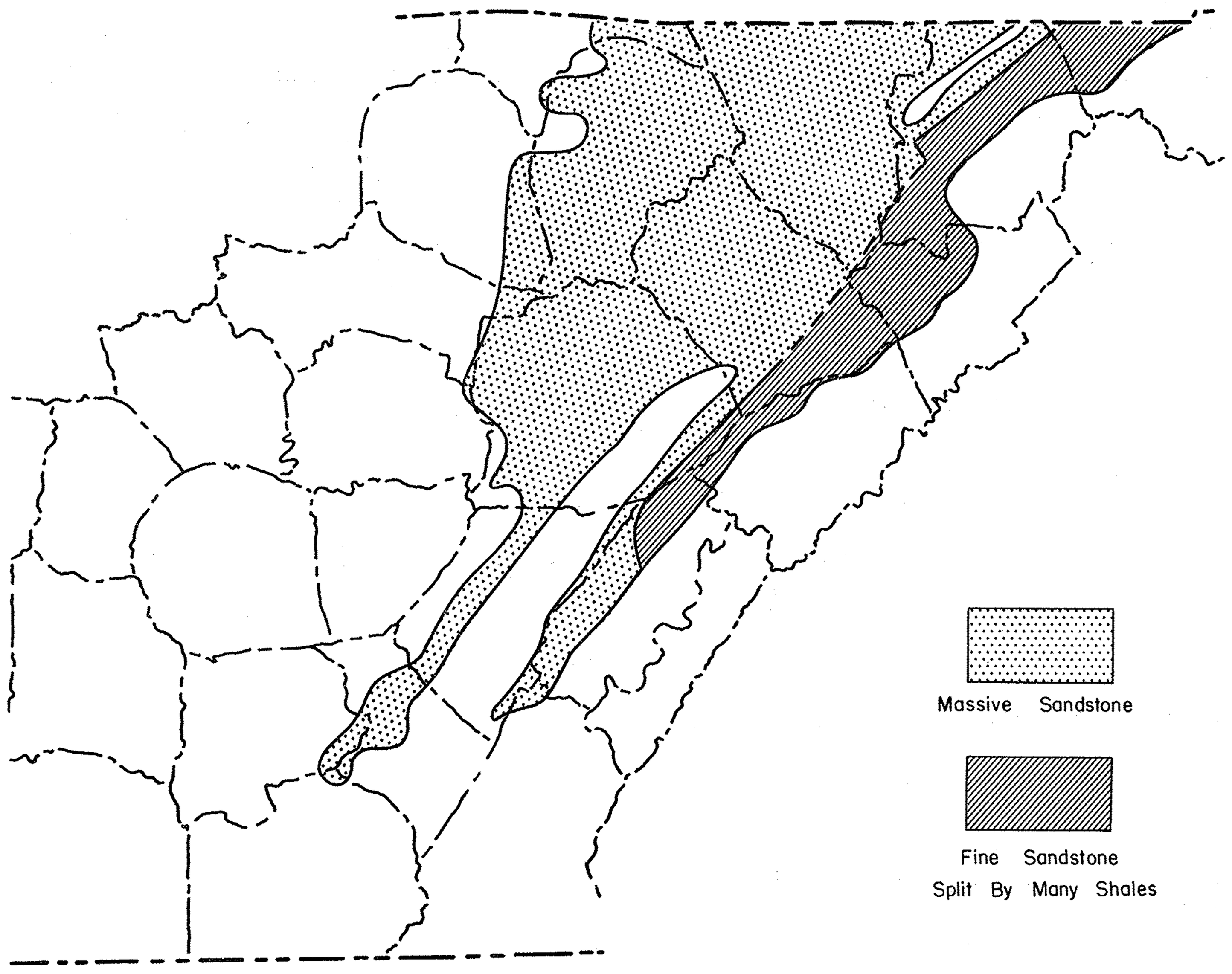
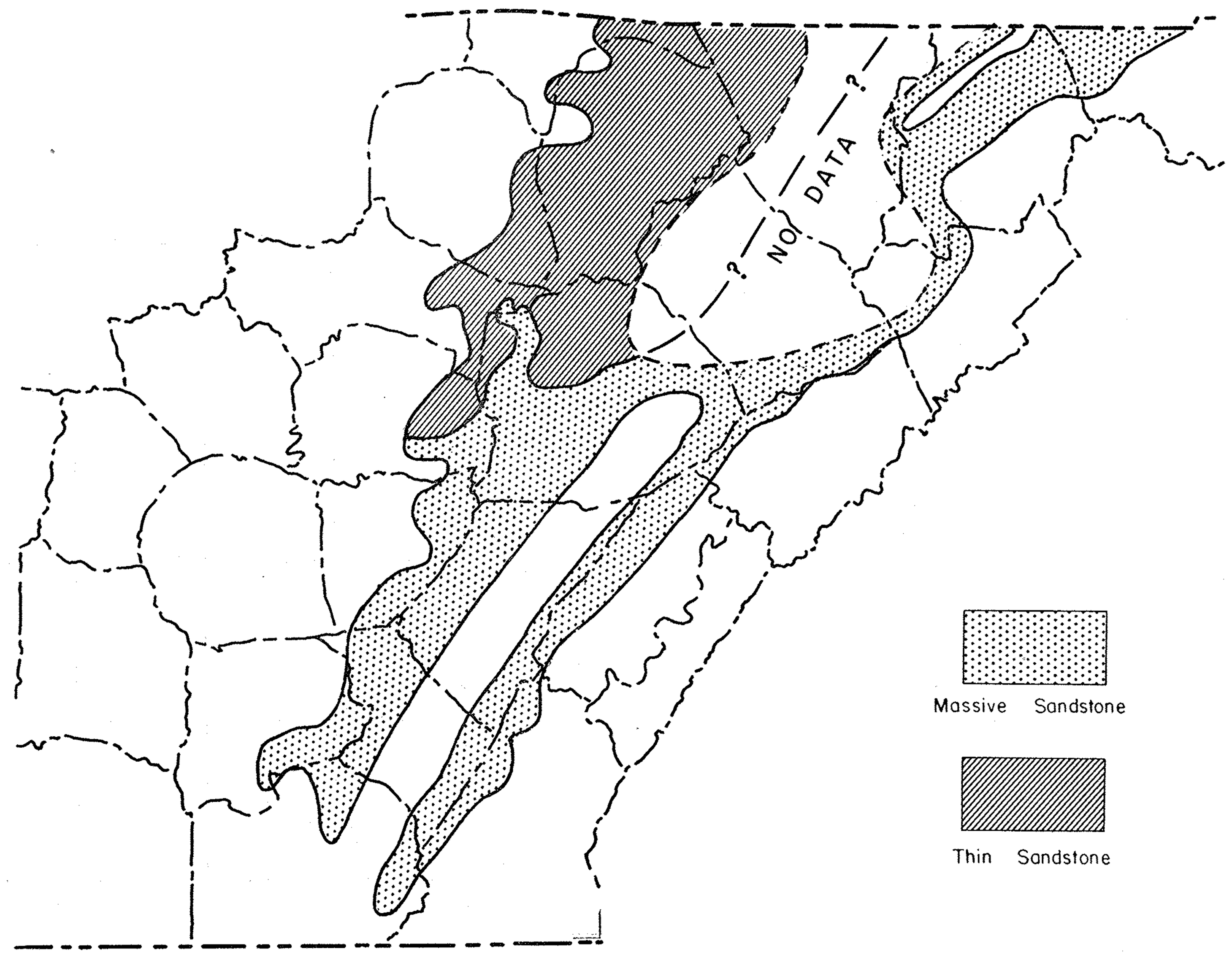


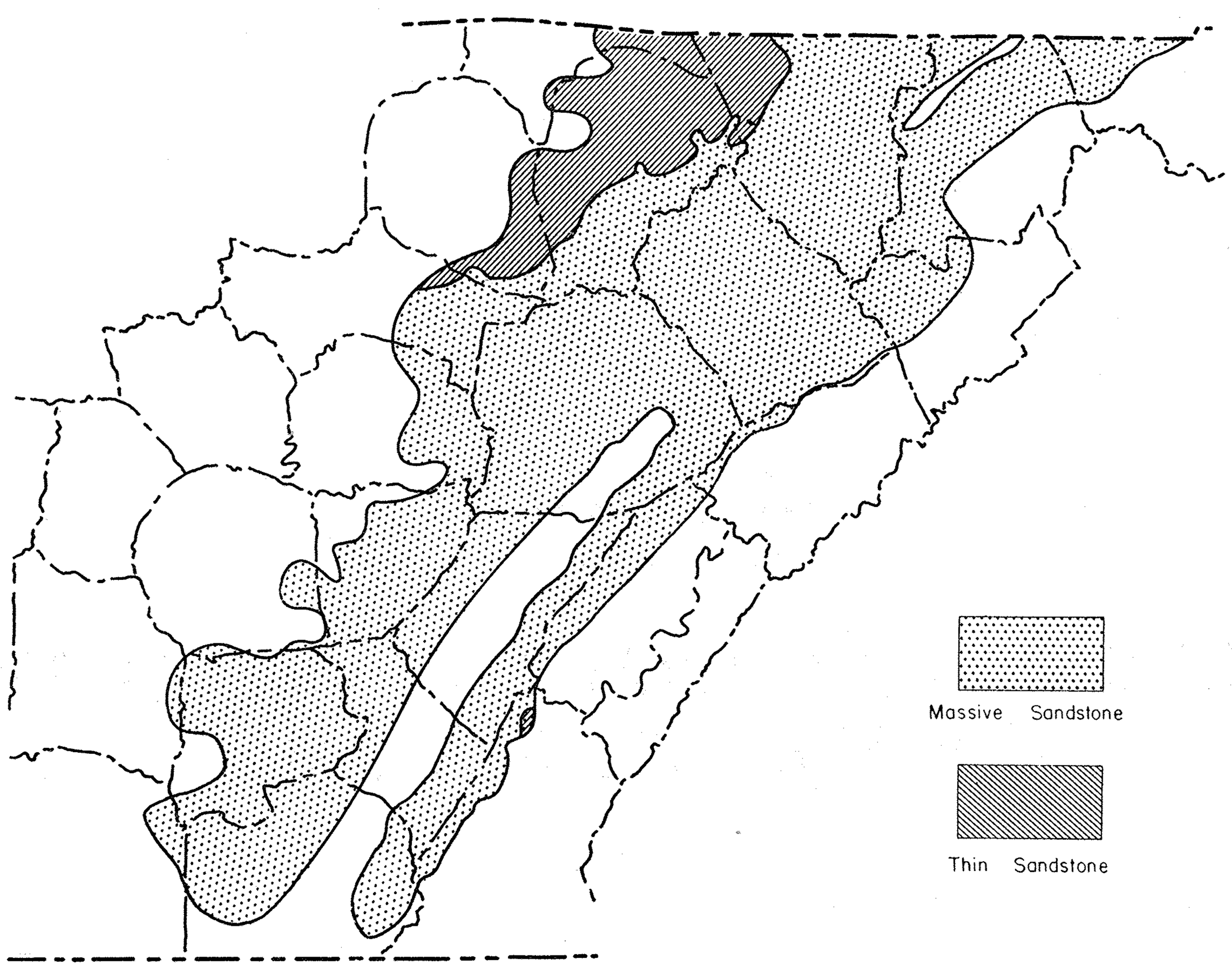
PLATE 11—SAND DISTRIBUTION MAPS



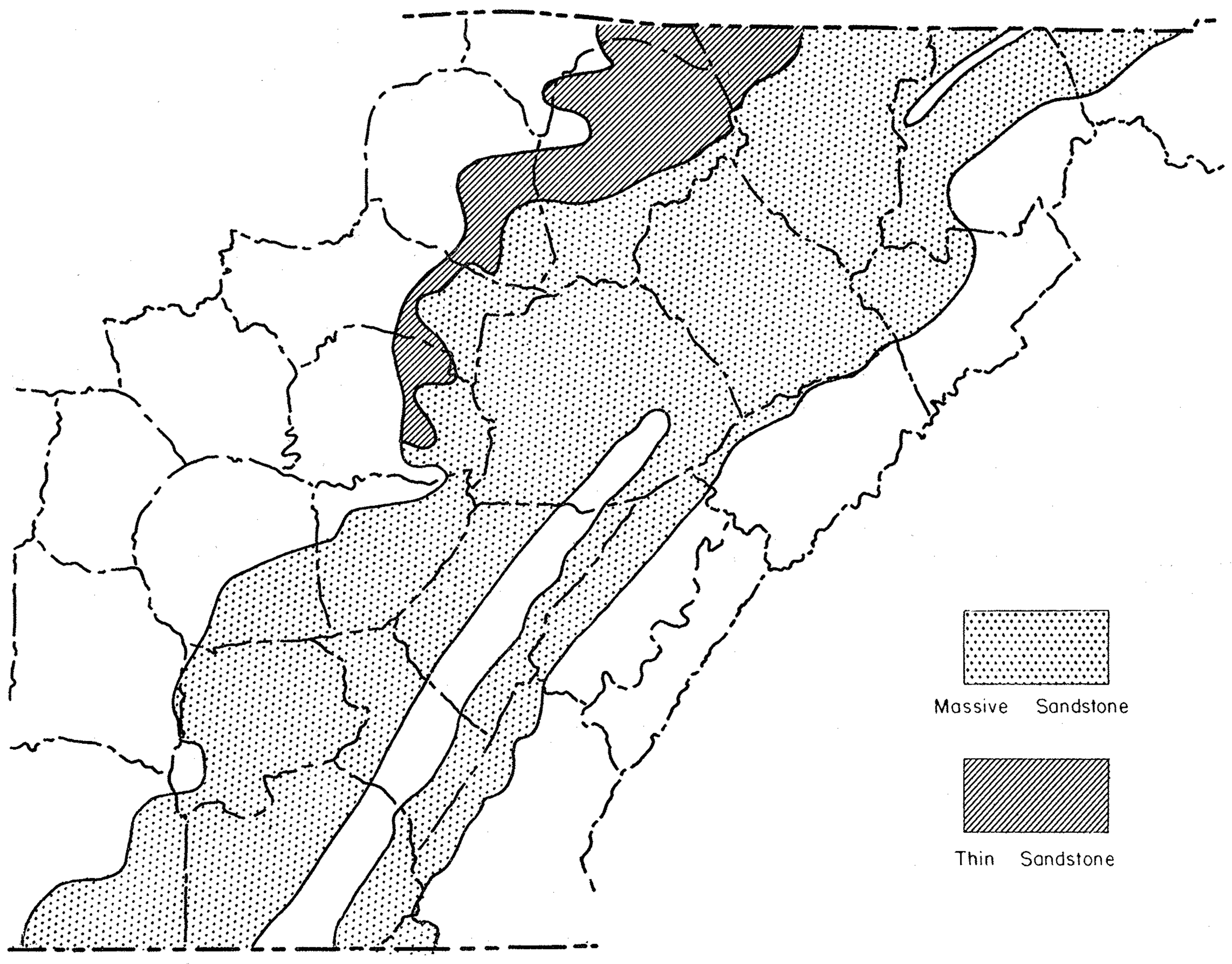
A—ROCKCASTLE CONGLOMERATE



B—NEWTON SANDSTONE



C—SEWANEE CONGLOMERATE



D—WARREN POINT SANDSTONE

Mapping and study of the Pennsylvanian strata revealed that sandstones show marked lateral variation in thickness and lithology. To illustrate the pattern of facies changes two aspects of the sandstones are arbitrarily defined. "Massive" sandstone is usually thicker than 20 feet, massively bedded, prominently crossbedded, and usually medium to coarse in texture. "Thin" sandstone is thinner than 20 feet, thinly bedded and slabby, usually shaly, rarely crossbedded, and fine in texture.

Sand-distribution maps show two distinctive types of patterns. To illustrate these, the sand-distribution maps of the fifteen major sandstones of the oldest five groups are presented on plates 11 and 12. Sandstones in younger groups are not shown because their area of preservation is so small.

Usually two types of distribution patterns occur: (1) a digitate pattern and (2) widespread "blankets." Generally, the digitate pattern occurs in younger sandstones and the blanket pattern in older sandstones. Several younger sandstones (not presented here) also showed development of this digitate pattern. The Pioneer and Stockstill sandstones (pl. 11, A and C) show neither pattern.

The digitate pattern shows "fingers" of massive sandstone trending generally northwest, in which the source of the sand was definitely from the southeast. The fingers of massive sandstone have a complex pattern, and most of them disappear northwestward, merging into thin phases of the same age. This pattern is best illustrated by the Indian Fork, Seeber Flats, Newcomb, Sand Gap, Petros, Stephens, and Coalfield sandstones.

The blanket pattern shows widespread areas of massive sandstone having a comparatively even trending boundary with thin sandstone of equivalent age. This pattern is developed in the Wartburg, Crossville, Rockcastle, Newton, Sewanee, and Warren Point sandstones.

These sand-distribution patterns are related to the group isopach patterns. The trend of thick belts in younger groups is generally the trend of the fingers of massive sand. The trend of the edge of massive sandstone blankets for the oldest three sandstones generally follows the isopach trend of the Crab Orchard Mountains and Gizzard groups. (Compare pl. 12, B-D with pl. 10.)

The massive Wartburg and Crossville sandstones contain quartz pebbles north of New River, Oneida South quadrangle, Scott County. In both of these sandstones the crossbedding dips predominantly to the south and southwest. Both of these features suggest transportation of the sand into Tennessee from the north. This does not mean that these clastics did not originally come from the conventionally postulated eastern source. They may have been first swept westward and then southward into Tennessee.

Plate 12 shows the areal relationship between massive and thin phases of four older sandstones, the Rockcastle, Newton, Sewanee, and Warren Point. Here, the massive phases are usually as thick as 100 feet and are often conglomeratic. Along the northern part of the Eastern Escarpment the Rockcastle is less massive and is split by partings of shale. The Newton, Sewanee, and Warren Point are thin, minor sandstones in the northwestern part of the Plateau, where they are part of the Fentress formation; throughout most of the Plateau, however, these are thick, massive sandstones or conglomerates.

Of the four older sandstones, three, the Warren Point, Sewanee, and Newton, thin abruptly along well defined lines which trend roughly northeast-southwest and parallel one another remarkably. All four of these sandstones thicken to the southeast. This southeastward thickening holds true for the whole Plateau, and for the intermediate shale units as well as the sandstones.

In contrast to the Wartburg and Crossville (pl. 11, I and K), which thin eastward, the Newton, Sewanee, and Warren Point (pl. 12, B-D) thin to the northwest. The source direction for these older sandstones is unknown, but it appears unlikely that it was from the north, as in the case of the Wartburg and Crossville.

Plate 11-L shows hypothetical maps of four of the sandstones before movement occurred along the Pine Mountain fault. In these maps the patterns shown southeast of the Cumberland Block are now present on the Cumberland Block (as shown on pl. 11, F-I), and the postulated connections are presumed to have been thrust over the Plateau and then removed by erosion.

PLATE 12—SAND DISTRIBUTION MAPS

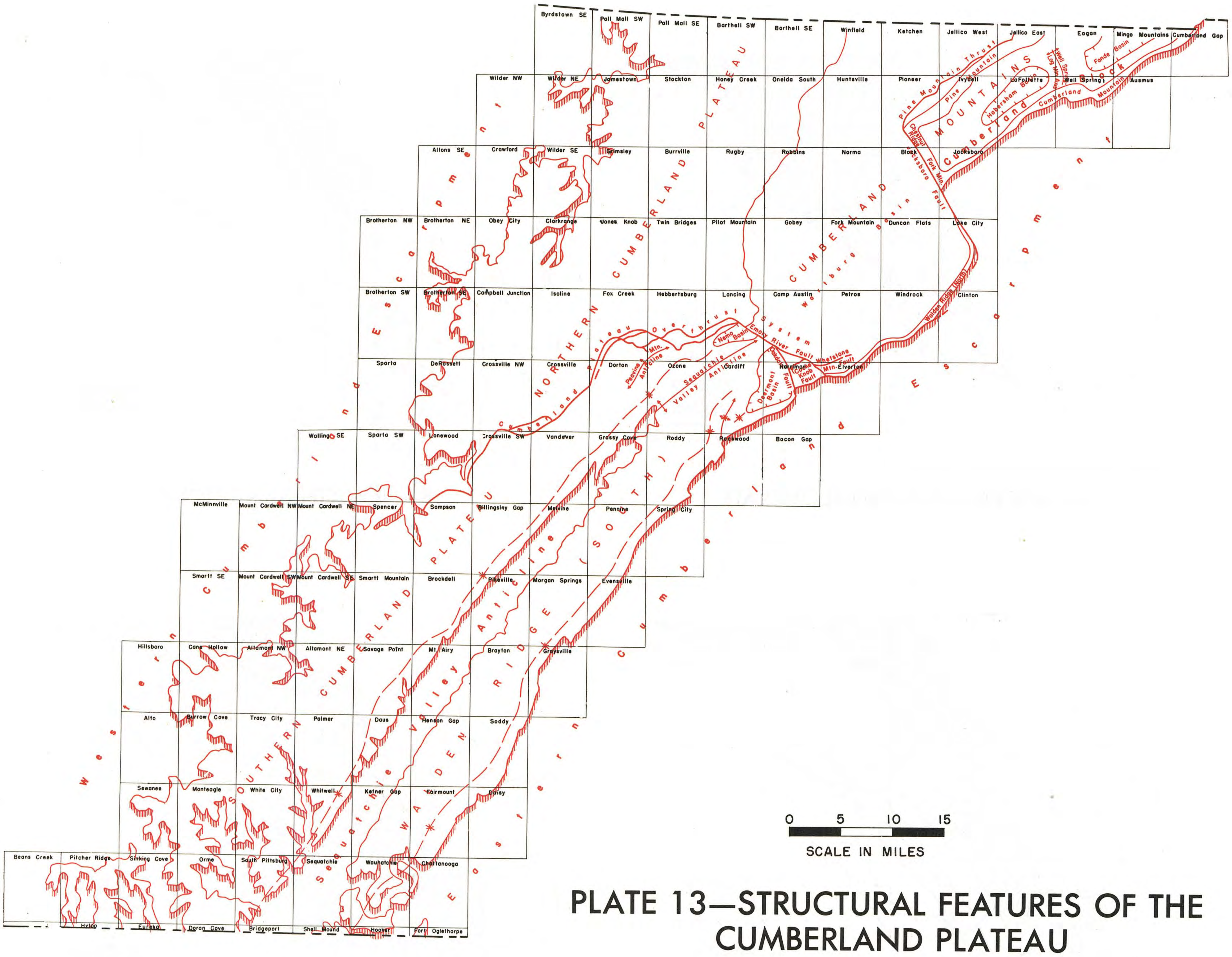


PLATE 13—STRUCTURAL FEATURES OF THE CUMBERLAND PLATEAU

STRUCTURE

Throughout most of the Cumberland Plateau the beds rise gently to the northwest away from the upturn of Walden Ridge. This Plateau is divided into several subordinate provinces by zones of faulting and uplift (pl. 13). The eastern boundary of the Plateau is itself an uplift involved with thrusting, and east of this boundary Pennsylvanian strata are known to occur but lie buried by thrusting in the Valley and Ridge province. This is shown by several fensters on the geologic maps (pls. 5 and 8).

The datum for plate 14 is variable because of the erosion pattern. (See geologic maps, pls. 5-8.) Where the Rockcastle is at least partly preserved from erosion, its top or base was used. However, to the south and west (pl. 14), it was necessary to use the Sewanee conglomerate as a datum, because it is the highest unit preserved from erosion. The Sewanee itself consists only of remnants in some areas.

On plate 14 the complexity of the fault patterns, particularly that of the Cumberland Plateau overthrust, is of necessity greatly simplified. Where two faults are close to each other, no attempt was made to contour the area between them. Similarly, the contour lines are drawn diagrammatically along the Eastern Escarpment and around both Sequatchie Valley and the Cumberland Block, in order to more clearly delimit these structural features.

CUMBERLAND BLOCK

The Cumberland Block is a portion of the Plateau set apart from the main body of the Plateau by the Pine Mountain and Jacksboro faults and is otherwise known as the Pine Mountain overthrust. Physiographically, it is part of the Cumberland Mountains and consists largely of irregular hills and valleys, which are surrounded by prominent strike ridges expressing the structure of the periphery of the block. It is bounded on the southeast by Cumberland Mountain, which here forms the Eastern Escarpment. On the northwest is Pine Mountain, which lies along the southeast side of Elk Valley. To the southwest, paralleling the Jacksboro fault, are Fork Mountain and Chestnut Ridge, the two being separated by Sharp Gap, through which Titus Creek flows.

This block is a rectangular structural basin with nearly flat beds throughout most of its extent and steeply dipping beds around its perimeter. It is underlain by the Pine Mountain thrust, which has its roots in the Valley and Ridge Province to the east. Along this thrust the strata have been moved northwestward about 10 miles and raised about 500 feet above their normal level on the adjacent part of the Plateau. The structural basin of the block is divided into two subordinate basins by the north-south Well Spring-Log Mountain cross-axis. The southwestern basin is here named the Habersham basin, and the northeastern, the Fonde basin. The structure and mechanics of this block have been discussed in detail by Butts (1927) and Rich (1934).

Along Pine Mountain the beds dip from 10 to 35 degrees to the southeast. The beds along Cumberland Mountain dip even more steeply to the northwest, being locally vertical. This dip flattens abruptly to merge into the floor of the basin. Along the Jacksboro fault, Fork Mountain and Chestnut Ridge represent a tightly folded anticline paralleling the Jacksboro fault.

In Tennessee, on the outcrop of the Pine Mountain thrust, beds ranging in age from Silurian to Mississippian have been thrust over Pennsylvanian. As this study relates only to Pennsylvanian strata, no attempt was made to map the complex structure in pre-Pennsylvanian beds. The fault continues northeastward across Kentucky into Virginia, where it merges with the Russell Fork fault.

There is a minor thrust, northwest of the Pine Mountain thrust, which extends about 12 miles northeast from the Pine Mountain-Jacksboro fault junction. This lesser fault slice consists of intensely deformed beds of the Gizzard and Crab Orchard Mountains groups, which override flat-lying Slatestone beds. An outlying klippe, known as Hells Point Ridge, occurs on the Pioneer and Ivydell quadrangles. Here, contorted older sandstones can be seen not far above mines in the flat-lying Blue Gem coal.

The Jacksboro cross fault forms the southwestern edge of the Cumberland Block and connects the Pine Mountain thrust with Valley and Ridge structure. Along its outcrop it is a high-angle fault, but northeastward, in the subsurface, it abruptly flattens and merges with the Pine Mountain thrust. Lateral movement along this fault was approximately 10 miles, but vertical movement was only about 500 feet. The beds are badly deformed along the fault. Immediately northeast of the fault lateral stresses accompanying the movement resulted in a tight anticline represented by Fork Mountain and Chestnut Ridge.

On the southwest side of the Cumberland Block beds of the Crab Orchard Mountains and Gizzard groups are faulted against nearly flat Slatestone beds. South of the Cumberland Block to Lake City, Cambrian to Mississippian beds are faulted against Pennsylvanian ranging from Slatestone to Gizzard groups (pl. 6). Walden Ridge (North) begins where resistant beds of the Crab Orchard Mountains and Gizzard groups appear at the surface against the Jacksboro fault.

WARTBURG BASIN AND NORTHERN CUMBERLAND PLATEAU

The Wartburg structural basin is bounded on the northeast by the Jacksboro fault, on the southeast by Walden Ridge, and on the southwest by the Emory River and Whetstone Mountain faults. It is arbitrarily limited on the west and northwest, and there merges with the Northern Cumberland Plateau (pl. 14).

Plate 14, drawn primarily on the Rockcastle, shows only general structure of this area. More detail on four horizons is shown on plate 15.

The structure on the top of the Rockcastle in the Northern Cumberland Plateau consists of a gentle rise to the west or northwest, averaging 25 feet per mile. This structural province merges into the Wartburg basin. It is separated from the Southern Cumberland Plateau by the Cumberland Plateau overthrust.

CUMBERLAND PLATEAU OVERTHRUST

The Cumberland Plateau overthrust is a complex system of thrusts and cross faults marking the northwest boundary of an extensive overthrust mass similar to the Pine Mountain Block. This fault system crosses the Plateau from Elverton on the east to the northwest corner of the Sampson quadrangle on the west. This faulting is the boundary between the Northern and Southern Cumberland Plateau sub-provinces.

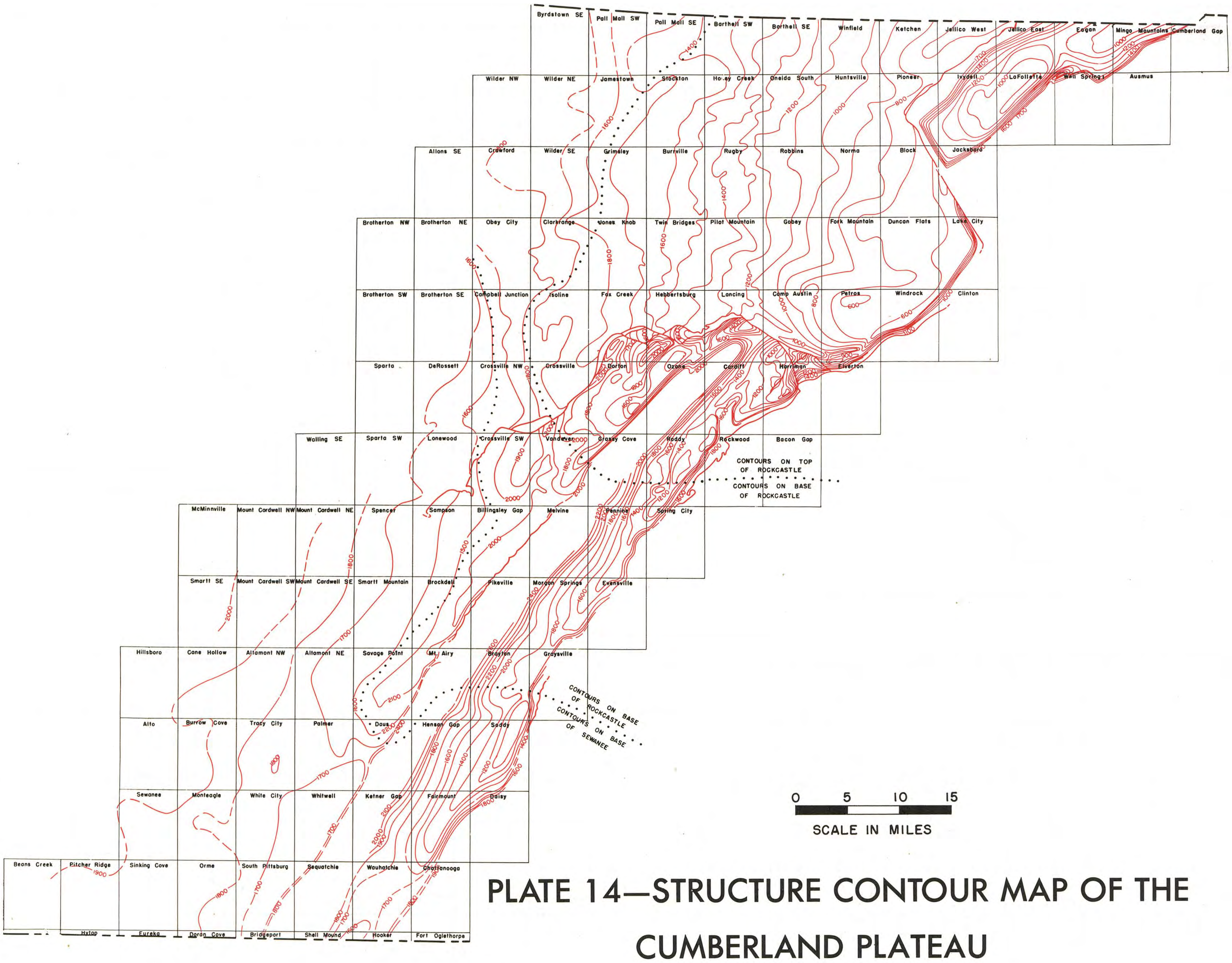


PLATE 14—STRUCTURE CONTOUR MAP OF THE CUMBERLAND PLATEAU

The outcropping fault system is the limit of extensive bedding thrusting believed to involve the entire southern part of the Cumberland Plateau. Movement along this thrust appears to be rotational, diminishing southward.

South of the Sampson quadrangle the fault is believed to continue as a bedding thrust along the face of the Western Escarpment. Evidence of this thrusting has been found in Van Buren, Grundy, Marion, and Hamilton Counties.

This thrust arches over the Sequatchie Valley anticline, following bedding. Its trace outcrops on both sides of this structure and around Grassy Cove and Crab Orchard Cove. This outcrop pattern of the Cumberland Plateau overthrust is not shown on the geologic and structure maps, except between the Melvine and Brockdell quadrangles, where offset occurs thrusting Mississippian beds on Gizzard (pl. 8). For additional information on the structural system, see Stearns (1954).

The Emory River fault, which joins Valley and Ridge structure near Elverton, forms the northeastern end of that part of the overthrust which affects Pennsylvanian beds. Beds southwest of this fault have been moved laterally northwestward. The Oakdale fault branches off the Emory River fault near Camp Austin and intersects the Eastern Escarpment just north of Harriman. At Harriman, where the Oakdale fault is overridden by a later thrust, there is a pronounced offset in Walden Ridge.

At some time prior to movement along the Emory River fault the Whetstone Mountain-Cooke Knob faulted anticline was formed parallel to Valley and Ridge structure (pl. 13). This anticline has been offset approximately 1 mile by the Emory River fault. The Whetstone Mountain-Cooke Knob fault is exceptional because the fault plane dips northwest. This faulted anticline dies out abruptly in the vicinity of Coalfield. A narrow syncline lies between this structure and the Eastern Escarpment.

SOUTHERN CUMBERLAND PLATEAU

The structure of the Southern Cumberland Plateau is generally simple, with a southeast dip of 15 to 20 feet per mile. To the north, near the outcrop of the fault system, it is complex, with a series of anticlines and basins.

The most prominent anticline is the Peavine Mountain structure. This structure represents arching of younger strata over older Pennsylvanian beds piled up in imbricate slices by the Cumberland Plateau overthrust, which underlies the entire area. This anticline does not affect Mississippian or older strata, as has been shown by drilling. Other anticlines are present in this general area, but it is not known whether they persist below the thrust plane.

The lowest structural position on the Southern Cumberland Plateau is encountered adjacent to the Sequatchie Valley anticline, as a result of the prevailing southeast dip.

Deepest of all is the Nemo basin adjacent to the Emory River fault. The Southern Cumberland Plateau is separated from Walden Ridge (South) by the Sequatchie Valley anticline.

SEQUATCHIE VALLEY ANTICLINE

This prominent anticline parallels Valley and Ridge structure and extends for 200 miles from Blount County, Alabama, northeastward to Cumberland County, Tennessee. It diminishes northeastward in the Lancing quadrangle and terminates at the Emory River fault. The southeastern flank dips gently, but the northwestern flank is steep and locally even vertical. The trace of the Cumberland Plateau overthrust, here a bedding plane thrust in the Gizzard group, occurs around this structure, as already described. The steep northwest limb is also broken by a thrust, along which beds ranging from Cambro-Ordovician to Mississippian in age are thrust over Mississippian and lower Pennsylvanian strata throughout most of the length of Sequatchie Valley.

Generally, this faulted anticline has had the resistant Pennsylvanian strata removed from its crest by erosion, exposing less resistant older formations into which the Sequatchie Valley has been cut. To the north, resistant Pennsylvanian strata have been breached by erosion over Grassy Cove and Crab Orchard Cove, permitting erosion to cut deep into the underlying Mississippian limestones and shales. The Crab Orchard Mountains are the unbreached portions of the Sequatchie Valley anticline north of these coves.

WALDEN RIDGE (SOUTH)

South of the Emory River fault the name, Walden Ridge, is applied to that part of the Cumberland Plateau lying between the Sequatchie Valley anticline and the Eastern Escarpment; whereas, north of this fault as far as Vasper, the name applies only to the narrow ridge along the Eastern Escarpment. Along most of its extent Walden Ridge (South) is an asymmetrical syncline, with the axis close to the Eastern Escarpment, except in the southernmost part.

In the south-central part of the Cardiff quadrangle a prominent anticline extends northward into the Plateau from the Eastern Escarpment, crossing the syncline of Walden Ridge. This anticline is the southwest boundary of the Deermont basin (pl. 13). Southwest of this anticline is another basin centering in the Roddy quadrangle, and a third basin occurs farther southwest, centered in the Soddy quadrangle. This basin is separated from the second by a broad, low arch. (See pl. 14.)

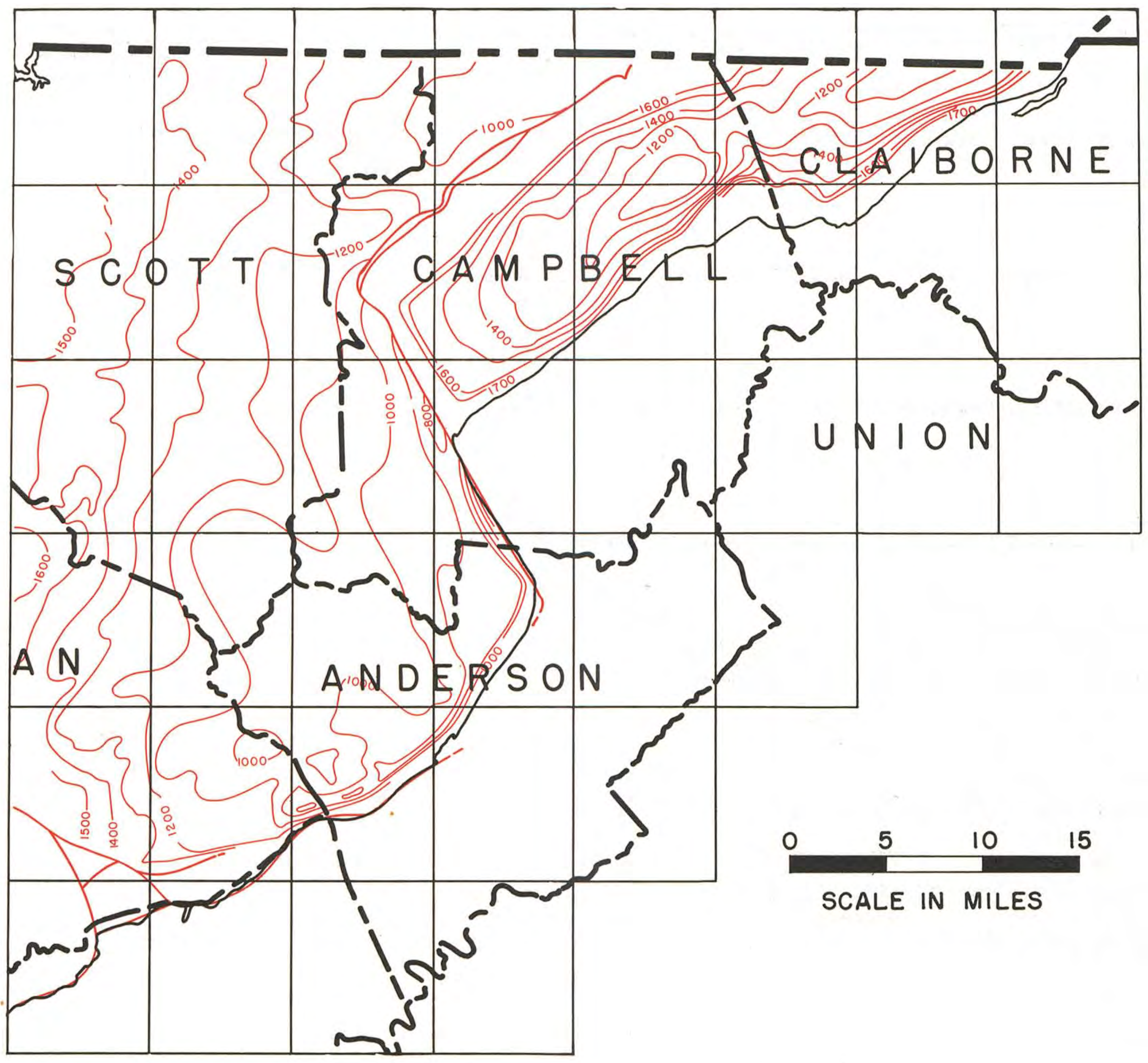
EASTERN ESCARPMENT

A prominent ridge marks the entire eastern limit of the Cumberland Plateau. This feature is called "Cumberland Mountain" north of the Jacksboro fault, "Walden Ridge (North)" between the Emory River fault and the Jacksboro fault, and is not named south of the Emory River fault, although it is almost as prominent.

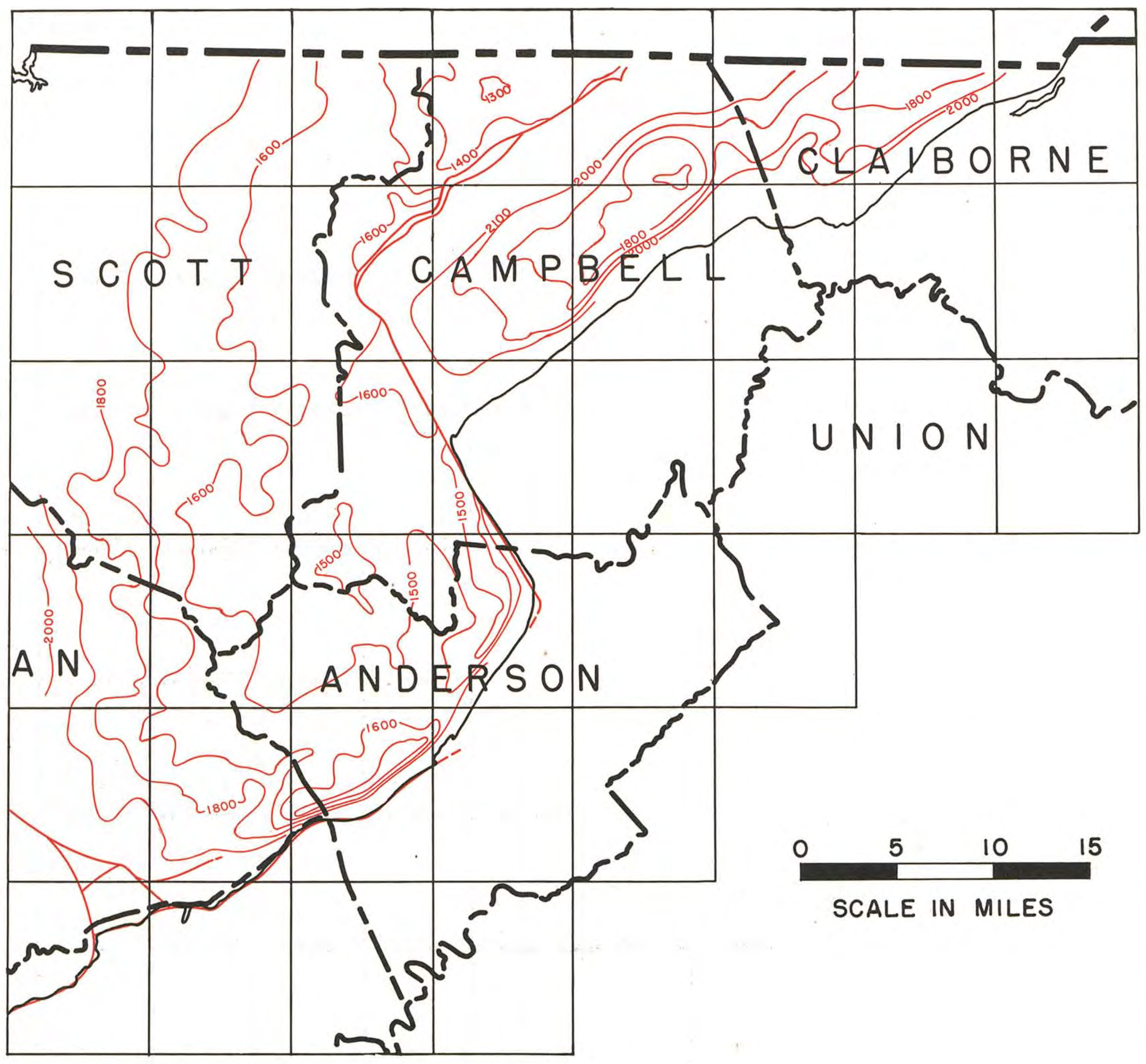
Steep northwest or vertical dips prevail and flattening is abrupt to the northwest, as the gentle southeast regional dip is joined. South of the Jacksboro fault this steeply dipping belt is involved with thrust faulting of the Valley and Ridge province to the east.

Locally, south of the Emory River fault, it is evident that the Eastern Escarpment is an anticline, with its southeast limb commonly buried by thrusting or faulted out. That Pennsylvanian beds actually extend eastward into the Valley beneath the thrusts is demonstrated by several fensters from Spring City northeastward to Rockwood. (See pls. 5 and 8.) Buried Pennsylvanian beds may occur beyond the fensters from near Dayton to near Oliver Springs.

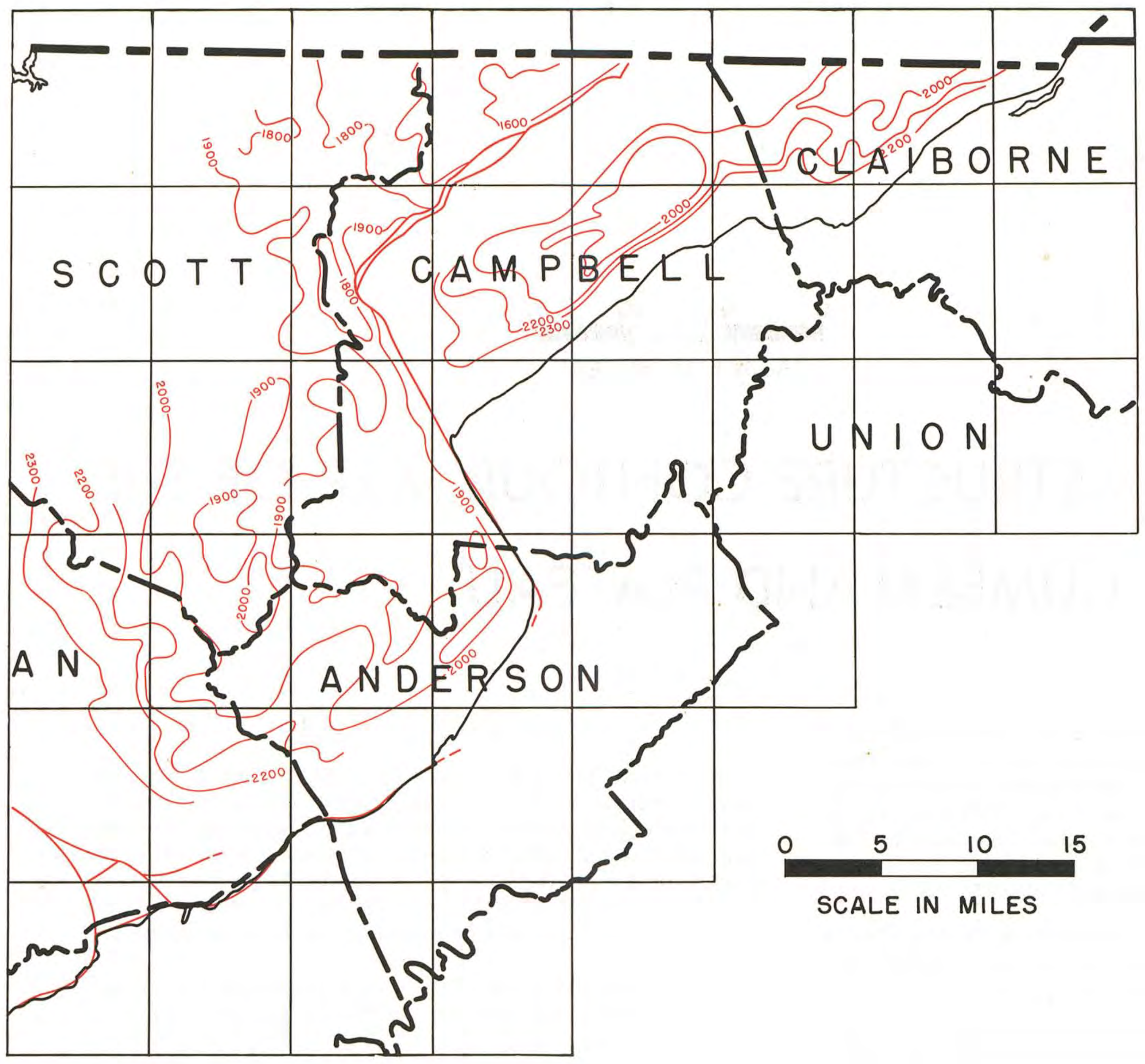
South of Dayton the only Pennsylvanian occurrences known east of the Escarpment are the synclinal preservations on Lookout Mountain (pl. 8) and on Grindstone Mountain farther to the east.



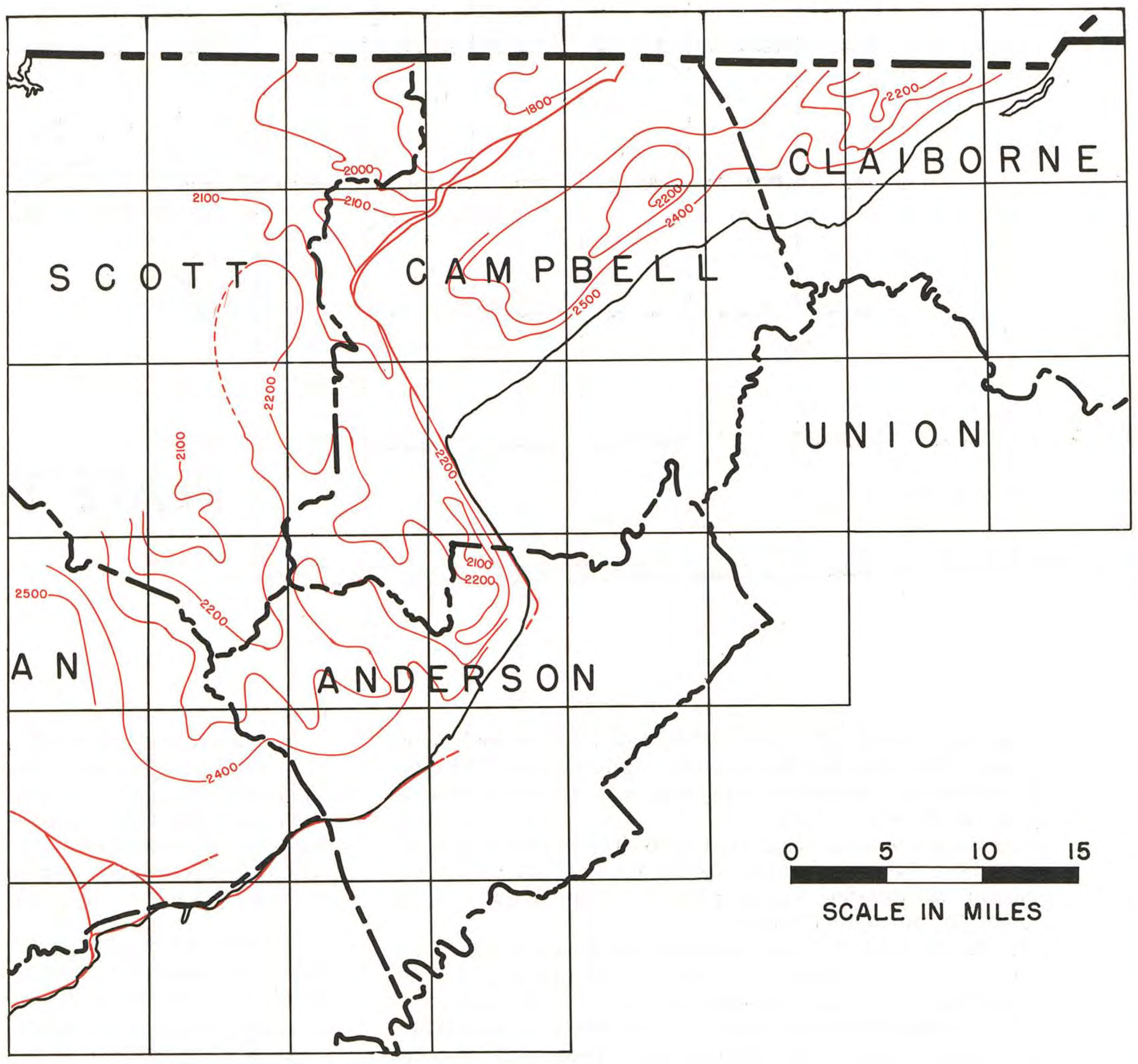
A—POPLAR CREEK COAL



B—JELLICO COAL



C—PIONEER SANDSTONE



D—WINDROCK COAL

The structural contour maps, plate 15, drawn on the Poplar Creek coal, the Jellico coal, the top of the Pioneer sandstone, and the Windrock coal show the structure of successively younger Pennsylvanian beds in the northeastern part of the Cumberland Plateau.

Control points for the structural contour map on the Poplar Creek coal are plentiful in the western part of the map area but are not so numerous in the eastern part. The regional rise of this coal is approximately the same as that of the top of the Rockcastle, and the Wartburg basin has a development similar to that shown by the structural contour map on the top of the Rockcastle (pl. 14). Note the synclines along Walden Ridge and the Jacksboro fault. The Cumberland Block as contoured on this horizon is a rectangular structural basin, divided into the Habersham and Fonde basins by the Well Spring-Log Mountain cross-axis. On this block the Poplar Creek coal is from 300 to 500 feet higher than on adjacent parts of the Northern Cumberland Plateau.

Inasmuch as the Jellico coal is widely prospected and mined, more control points are available for this than any other horizon. The structural contour map on this coal therefore presents the most accurate structural pattern of all the maps. The rate of regional rise to the west is less than on the Poplar Creek coal, averaging no more than 15 feet per mile. In the Gobey quadrangle the dip is locally as high as 50 feet per mile, but this involves more than regional dip. Structure contours on the Jellico coal show the Wartburg basin to be approximately the same as contoured on the Poplar Creek coal, except that the central part is essentially flat. The synclines along Walden Ridge and the Jacksboro fault, and the structure of the Cumberland Block, are essentially the same as contoured on the Poplar Creek coal.

The structural pattern shown by the top of the Pioneer sandstone is approximately the same as that on the Jellico coal, with one significant exception. This horizon has no true regional rise to the west or northwest as do all the older horizons contoured.

In the case of the younger Windrock coal regional dip actually reverses, and, instead of rising to the northwest, it rises to the southeast at the rate of about 20 feet per mile. Apparently, the northwestward thinning of the underlying beds more than counterbalances any superimposed structure. All beds younger than the Windrock also dip to the west or northwest.

Another characteristic structural feature of the Windrock coal that was not shown by the older horizons is the presence of an alternation of northwest-striking structural "highs" and "lows." The highs coincide with the belts of thick sediments, and the lows with the belts of thin sediments shown on plate 9-F. The highs and lows are therefore believed to represent the cumulative effect of concentration of more massive phases of the sandstones within the limits of the thick belts (or highs of the Windrock) and of concentration of coal seams within the limits of the thin belts (or lows of the Windrock). This relationship was not shown by any of the older horizons, and the Windrock is the youngest horizon with enough control points for satisfactory contouring.

Along Walden Ridge the Windrock has been removed by erosion far enough from the Ridge that the contours show no suggestions of the synclinal belt along this structural feature. Along the Jacksboro fault, however, the Windrock has been preserved, and the synclinal belt shown on the older horizons is well developed.

The Windrock coal has a limited area of preservation on the Cumberland Block, being restricted to the central part of the Ivydell quadrangle and to the Habersham and Fonde basins.

PLATE 15—STRUCTURE CONTOUR MAPS OF THE CUMBERLAND MOUNTAINS AREA

TABULAR STRATIGRAPHIC SEQUENCE

In this tabular sequence no attempt is made to describe the lithology of the shale and sandstone units, because: (1) this is a *composite* sequence, and the lithology of the units varies so much between different parts of the Plateau that a detailed description would be meaningless, and (2) the lithology of the rocks in each 15-minute quadrangle will be described in varying detail in later reports. The ranges in thickness given below are the *total variations from all the type and reference sections presented on plates 2 and 3, and the type sections of some of the formations.* Single thicknesses are given where only one measurement has been made. The differences between maximum and minimum thicknesses of the units throughout the entire Cumberland Plateau are so great that they would be meaningless for comparative purposes. No thickness is given for the coals because of their variability. Many coal seams are extensive and have been given various names. The names used below are those most widely used, or the names first used in geologic publications.

	Thickness (in feet)
CROSS MOUNTAIN GROUP	(Max. of 554 feet in type section)
Sandstone and shale with thin coals (Top of Cross Mountain)	50
Sandstone	20
Shale and thin sandstone with thin coals	74
Sandstone	26
Shale	40
Sandstone	22
Shale with thin coal	35
Tub Spring sandstone, named from the sandstone on top of Frozen Head Mountain, Petros quadrangle, Morgan County. Tub Spring is located on the south edge of the Fork Mountain quadrangle on the north side of Frozen Head Mountain. Elevation 3,274 to 3,324 feet	50 (plus)
Shale and thin sandstone with thin coals	76
Upper Wild Cat coal	
Shale	30
Lower Wild Cat coal. Glenn (1925, pp. 25 and 35), from Wild Cat cliffs, Lake City quadrangle, Anderson County. These cliffs are not shown on the T. V. A. Lake City quadrangle. Elevation at type locality 3,155 feet.	
Sandstone	20-40
Shale	30-70
Cold Gap coal. Glenn (1925, pp. 25 and 35), from Cold Gap, Lake City quadrangle, Anderson County. Elevation at type locality 3,120 feet.	
Low Gap sandstone, named from exposures in Low Gap, Lake City quadrangle, Anderson County	5-45
Shale and thin sandstone	50-100
Upper Grassy Spring coal. Glenn (1925, p. 34), from "Grassy Spring on Vowell Mountain, Campbell County, some 3½ miles northwest of Cross Mountain," Duncan Flats quadrangle. This spring is not shown on the T. V. A. Duncan Flats quadrangle. Elevation at type area 3,100 feet.	
Shale and sandstone	30-45
Lower Grassy Spring coal	
Shale	0-10
VOWELL MOUNTAIN GROUP	(230-375)
Frozen Head sandstone. Glenn (1925, p. 324), from exposures on Frozen Head Mountain, Petros quadrangle, Morgan County. Elevation at type section on road to fire tower 2,915 to 2,950 feet	35-60
Shale	0-45
Rock Spring coal. Glenn (1925, pp. 73 and 132), from spring in Rock Spring Gap, Block quadrangle, Campbell County. Elevation at type locality about 2,630 feet.	
Shale	40-75
Upper Pine Bald coal	
Shale	0-20
Sandstone	30-60
Shale	0-15
Lower Pine Bald coal, named from mine on north side of Pine Bald (Mountain), Block quadrangle, Campbell County, at elevation of 2,740 feet. Even though this mine is called the "Petree" mine, the seam is not the one named Petree by Glenn.	
Shale	0-15
Pilot Mountain sandstone. Glenn (1925, p. 23), from Pilot Knob (now called Pilot Mountain), Duncan Flats quadrangle, Anderson County. Elevation 2,880 to 2,940 feet	10-60
Shale	10-60
Petree coal. Glenn (1925, p. 26), for Mr. L. J. A. Petree, at elevation of 2,662 feet in the Beech Grove section, Lake City quadrangle, Anderson County.	
Shale with a sandstone	20-50
Split coal. Glenn (1925, p. 31), from occurrence of a clay parting, Anderson County.	
Shale and sandstone	20-40
REDOAK MOUNTAIN GROUP	(340-420)
Pewee coal. Glenn (1925, pp. 30 and 128), from Sun mines, Jacksboro quadrangle, Campbell County. Elevation 2,550 feet.	
Shale	0-10
Silvey Gap sandstone, named from exposures in and below Silvey Gap, Windrock quadrangle, Anderson County. Elevation 2,680 to 2,740 feet	0-60
Shale and thin sandstone	5-45
Walnut Mountain coal. Glenn (1925, p. 127), from its occurrence near the top of Walnut Mountain, Ivydell quadrangle, Campbell County. Elevation 2,770 feet, 40 feet above the opening in the Red Ash coal shown on the map.	
Shale and sandstone	30-65
Red Ash coal. Glenn (1925, pp. 125-127), from Red Ash Mine, Block quadrangle, Campbell County. Elevation 2,400 feet.	
Fodderstack sandstone, named from bench on which trails are developed around Little Fodderstack (Mountain), Petros quadrangle, Anderson and Morgan Counties. Elevation about 2,600 feet. Forms the "Big Bench" of Glenn	0-10
Shale with a sandstone near base	50-125
Sharp coal. Glenn (1925, pp. 26 and 29). Named by Mr. Petree from the Beech Grove section at elevation of 2,423 feet. Origin of name unknown.	
Shale	20-70
Caryville sandstone, named from Caryville section, Jacksboro quadrangle, Campbell County. Elevation 2,270 to 2,330 feet	0-60
Shale	10
Beech Grove coal. Glenn (1925, pp. 26 and 29), from Beech Grove section, Lake City quadrangle, Anderson County. Elevation 2,352 feet.	
Shale	0-15
Sandstone	0-30
Shale with local marine zone in base	45-75
Big Mary coal. Ashley (1911, p. 198), and Glenn (1925, pp. 28-29). Origin of name unknown. Elevation 2,345 feet on road to Frozen Head fire tower.	
Shale with sandstone near middle	20-110
GRAVES GAP GROUP	(275-385)
Windrock coal. Glenn (1925, pp. 53-58), from mine and town of Windrock, Windrock quadrangle, Anderson County. Widespread flint clay beneath coal. Elevation 2,400 feet.	
Shale and sandstone	30-60
Craig coal. Glenn (1925, pp. 27 and 53). Named by Mr. Petree from the Beech Grove section; source of name unknown. Lake City quadrangle, Anderson County. Elevation 2,134 feet.	
Shale	0-30
Roach Creek sandstone, named from exposures in road from Dean, which is on Roach Creek, Block quadrangle, Scott County, up Gray Mountain to the mine in the Big Mary coal. Sandstone is between elevations of 2,040 and 2,100 feet	6-60
Shale	10-40
Upper Pioneer coal. Glenn (1925, pp. 121 and 165). Upper of two coals formerly mined at Old Pioneer (Poteet Gap of T. V. A. Pioneer quadrangle), Campbell County. Elevation about 1,900 feet, on the north side of Poteet Gap.	
Shale with thin sandstone	50-90
Lower Pioneer coal. Glenn (1925, pp. 120-121). Lower of two coals formerly mined at Old Pioneer, Pioneer quadrangle, Campbell County. Elevation about 1,840 feet, on the north side of Poteet Gap.	
Shale with thin sandstone	15-45
Armes Gap sandstone, named from exposures in Armes Gap, Petros quadrangle, Morgan County. Elevation 2,135 to 2,140 feet	5-45
Shale with thin sandstone	10-100
Norman Pond coal, named from an exposure on the incline up the west face of Norman Pond Knob, Fork Mountain quadrangle, Morgan County. Elevation 2,140 feet.	
Shale with local sandstone underlying the Normal Pond coal	40-100
Jordan coal. Ashley (1911, pp. 197-198), and Glenn (1925, pp. 120 and 160-164). Named for Mr. John Jordan, who formerly owned the land where the Gem Mine at Peabody, La Follette quadrangle, Campbell County, is located.	
Shale	0-30
INDIAN BLUFF GROUP	(160-415)
Pioneer sandstone. Glenn (1925, pp. 18-19 and 114), from the gap at Old Pioneer (Poteet Gap of the T. V. A. Pioneer quadrangle), Campbell County. Elevation 1,700 to 1,755 feet	5-60
Shale with thin coal	40-80
Indian Fork coal, named from exposure along incline on north side of Indian Fork, a short distance west of Braytown, Fork Mountain quadrangle, Anderson County. Elevation 1,895 feet.	
Shale	0-10
Indian Fork sandstone, named from same section as coal. Elevation 1,875 to 1,890 feet	5-20
Shale	20-95
Stockstill coal, named from exposure on road from Brushy Mountain State Prison, which is in the valley of Stockstill Creek, to Armes Gap. Elevation 1,855 feet.	
Shale	0-15
Stockstill sandstone, named from same section as coal. Elevation 1,810 to 1,850 feet	5-40
Shale with thin sandstone	50-120
Joyner coal. Glenn (1925, pp. 158-160), from Joyner Mine on the road from Big Mountain community up Big Mountain to American Knob, Petros quadrangle, Morgan County. Elevation 1,840 feet. All traces of the incline are now obliterated, but the mine opening is still visible at road level.	
Shale	0-20
Seeber Flats sandstone, named from the flat which the sandstone forms on the road from Briceville to Seeber Flats, Lake City quadrangle, Anderson County. Elevation 1,600 to 1,630 feet	25-40
Shale	70-80
SLATESTONE GROUP	(500-720)
Jellico coal. Crandall (1891, pp. 28-37) and Glenn (1925, pp. 116-117), from the mining district between Jellico and Newcomb, Campbell County.	
Shale	0-20
Newcomb sandstone, named from the town of Newcomb, Campbell County, and defined as the sandstone that immediately underlies the Jellico coal in the Jellico-Newcomb mining district	10-50
Shale	60-90
Terry Creek coal, named from opening on the north side of Terry Creek at elevation of 1,370 feet, nearly ½ mile northwest of Terry Creek School, Pioneer quadrangle, Campbell County.	
Sand Gap sandstone, named from exposures in and below Sand Gap, a short distance north of Elk Valley in the Pioneer quadrangle, Campbell County. Elevation 1,345 to 1,440 feet	0-95
Shale	0-15
Blue Gem coal. Miller (1908, p. 33; 1910, pp. 61-62), and Glenn (1925, pp. 115-116), reportedly named from its glistening bluish-black color, Jellico-Newcomb mining district, Campbell County.	
Shale	0-10
Sandstone	0-35
Shale	45-80
Upper Petros sandstone	5-25
Shale	0-10
Petros coal, named from exposures in the town of Petros, Petros quadrangle, Morgan County.	
Shale	0-15
Lower Petros sandstone, named from same section as coal. The town of Petros occupies both benches of this bipartite sandstone	5-30
Shale	70-140
Sandstone	0-10
Coal Creek coal. Killebrew and Safford (1874) and Glenn (1925, pp. 17 and 44-47), from mines along Coal Creek, Lake City quadrangle, Anderson County.	
Shale	0-30
Stephens sandstone, named from exposures beginning at the bridge over Middle Fork on State Highway 62, at the north end of the gap just south of Stephens, Petros quadrangle, Morgan County	8-25
Shale with local sandstone at base	75-130
Ant coal. Glenn (1925, pp. 312 and 315), from vicinity of Coalfield, Petros quadrangle, Morgan County. Source of name unknown.	
Shale with local sandstones at top and base	50-60
CROOKED FORK GROUP	(320-455)
Poplar Creek coal. Glenn (1925, pp. 16-17, 43-44, and 311-315), from mines along Poplar Creek, Windrock quadrangle, Anderson County.	
Shale	0-10
Wartburg sandstone. Keith (1896 and 1897), and Glenn (1925, pp. 19 and 310-311), from the sandstone that forms the flat on which Wartburg is located, Camp Austin quadrangle, Morgan County. Conglomeratic north of New River, Oneida South quadrangle, Scott County	0-50
Glenmary shale, named from exposures on Glenmary-Coal Hill road about ½ mile east of Glenmary, Robbins quadrangle, Scott County. Elevation 1,430 to 1,480 feet:	
Shale	50-150
Coal	
Shale	0-5
Coalfield sandstone, named from the flat on which Coalfield is located, Petros quadrangle, Morgan County	0-80
Burnt Mill shale, named from exposures along road between West Robbins and Burnt Mill Bridge over Clear Fork, beginning at 1,400 feet 0.7 mile south of Crossroads Church, Robbins quadrangle, and ending a short distance north of the church at 1,280 feet, Oneida South quadrangle, Scott County:	
Shale	70-110
Sandstone	0-10
Shale	0-5
Hooper coal. Glenn (1925, pp. 313 and 337-339), from Hooper mines near Winslow siding on Little Emory River, Elverton quadrangle, Morgan County.	
Shale	0-5
Crossville sandstone. Wanless (1946, p. 37), from the sandstone extensively quarried between Crab Orchard and Crossville, Cumberland County. Conglomeratic north of New River, Oneida South quadrangle, Scott County	30-70
Dorton shale, named from exposures 1 mile northeast of Dorton, on the road to Chestnut Hill School, Dorton quadrangle, Cumberland County. Elevation approximately 1,730 to 1,770 feet. The following detailed breakdown of the Dorton shale is from the type locality of the Crooked Fork group in Morgan County:	
Shale	0-2
Potters Falls coal, named from this falls on Crooked Fork, southeast of Wartburg, Camp Austin quadrangle, Morgan County. Elevation 1,070 feet.	
Shale	40-80
Rex coal. Ashley and Glenn (1906, pp. 36, and 210-211); Ashley (1911, p. 196); and Glenn (1925, pp. 111-112), from the Rex Mine near La Follette, Campbell County. Essentially equivalent to the Christmas coal, Glenn (1925, pp. 312 and 336-337), from mines near Christmas siding, Elverton quadrangle, Morgan County.	
Shale	0-70
CRAB ORCHARD MOUNTAINS GROUP	(630-640)
Rockcastle conglomerate. Usage in this report follows Wanless (1946, pp. 16 and 35-36), from exposures around Rockcastle Cove, Jamestown quadrangle, Fentress County. The Nemo coal, named from Nemo, Lancing quadrangle, Morgan County, where is has been mined, occurs in a shale parting in this bipartite conglomerate. This is approximately the same as the Bumbee coal mined on Bumbee Creek near Spring City, Spring City quadrangle, Rhea County	150-175
(In the northwestern part of the Plateau, where the Sewanee conglomerate is not mappable, all Pennsylvanian beds below the base of the Rockcastle conglomerate are included in the Fentress formation, Glenn, 1925, pp. 276 and 384-385, from occurrence in Fentress County.)	
Vandever formation. Butts (1916, pp. 107-110), from exposures at Vandever, Vandever quadrangle, Cumberland County. Thickness at type locality 250 feet. Detailed section at type locality of Crab Orchard Mountains group	220-275
Shale. In this shale just below the Rockcastle is the Morgan Springs coal, Phalen (1911, pp. 147-148), from Morgan Springs, Morgan Springs quadrangle, Bledsoe County. This is the same as the Isoline coal, Glenn (1913, p. 9), named from the mining town of Isoline, Isoline quadrangle, Cumberland County	50-90
Sandstone. Conglomeratic in southern part of Walden Ridge in Hamilton County	20-70
Shale, containing the Lantana coal near its base, Nelson (1925, pp. 52, 67, and 95-96), from Lantana Post Office, Crossville quadrangle, Cumberland County. This is No. 12 coal at Soddy, Soddy quadrangle, Hamilton County. West of Crab Orchard, Dorton quadrangle, in the group type area this shale may be thickened by structure	115-150
Newton sandstone. Nelson (1925, pp. 50-51), from Newton Post Office, Crossville S. W. quadrangle, Cumberland County. Conglomeratic in southern Cumberland County and northern Bledsoe County	80-100
Whitwell shale. Butts and Nelson (1925, pl. 4 and p. 7), from Whitwell, Whitwell quadrangle, Marion County. Contains the Upper Sewanee coal, Safford (1869, pp. 369-379), and Nelson (1925, pp. 48 and 65-66), from mines near Sewanee, Sewanee quadrangle, Franklin County. In the lower part, not far above the Sewanee conglomerate, is the Lower Sewanee or Richland coal, Phalen (1911, pp. 145-146), from Richland mines along Richland Creek, near Morgantown, Morgan Springs quadrangle, Rhea County. Other names of coals in the Aetna Mountain area: Kelley, Slate, and Oak Hill; Nos. 7, 8, 9, and 10 at Soddy; and the Clifty coals in the Eastland-Clifty area of White and Cumberland Counties	75-100
Sewanee conglomerate. Safford (1893, pp. 89-98), from conglomerate on which Sewanee, Sewanee quadrangle, Franklin County, is located	20-100
GIZZARD GROUP	(224 feet at type locality)
Signal Point shale, named from exposures along State Highway 8 east of Signal Point and just south of town of Signal Mountain, between elevations of 1,611 and 1,663 feet, Chattanooga quadrangle, Hamilton County. Thickness at type section 52 feet. Contains Wilder coal, Glenn (1913, p. 7; 1925, pp. 275, 283-284, and 374-376), from Wilder, Wilder S. E. quadrangle, Fentress County. It is the same as the Angel coal, Phalen (1911, pp. 144-145), mined in Cumberland and Bledsoe Counties; and the Ravenscroft coal, Nelson (1913, p. 31; 1925, pp. 164-165, and 227), from Ravenscroft, De Rossett quadrangle, White County. In the northern part of the Plateau, where this unit is thicker, a lower split is here named the Lower Wilder coal. It overlies the Warren Point sandstone	10-52
Warren Point sandstone. Nelson (1925, pp. 43-44, 148-149, and 184), from Warren Point, ½ mile north of Monteagle, Monteagle quadrangle, Grundy County. Conglomeratic in southern Hamilton and Marion Counties and locally along the Western Escarpment as far north as Overton County	65
Raccoon Mountain formation, named from Raccoon Mountain, Hamilton and Marion Counties, with type section along mine road 0.4 mile northwest of Whiteside up Scratch Ankle Hollow, Shellmound quadrangle, Marion County. Elevations of top and bottom are 1,318 and 965, respectively	149-353
The following detailed section is from the type section of the formation, rather than from the type section of the group, as has been the case with the formations described previously:	
Shale with thin sandstones. Contains the Bon Air coals, Hayes (1895) from Bon Air, De Rossett quadrangle, White County, and its approximate equivalents, the Nelson coal, Hayes (1895), from the Nelson mines, Morgan Springs quadrangle, Rhea County, and the Etna, Battle Creek, or Orme coal in Marion County. It also contains the older White Oak coal, Glenn (1925, pp. 180-181), from mines along White Oak Creek, Fentress County, and its approximate equivalents, the Goodrich coals (origin of name unknown), Phalen (1911), from area near Dayton, Rhea County, and the Dade and Rattlesnake coals of Marion County	95
Fine-grained sandstone	27
Shale and sandy shale containing the Sale Creek coals, Nelson (1925, pp. 134-136), from mines along Sale Creek, Hamilton County; also known as the Red Ash and Mill Creek coals in Marion County. Two unnamed coals encountered in drill holes in Fentress County are of approximately the same age	125
Sandstone	20
Shale	86

ECONOMIC GEOLOGY

COAL

Coal is by far the most important mineral product of Tennessee. In 1955 Tennessee produced 7,300,000 tons valued at more than $30,000,000, all of which came from the Cumberland Plateau. Every county in which Pennsylvanian strata occur, except Cannon County, has coal beds that either were mined in the past or are now being mined. Some of these seams are quite extensive and widely mined, but others are found only locally.

Many names, both local and widely used, have been applied to some of the more extensive seams. The occurrence of each of these is discussed under the group headings in Detailed Stratigraphy and Tabular Stratigraphic Sequence.

Correlation of coals between mining districts is difficult because of their splitting or wedging out. Most coals are recognized by their occurrence in the same stratigraphic position relative to widely mapped sandstones. Some coals such as the Sewanee, Poplar Creek, and Big Mary are so extensively mined and prospected that they can be used as the main mapping guides over large areas.

The most widely mined seams are: the Bon Air and Wilder coals in the Gizzard group; the Sewanee coals in the Crab Orchard Mountains group; the Rex and Poplar Creek coals in the Crooked Fork group; the Coal Creek and Jellico coals in the Slatestone group; the Windrock coal in the Graves Gap group; and the Big Mary, Red Ash, and Pewee coals in the Redoak Mountain group.

Estimation of reserves for the entire Cumberland Plateau was begun in cooperation with the Tennessee Valley Authority and U. S. Bureau of Mines. Measured and indicated reserves have already been published for Putnam, Anderson, Grundy, Marion, Overton, Sequatchie, Fentress, Scott and Van Buren Counties (U.S. Bureau of Mines, 1954, 1955, and 1956). This work is continuing in cooperation with the Tennessee Valley Authority, and additional reserve information will be compiled and made available in the future.

Major reserves are known in the Sewanee coal in Marion and Sequatchie Counties, the Wilder coal in Fentress and Putnam Counties, the Coal Creek coal in Campbell County, and the Big Mary coal in Anderson County. Additional appreciable reserves are reported in the Coal Creek, Windrock, and Pewee coals in Anderson County; the Poplar Creek, Big Mary, Red Ash, and Pewee coals in Campbell County; the Coal Creek coal in Claiborne County; and the Big Mary coal in Scott County.

Summary of Coal Mining and Correlation

CROSS MOUNTAIN GROUP

Cold Gap Coal. This seam, locally known as the Bald Knob coal, has been opened between Bald Knob, Fork Mountain quadrangle, and Frozen Head Mountain, Petros quadrangle, Morgan County.

VOWELL MOUNTAIN GROUP

Rock Spring coal has been mined in the eastern part of the Block quadrangle, Campbell County.

The U. S. Bureau of Mines (unpublished manuscript, 1955) shows reserves in the Block quadrangle.

Lower Pine Bald coal has been mined on Pine Bald (Mountain), Block quadrangle, Campbell County.

The U. S. Bureau of Mines (unpublished manuscript, 1955) refers to this seam as the "Petree" and shows reserves in the Block quadrangle.

REDOAK MOUNTAIN GROUP

Pewee coal. This seam has been extensively mined in parts of the Block, Duncan Flats, Fork Mountain, Jacksboro, Lake City, Petros, and Windrock quadrangles in Anderson, Campbell, Morgan, and Scott Counties. It has also been mined in the Mingo Mountains quadrangle, Claiborne County, where it is called the Lower Hignite coal.

The U. S. Bureau of Mines (Reports of Investigations 5185, 5229, and 5232; and unpublished manuscripts, 1955 and 1956) shows reserves of the Pewee coal in the Fork Mountain, Petros, Windrock, Duncan Flats, and Lake City quadrangles, Anderson County; in the Block, Lake City, Duncan Flats, Jacksboro, and Pioneer quadrangles, Campbell County; in the Mingo Mountains quadrangle, Claiborne County; in the Petros, Fork Mountain, and Gobey quadrangles, Morgan County; and in the Fork Mountain and Duncan Flats quadrangles, Scott County.

Walnut Mountain coal.
The U. S. Bureau of Mines (unpublished manuscript, 1955) shows reserves of the Walnut Mountain coal in the Duncan Flats, Block, Jacksboro, and Pioneer quadrangles, Campbell County.

Red Ash coal has been mined along the west side of the Jacksboro fault between Caryville and Pioneer in the Jacksboro, Block, and Pioneer quadrangles, Campbell and Scott Counties.

The U. S. Bureau of Mines (unpublished manuscripts, 1955 and 1956; Report of Investigations 5232) shows reserves of the Red Ash coal in the Lake City, Duncan Flats, Block, Jacksboro, and Pioneer quadrangles, Campbell County; in the Gobey quadrangle, Morgan County; and in the Pioneer, Block, and Norma quadrangles, Scott County.

Big Mary coal. This seam has been extensively mined in parts of Block, Duncan Flats, Fork Mountain, Norma, Lake City, Petros, and Windrock quadrangles in Anderson, Campbell, Morgan, and Scott Counties. It has also been mined as the Klondike coal in the Mingo Mountains quadrangle, Claiborne County.

The U. S. Bureau of Mines (Reports of Investigations 5185, 5229, and 5232; and unpublished manuscripts, 1955 and 1956) shows reserves of the Big Mary coal in the Lake City, Duncan Flats, Fork Mountain, Petros, and Windrock quadrangles, Anderson County; in the Jacksboro, Block, Duncan Flats, Lake City, Pioneer, Ketchen, and Jellico West quadrangles, Campbell County; in the Mingo Mountains quadrangle, Claiborne County; in the Gobey, Fork Mountain, and Petros quadrangles, Morgan County; and in the Gobey, Fork Mountain, Duncan Flats, Norma, Robbins, Block, Pioneer, and Ketchen quadrangles, Scott County.

GRAVES GAP GROUP

Windrock coal. This seam has been mined in the Duncan Flats, west-central Lake City, and north-central Windrock quadrangles in Anderson, Campbell, and Scott Counties. It has been mined as the Poplar Lick coal, Mingo Mountains quadrangle, Claiborne County. West of Newcomb, Jellico West quadrangle, Campbell County, it has been locally mined as a cannel coal.

The U. S. Bureau of Mines (Reports of Investigations 5185 and 5232; and unpublished manuscript, 1955) shows reserves of the Windrock coal in the Lake City, Duncan Flats, Fork Mountain, Petros, and Windrock quadrangles, Anderson County; in the Block, Jacksboro, Duncan Flats, Ivydell, Lake City, Pioneer, Ketchen, and Jellico West quadrangles, Campbell County; and in the Gobey, Robbins, Norma, Block, Pioneer, and Ketchen quadrangles, Scott County.

Upper Pioneer coal was formerly mined at Poteet Gap and Pioneer, Pioneer quadrangle, Campbell County.

The U. S. Bureau of Mines (unpublished manuscript, 1955) shows reserves of the Upper Pioneer coal in the Block, Pioneer, and Ketchen quadrangles, Campbell County.

Lower Pioneer coal was formerly mined at Poteet Gap. The Sandstone Parting coal, which is one of the Pioneer coals (probably the Lower), has been mined in the Mingo Mountains quadrangle, Claiborne County.

The U. S. Bureau of Mines (Report of Investigations 5229) shows reserves of the Lower Pioneer coal in the Mingo Mountains quadrangle, Claiborne County.

Jordan coal. This is an important coal in the La Follette quadrangle, Campbell County. The Splint coal, which is mined in Ketchen quadrangle, north of Elk Valley Community, Campbell County, is probably the same seam.

The U. S. Bureau of Mines (unpublished manuscript, 1955) shows reserves of the Jordan coal in the Block, Pioneer, Jellico West, Ivydell, and La Follette quadrangles, Campbell County.

INDIAN BLUFF GROUP

Joyner coal has been mined in three small, isolated areas: Chimney Top Mountain, Camp Austin quadrangle, Morgan County; the east end of Little Brushy Mountain, Petros quadrangle, Morgan County; and on a prominent bench a mile east of Graves Gap, Lake City quadrangle, Anderson County.

The U. S. Bureau of Mines (Report of Investigations 5185; and unpublished manuscripts, 1955 and 1956) shows reserves of the Joyner coal in the Duncan Flats and Lake City quadrangles, Anderson County; in the Lake City, Duncan Flats, Block, Pioneer, Jellico West, and Ketchen quadrangles, Campbell County; and in the Petros and Camp Austin quadrangles, Morgan County.

SLATESTONE GROUP

Jellico coal. Although the major mining of this seam has been in the Jellico-Newcomb mining district, Jellico West quadrangle, Campbell County, and around Petros and Fork Mountain Community, north-central Petros and south-central Fork Mountain quadrangles, Morgan and Anderson Counties, it has been very widely prospected and opened throughout the area of its preservation. Other mining areas are near Wartburg, Camp Austin quadrangle, Morgan County; along New River and Ligias Fork, Duncan Flats quadrangle, Anderson County; and in an area north of Elk Valley and Pioneer, Pioneer quadrangle, Campbell County. The Log Mountain, or Jellico, coal has been mined on the Cumberland Block in the Mingo Mountains and Log Mountain quadrangles, Claiborne County, and in the Ivydell and La Follette quadrangles, Campbell County.

The U. S. Bureau of Mines (Reports of Investigations 5185, 5229, and 5232; and unpublished manuscripts, 1955 and 1956) shows reserves of the Jellico coal in the Petros, Fork Mountain, Duncan Flats, Windrock, and Lake City quadrangles, Anderson County; in the Lake City, Duncan Flats, Jacksboro, Ivydell, La Follette, Block, Pioneer, Ketchen, Jellico West, Jellico East, and Eagan quadrangles, Campbell County; in the Mingo Mountains and Eagan quadrangles, Claiborne County; in the Petros, Camp Austin, and Fork Mountain quadrangles, Morgan County; and in the Gobey, Robbins, Fork Mountain, Norma, Block, Pioneer, Ketchen, and Winfield quadrangles, Scott County.

Blue Gem coal. Mining of the Blue Gem coal has been centered around the Jellico-Newcomb mining district, Jellico West quadrangle, and north of Elk Valley, Pioneer quadrangle, both in Campbell County. This coal has been prospected and opened at many other localities, including the Ivydell, La Follette, Log Mountain, and Mingo Mountains quadrangles, Campbell and Claiborne Counties, where it is known as the Rich Mountain coal.

The U. S. Bureau of Mines (Report of Investigations 5229; and unpublished manuscripts, 1955 and 1956) shows reserves of the Blue Gem coal in the Duncan Flats, Block, Jacksboro, Pioneer, Ketchen, Jellico West, Jellico East, Ivydell, and La Follette quadrangles, Campbell County; in the Mingo Mountains and Eagan quadrangles, Claiborne County; and in the Camp Austin, Petros, Fork Mountain, Robbins, Gobey, and Pilot Mountain quadrangles, Morgan County.

Coal Creek coal has been extensively mined along Walden Ridge in the Windrock, Clinton, Lake City, and Jacksboro quadrangles in Anderson and Campbell Counties. It has also been mined as the Kent coal on the Cumberland Block in Campbell and Claiborne Counties.

The U. S. Bureau of Mines (Reports of Investigations 5185 and 5229; and unpublished manuscript, 1955) shows reserves of the Coal Creek coal in the Fork Mountain, Petros, Duncan Flats, Windrock, Lake City, and Clinton quadrangles, Anderson County; in the Lake City, Duncan Flats, Jacksboro, Block, Pioneer, Ivydell, Jellico West, Jellico East, La Follette, and Eagan quadrangles, Campbell County; and in the Mingo Mountains, Eagan, Cumberland Gap, and Well Spring quadrangles, Claiborne County.

CROOKED FORK GROUP

Poplar Creek coal has been mined extensively within two large areas, one of which is along Walden Ridge across Windrock, Petros, and eastern Camp Austin quadrangles, Anderson and Morgan Counties. The other area is a broad, northeast-southwest belt in southeastern Rugby, Robbins, northwestern Norma, southeastern Oneida South, and Huntsville quadrangles, Morgan and Scott Counties. It has also been mined in small areas in the Winfield quadrangle, Scott County; and near Jellico, Jellico West quadrangle, Campbell County, where it is called the Swamp Angel coal.

The U. S. Bureau of Mines (Reports of Investigations 5185 and 5232; and unpublished manuscripts, 1955 and 1956) shows reserves of the Poplar Creek coal in the Windrock, Duncan Flats, Fork Mountain, and Petros quadrangles, Anderson County; in the Duncan Flats, Block, Pioneer, Jacksboro, Ivydell, La Follette, Jellico West, and Jellico East quadrangles, Campbell County; in the Rugby, Robbins, Fork Mountain, Gobey, Camp Austin, Petros, and Windrock quadrangles, Morgan County; and in the Fork Mountain, Robbins, Norma, Huntsville, Helenwood (Oneida South), Winfield, Barthell S. E., and Ketchen quadrangles, Scott County.

Hooper coal has been mined along Walden Ridge in the Windrock, Petros, Elverton, and Harriman quadrangles, Morgan County.

The U. S. Bureau of Mines (unpublished manuscript, 1956) shows reserves of the Hooper coal in the Gobey, Pilot Mountain, Windrock, Petros, Elverton, and Camp Austin quadrangles, Morgan County.

Rex coal has been mined in the Ivydell and La Follette quadrangles, Campbell County, and the Christmas coal in Elverton, Harriman, Camp Austin, and Lancing quadrangles, Morgan County.

The U. S. Bureau of Mines (Report of Investigations 5229; and unpublished manuscripts, 1955 and 1956) shows reserves of the Rex coal in the Pioneer, Block, Ivydell, Jacksboro, and La Follette quadrangles, Campbell County; in the Well Spring and Eagan quadrangles, Claiborne County; and in the Elverton, Petros, Camp Austin, and Lancing quadrangles, Morgan County.

CRAB ORCHARD MOUNTAINS GROUP

Nemo coal has been mined near Nemo, Lancing quadrangle, Morgan County; and the equivalent Bumbee coal in the Spring City quadrangle, Rhea County.

The U. S. Bureau of Mines (Report of Investigations 5235) shows reserves of the Nemo coal in the Jamestown, Stockton, Honey Creek, Burrville, Grimsley, Jones Knob, and Wilder S. E. quadrangles, Fentress County.

Morgan Springs coal has been mined in the Morgan Springs quadrangle, Bledsoe County; and the equivalent Isoline coal in the Isoline quadrangle, Cumberland County.

The U. S. Bureau of Mines (Report of Investigations 5234) shows reserves of the Morgan Springs coal in the Brayton, Grassy Cove, Pennine, and Brockdell quadrangles, Bledsoe County.

Lantana coal has been mined chiefly in the vicinity of Lantana, Crossville quadrangle, Cumberland County, and along the flanks of the Crab Orchard Mountains, Grassy Cove, Dorton, and Ozone quadrangles, Cumberland County. The equivalent No. 12 coal has been mined near Soddy, Soddy quadrangle, Hamilton County.

The U. S. Bureau of Mines (Reports of Investigations 5234 and 5208) shows reserves of the Lantana coal in the Grassy Cove, Pennine, Melvine, Billingsley Gap, Brockdell, Smartt Mountain, Soddy, and Brayton quadrangles, Bledsoe County; and in the Smartt Mountain quadrangle, Van Buren County.

Sewanee coal has been extensively mined in the Palmer, Whitwell, and Tracy City quadrangles, Marion, Grundy, and Sequatchie Counties.

The U. S. Bureau of Mines (Reports of Investigations 5234, 5235, 5148, 5159, 5136, and 5208) shows reserves of the Sewanee coal in the Brayton, Brockdell, Mount Airy, Lonewood, Herbert Domain (Crossville S. W.), Sampson, Billingsley Gap, and Pennine quadrangles, Bledsoe County; in the Clarkrange, Wilder S. E., Grimsley, Jamestown, Burrville, Pall Mall S. E., Stockton, and Honey Creek quadrangles, Fentress County; in the Palmer and Tracy City quadrangles, Grundy County; in the Wauhatchie, Sequatchie, Ketner Gap, Daus, Palmer, Whitwell, and White City quadrangles, Marion County; in the Smartt Mountain, Savage Point, Daus, Palmer, Ketner Gap, Fairmount, and Henson Gap quadrangles, Sequatchie County; and in the Lonewood, Sampson, Spencer, Mount Cardwell S. E., and Smartt Mountain quadrangles, Van Buren County.

Lower Sewanee, or Richland, coal, has been mined around Richland Creek, Morgan Springs quadrangle, Rhea County.

The U. S. Bureau of Mines (Report of Investigations 5208) shows reserves of the Lower Sewanee coal in the Mount Cardwell S. E., Smartt Mountain, Spencer, and Sampson quadrangles, Van Buren County.

Sewanee equivalent coals. In the Aetna Mountain area, Wauhatchie quadrangle, Marion County, the Kelley, Slate, and Oak Hill coals have been mined. Near Soddy, Soddy quadrangle, Hamilton County, coals No. 7, 9, and 10 are commercial. The Clifty coals have been mined in the Eastland-Clifty area, Crossville N. W. quadrangle, White and Cumberland Counties.

GIZZARD GROUP

Wilder coal has been widely mined along the Western Escarpment in Fentress, Overton, Putnam, and Cumberland Counties. The equivalent Ravenscroft coal was formerly mined at Ravenscroft, De Rossett quadrangle, White County; and the Angel coal has been mined in the Billingsley Gap and Pikeville quadrangles, Bledsoe and Cumberland Counties.

The U. S. Bureau of Mines (Reports of Investigations 5235, 5131, and 5029) shows reserves of the Wilder coal in the Clarkrange, Wilder S. E., Grimsley, Burrville, Stockton, Jamestown, Wilder N. E., Byrdstown S. E., Pall Mall S. E., Honey Creek, and Pall Mall S. W. quadrangles, Fentress County; in the Obey City, Clarkrange, Crawford, and Wilder S. E. quadrangles, Overton County; and in the Obey City, Campbell Junction, and Brotherton S. E. quadrangles, Putnam County.

Lower Wilder coal was formerly mined in a small area along South Fork near the southwest corner of Barthell S. E. quadrangle, Scott County.

Bon Air coals have been mined in the Sparta, De Rossett, and Lonewood quadrangles, White County; the Nelson coal in the Morgan Springs quadrangle, Rhea County; and the Battle Creek, Etna, Castle Rock, or Orme coals in Marion County.

White Oak coal was formerly mined near Zenith, Honey Creek quadrangle, Fentress County. Coals of about the same age include the Dade and Rattlesnake coals of the Whiteside mining district, Sequatchie, Wauhatchie, Shellmound, and Hooker quadrangles, Marion County; and the Upper and Lower Goodrich coals of the Sale Creek mining district northeast of Chattanooga, Graysville quadrangle, Hamilton and Rhea Counties.

The U. S. Bureau of Mines (Report of Investigations 5235) shows reserves of the White Oak coal in the Pall Mall S. W., Pall Mall S. E., Wilder N. E., Wilder S. E., Clarkrange, Grimsley, Jamestown, Stockton, Honey Creek, and Byrdstown S. E. quadrangles, Fentress County.

Sale Creek coals have been mined in the Sale Creek mining district, Graysville quadrangle, Hamilton and Rhea Counties. The equivalent Mill Creek and Red Ash coals have been mined in the Whiteside area, Sequatchie, Wauhatchie, Shellmound, and Hooker quadrangles, Marion County.

BUILDING STONE

The production of building stone from Pennsylvanian strata has greatly increased in recent years. This industry, concentrated largely in Cumberland County, had an annual output valued in excess of $1,500,000 in 1954 and more than $2,000,000 in 1955.

Most of the stone is quarried from the Crossville sandstone. This formation, around Crossville, is a fine-grained, multicolored, thinly bedded sandstone. It is strongly cemented with silica and is often referred to in the building trade as a "quartzite." It is an excellent building stone because of its durability, imperviousness, high strength, attractive variations in color, and ease of working. It is used as flagstone, dimension stone, trim, fireplace facing, hearths, roofing, memorials, etc.

Several other sandstones have been quarried for building stone, but none of these approaches the volume produced from the Crossville sandstone. These producing formations are the Warren Point sandstone, Sewanee conglomerate, Newton sandstone, Vandever formation, and the Rockcastle conglomerate. The Warren Point sandstone has been quarried in Franklin and Grundy Counties and on Hinch Mountain in Cumberland County. The Sewanee conglomerate has been worked near Beersheba Springs in Grundy County and South Pittsburg in Marion County. East of Pleasant Hill, in Cumberland County, the Newton sandstone has been quarried extensively. West of Jamestown, in Fentress County, and near Fairmount in Hamilton County, there are a few small quarries in sandstone at the top of the Vandever formation. The Rockcastle conglomerate has been quarried near Clarkrange, Fentress County, and in the vicinity of Crab Orchard and Ozone in Cumberland County.

SAND AND GRAVEL

Sand and gravel production on the Cumberland Plateau is largely limited to a single formation, the Sewanee conglomerate. This use for the conglomerate seems to depend primarily on the absence of strong cementation, which makes it possible to crush the material and screen out the pebbles. At present, Monterey, in Putnam County, is the center of the largest producing area, but the absence of strong cementation, which makes possible the quarrying operations in this area, may also be found in many other localities.

The Sewanee conglomerate has also been quarried for this purpose near Henson Gap in Sequatchie County and south of Crab Orchard in Cumberland County, and is probably the source of the sand quarried on Fork Mountain 2 miles northwest of Caryville, Campbell County.

GLASS SAND

Sand mined exclusively for use in making glass is produced near Sewanee in Franklin County, where the producing horizon is the Sewanee conglomerate. At present, this is the only glass sand operation on the Cumberland Plateau. Analyses of samples of the sand show a range in silica content of 99.36 to 99.8%. These analyses are indicative of the high quality of the glass sand available in this region. Although analyses from other areas are not available, the Sewanee conglomerate seems to be a high-silica sand at Monterey and in many other localities, and may constitute an important source of glass sand in the future.

ROAD METAL

Pennsylvanian sandstones and shales have been locally used for road metal in various parts of the Plateau but probably are not as satisfactory for this purpose as limestone. Shale used is mostly oxidized shale, taken from mine dumps, and is locally known as "red dog."

CLAY AND SHALE

The use of clays and shales from the Cumberland Plateau for raw material in the ceramic and allied industries has been small in the past, but possibilities exist for greatly expanded utilization of these deposits. Several underclays have been used in the ceramic industry. The underclay beneath the Hooper coal near Oliver Springs and the underclay beneath the Poplar Creek coal at Robbins have been used to make bricks.

Clays and shale that possess bloating characteristics have been mined near Briceville for making lightweight aggregate. Other shale and clay horizons on the Cumberland Plateau are known to possess good bloating qualities, and these horizons may constitute valuable resources in the future.

OIL AND GAS

There is at present no oil or gas production from rocks of Pennsylvanian age on the Cumberland Plateau, although most of Tennessee's oil and gas production is from wells located on the Plateau. More than a hundred wells have been drilled on the Cumberland Plateau, and several have produced oil and gas, but all important production has come from older rocks, mostly of the Chester group of Mississippian age. A few gallons of oil were recovered from Pennsylvanian beds in a deep water well near Petros. Six barrels of oil were recovered from Pennsylvanian rocks at Winfield, Scott County, but the well was abandoned because of salt water. Most of the oil tests that penetrate the Pennsylvanian beds are concentrated in Fentress, Scott, and Morgan Counties.

GROUND WATER

Ground water conditions on the Cumberland Plateau were investigated in a reconnaissance survey by the Tennessee Division of Geology in cooperation with the Ground Water Branch of the U. S. Geological Survey in 1952. According to the results of this unpublished investigation, water horizons appear to occur most frequently under one of the following conditions: at the contact between a sandstone and an underlying clay or shale, at the contact between coals and underclays, along pronounced unconformities, and along faults.

This reconnaissance study indicates that, although ground water is available on the Cumberland Plateau, the yield probably would be too small to sustain a high degree of industrialization. However, ground water is found in sufficient quantities to supply most domestic needs.

The most noteworthy chemical characteristic of the ground water is the high iron content. On the whole it is also quite acidic, and a pH as low as 4.5 has been reported.

ACKNOWLEDGMENTS

W. D. Hardeman, State Geologist, has been associated with this project from its beginning in 1947, when he was leader of the field party that began the mapping. Since that time he has contributed much time and effort, and has shown a continuing interest in this work.

Robert L. Wilson spent 4 summers mapping and measuring sections. He mapped the Fork Mountain, Twin Bridges, Pilot Mountain, Gobey, and other quadrangles. He also assisted in mapping much of the Northern Plateau.

Robert M. Mitchum, Jr., measured and described many stratigraphic sections including the type and reference sections of the Cumberland Mountains. Also, he mapped the Lancing and part of the Camp Austin quadrangles.

Other workers were Bailey Rascoe, Jr., who mapped the Fox Creek quadrangle, George D. Swingle who mapped the Monteagle, Orme, and part of the Sinking Cove quadrangles, and W. D. Rose, Jr., who mapped part of the Camp Austin quadrangle. Richard G. Stearns mapped the Keith Springs area in Franklin County and part of the Crab Orchard Mountains area. Robert J. Floyd did the final editing and proofreading.

REFERENCES CITED

Ashley, G. H., and Glenn, L. C. (1906) Geology and mineral resources of part of the Cumberland Gap coal field, Kentucky: U. S. Geol. Survey Prof. Paper 49, 239 pp.

Ashley, G. H. (1911) Coal field of Tennessee: Tennessee Geol. Survey, Resources of Tennessee, vol. 1, pp. 188-202.

Butts, Charles (1916) Structure of the southern part of Cumberland County, Tennessee, in relation to the possible occurrence of oil and gas: Tennessee Geol. Survey, Resources of Tennessee, vol. 6, pp. 107-110.

Butts, Charles, and Nelson, W. A. (1925) Geology and mineral resources of the Crossville quadrangle, Tennessee: Tennessee Div. Geology Bull. 33-D, 41 pp.

Butts, Charles (1927) Fensters in the Cumberland overthrust block in southwestern Virginia: Virginia Geol. Survey Bull. 28, 12 pp.

Crandall, A. R. (1891) Report on the geology of Whitley County, and on a part of Pulaski County: Kentucky Geol. Survey, vol. C, pt. 2, 44 pp.

Glenn, L. C. (1913) The general features of the Tennessee coal field north of the Tennessee Central Railroad: Tennessee Geol. Survey, Resources of Tennessee, vol. 3, pp. 4-25. (Also Tennessee Geol. Survey Bull. 2-B.)

Glenn, L. C. (1925) The northern Tennessee coal field, included in Anderson, Campbell, Claiborne, Fentress, Morgan, Overton, Pickett, Roane, and Scott Counties: Tennessee Div. Geology Bull. 33-B, 478 pp.

Hayes, C. W. (1895) Description of the Pikeville sheet: U. S. Geol. Survey Geol. Atlas, Pikeville folio (no. 21), 4 pp.

Keith, Arthur (1896) Description of the Briceville quadrangle: U. S. Geol. Survey Geol. Atlas, Briceville folio (no. 33), 4 pp.

Keith, Arthur (1897) Description of the Wartburg quadrangle: U. S. Geol. Survey Geol. Atlas, Wartburg folio (no. 40), 4 pp.

Killebrew, J. B., and Safford, J. M. (1874) Introduction to the resources of Tennessee: Tennessee Bur. Agr., First and Second Repts., 1193 pp.

Miller, A. M. (1908) Abstract of report on the lower (or "conglomerate") measures along the western border of the eastern coal field: Kentucky Geol. Survey Rept. Prog. 1906-07, pp. 27-35.

Nelson, W. A. (1925) The southern Tennessee coal field, included in Bledsoe, Cumberland, Franklin, Grundy, Hamilton, Marion, Putnam, Rhea, Sequatchie, Van Buren, Warren, and White Counties: Tennessee Div. Geology Bull. 33-A, 239 pp.

Phalen, W. C. (1911) Preliminary report of the coal resources of the Pikeville special quadrangle of eastern Tennessee: Tennessee Geol. Survey Bull. 9, 72 pp. (Also Resources of Tennessee, vol. 1, pp. 117-162.)

Rich, J. L. (1934) Mechanics of low angle overthrust faulting as illustrated by Cumberland thrust block, Virginia, Kentucky, and Tennessee: Am. Assoc. Petroleum Geologists Bull., vol. 18, pp. 1584-1596.

Safford, J. M. (1869) Geology of Tennessee: Nashville, 550 pp.

Safford, J. M. (1893) The topography, geology, and water supply of Sewanee: Tennessee State Board of Health Bull., vol. 8, no. 6 (as corrected from 1892, vol. 8, no. 5), pp. 89-98.

Stearns, R. G. (1954) The Cumberland Plateau overthrust and geology of the Crab Orchard Mountains area, Tennessee: Tennessee Div. Geology Bull. 60, 47 pp.

U. S. Bureau of Mines (1954) Estimate of known recoverable reserves and the preparation and carbonizing properties of coking coal in Putnam County, Tenn., by Williams, Lloyd, Lowe, Robert, Turnbull, L. A., Carman, E. P., Crentz, W. L., Reynolds, D. A., and Abernethy, R. G.: Rept. Inv. 5029, 21 pp.

U. S. Bureau of Mines (1955) Estimate of known recoverable reserves and the preparation and carbonizing properties of coking coal in Anderson County, Tenn., by Williams, Lloyd, James, Curtis, Gandrud, B. W., and Reynolds, D. A.: Rept. Inv. 5185, 52 pp.

U. S. Bureau of Mines (1955) Estimate of known recoverable reserves of coking coal in Grundy County, Tenn., by Hershey, R. E., Williams, Lloyd, and Gandrud, B. W.: Rept. Inv. 5148, 16 pp.

U. S. Bureau of Mines (1955) Estimate of known recoverable reserves and the preparation and carbonizing properties of coking coal in Marion County, Tenn., by Williams, Lloyd, Hershey, R. E., and Gandrud, B. W.: Rept. Inv. 5159, 30 pp.

U. S. Bureau of Mines (1955) Estimate of known recoverable reserves and the preparation and carbonizing properties of coking coal in Overton County, Tenn., by Williams, Lloyd, Abernethy, R. F., Gandrud, B. W., Reynolds, D. A., and Wolfson, D. E.: Rept. Inv. 5131, 27 pp.

U. S. Bureau of Mines (1955) Estimate of known recoverable reserves and the preparation and carbonizing properties of coking coal in Sequatchie County, Tenn., by Williams, Lloyd, Hershey, R. E., Abernethy, R. F., Gandrud, B. W., and Reynolds, D. A.: Rept. Inv. 5136, 28 pp.

U. S. Bureau of Mines (1956) Estimate of known recoverable reserves and preparation characteristics of coking coal in Fentress County, Tenn., by Lowe, R. W., Crentz, W. L., and Miller, J. W.: Rept. Inv. 5235, 34 pp.

U. S. Bureau of Mines (1956) Estimate of known recoverable reserves and preparation characteristics of coking coal in Scott County, Tenn., by Williams, Lloyd, Gibbs, H. K., Crentz, W. L., and Miller, J. W.: Rept. Inv. 5232, 36 pp.

U. S. Bureau of Mines (1956) Estimate of known recoverable reserves and preparation characteristics of coking coal in Van Buren County, Tenn., by Hershey, R. E., Williams, Lloyd, Crentz, W. L., and Miller, J. W: Rept. Inv. 5208, 25 pp.

U. S. Bureau of Mines (unpublished manuscript, 1955) Estimate of known recoverable reserves and the preparation and carbonizing properties of coking coal in Campbell County, Tenn., by Williams, Lloyd, Gibbs, H. K., Crentz, W. L., Miller, J. W., and Reynolds, D. A.

U. S. Bureau of Mines (unpublished manuscript, 1956) Estimate of known recoverable reserves and the preparation characteristics of coking coal in Morgan County, Tenn., by Williams, Lloyd, James, Curtis, Crentz, W. L., and Miller, J. W.

Wanless, H. R. (1946) Pennsylvanian geology of a part of the Southern Appalachian coal field: Geol. Soc. America Mem. 13, 162 pp.