TISHOMINGO COUNTY GEOLOGY AND MINERAL RESOURCES

Robert K. Merrill
Delbert E. Gann
Stephen P. Jennings

BULLETIN 127

MISSISSIPPI DEPARTMENT OF NATURAL RESOURCES
BUREAU OF GEOLOGY

CONRAD A. GAZZIER
Bureau Director

Jackson, Mississippi
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COVER: Jeans Overhang, sculptured by weathering of cliff-forming sandstones comprising the Hartselle Formation, offers a challenge to beginning rock climbers who visit Tishomingo State Park. Scale in feet. Location: NE/4, NE/4, NE/4, Sec. 31, T.5S., R.11E.

STATE OF MISSISSIPPI
RAY MABUS
GOVERNOR

I am pleased to transmit to the people of Mississippi and this nation an excellent scientific report on the geology and mineral resources of Tishomingo County. Bureau of Geology Bulletin 127 is an outstanding contribution to the understanding of the natural environment of northeastern Mississippi.

This bulletin relates the geologic history of Tishomingo County and describes the rocks that lend distinction to two of the most beautiful State Parks in the country. It will be a valuable reference for geologists, planners, developers and the general public and provide the basic information needed to answer questions on the geologic make-up of this area. Its publication comes at a time when such information is vitally needed for future development of the Tennessee-Tombigbee Waterway and other proposed development in this part of the State.

The authors and the Department of Natural Resources are to be commended for their efforts in developing such an outstanding scientific report.

Sincerely,

Ray Mabus

RAY MABUS
Governor

RM:MG:rc

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LETTER OF TRANSMITTAL

Mississippi Department of Natural Resources

Bureau of Geology

Mr. Jolly McCarty, Chairman, and
Members of The Commission
Department of Natural Resources

Commissioners:

The Bureau of Geology is pleased to transmit to you Bulletin 127, entitled "Tishomingo County Geology and Mineral Resources," by Robert K. Merrill and others.

This bulletin details the geology and mineral resources of the county, and summarizes tests performed on certain clay minerals, as well as ground water resources. The rocks that crop out in Tishomingo County are the oldest such rocks in Mississippi and occur only in this county. The county geologic map and cross sections are presented at an expanded scale in order to illustrate Mississippi's most complex and interesting geology in precise detail.

State, county and local government will find this report an invaluable resource to aid the economic development of this entire region. This publication is an excellent contribution to the growing knowledge of the state's geology, and the extent and value of its mineral resources.

Respectfully submitted,

Conrad A. Gazzier
Director and State Geologist

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TISHOMINGO COUNTY GEOLOGY AND MINERAL RESOURCES

by
Robert K. Merrill

ABSTRACT

Tishomingo County comprises the northeast corner of Mississippi, and the northern and eastern county boundaries occur at the Tennessee and Alabama state lines, respectively. The total land area of the county is 436 square miles, and the population is 18,434 (1980 Census count). Tishomingo County is the site of the most beautiful landscape and two of the finest state parks in Mississippi. J. P. Coleman State Park and Tishomingo State Park provide a broad range of recreational opportunities, as well as unusual geologic settings and picturesque terrain developed on the Paleozoic sedimentary rocks. Tishomingo County is the site of the highest elevation (806 feet on Woodall Mountain) and the most rugged terrain in Mississippi. Northeastern portions of Tishomingo County comprise the transition zone between the Coastal Plain and Interior Low Plateaus Physiographic Provinces; the remainder of Mississippi lies entirely within the Coastal Plain Province. The oldest exposed rocks in Mississippi occur in Tishomingo County.

Paleozoic sedimentary rocks of Devonian and Mississippian age that comprise the Highland Rim Physiographic Section are recognized at the surface of Tishomingo County as the Ross, Chattanooga, Fort Payne, Tuscumbia, Pride Mountain, and Hartselle formations. Stratigraphic units of Late Cretaceous age which comprise the East Gulf Coastal Plain Section are recognized at the surface of Tishomingo County as the Tuscaloosa Group (undifferentiated) and the McShan, Eutaw, and Coffee formations.

Strike of the Paleozoic sedimentary rocks is approximately N. 70° W.; dip is south-southwest at about 1/2°, with local structural variations imposed by gentle folds and undulations in otherwise essentially flat-lying strata. A system of vertical fractures (joints) extends throughout the Paleozoic rock sequence exposed in Tishomingo County. The two dominant or primary directions (strikes) of fracture consistently trend approximately N. 55° W. and N. 40° E., and dip is essentially vertical. Structural control of drainage imposed by the fracture system occurred as streams encountered Paleozoic rocks and established their courses along directions of weakness imposed by the joint system. Bear Creek is locally confined within valley walls composed of sedimentary rocks of Late Mississippian (Chesterian) age, and each leg of Horseshoe Bend is parallel to a direction of fracture in the rocks.

Strike of Upper Cretaceous strata is generally north-south, with local variations imposed by slight relief on bedding surfaces, as well as subtle depressions above areas of thick sediment accumulation preserved in subsurface Tuscaloosa paleovalleys. Dip is generally westward at less than 1/2° (25 to 40 feet per mile). Paleozoic strata deposited above the Hartselle Formation were removed by erosion prior to and during deposition of the Tuscaloosa fluvial sequence. Progressively older Paleozoic strata are truncated westward by the erosional surface at the base of the Tuscaloosa Group. Residual clays (kaolinite) that developed in situ on the uppermost Paleozoic surface are locally preserved beneath the Cretaceous cover. The remainder of the clays were incorporated as terrigenous sediments in the Tuscaloosa fluvial systems above the Paleozoic surface in Late Cretaceous time.

A wealth of naturally occurring resources, in the form of limestone for riprap, gravel, agricultural lime, and cement, as well as esthetically pleasing, very well cemented sandstones for building purposes, are available in the Paleozoic rock sequence of Tishomingo County. Tripoli and kaolinitic clays are preserved locally in the county. The Upper Cretaceous Coastal Plain strata contain a wealth of chert gravel and sand, suitable for all types of aggregate and other construction needs.

INTRODUCTION

The objectives of this study were to determine and describe the distributions, thicknesses, and lithologies of stratigraphic units exposed in Tishomingo County, and to determine and evaluate naturally occurring resources of potential economic and otherwise beneficial value to the State of Mississippi and the residents of Tishomingo County.

Detailed mapping of stratigraphic units on topographic base maps began in July of 1985, and the surface map of the 436 square miles occupied by Tishomingo County was complete in June of 1987. Initial visits for purposes of field reconnaissance and initial development of a program of study in Tishomingo County were conducted as early as the summer of 1984, prior to publication of the previous county geologic report (Newton County Geology and Mineral Resources) in July of 1985. Field work included geologic mapping of all exposed strata in Tishomingo County on 7½-minute topographic base maps, determination of geologically advantageous test hole sites, a county-wide drilling and sampling program, and final field checks to insure the accuracy of the geologic map.

A wealth of subsurface information was gathered during large-scale drilling operations concerning groundwater and other geologic studies conducted during work on the Tennessee-Tombigbee Waterway. This information was made available by the U.S. Army Corps of Engineers and the U.S. Geological Survey, and greatly enhanced geologic insight concerning the subsurface and surface distribution of stratigraphic units in Tishomingo County. Subsurface stratigraphic correlations of geologic units that underlie Tishomingo County are illustrated on the three cross sections that accompany this report. Generalized deep subsurface correlations were afforded by data gathered for the proposed Yellow Creek Nuclear Plant and during previous petroleum test well drilling operations in Tishomingo County.

The intricate and complex stratigraphy of Tishomingo County necessitated expansion of formats previously utilized in the county bulletin series. An expanded scale was utilized for the geologic map that accompanies this report in order to more accurately delineate county-wide surface distributions of the various stratigraphic units. The map is divided into a north half and a south half that can be joined at the match line indicated on the two sheets.

The north-south trending cross section (Plate 2) is also divided into north and south halves, which can be joined at the match line indicated on the two sheets. The shorter east-west (Plate 3) and southwest-northeast (Plate 4) trending cross sections were prepared in order to illustrate the three dimensional aspects of strata that occupy the surface and subsurface of Tishomingo County.

Representative clay samples retrieved from deposits of potential economic value were analyzed mineralogically by Dr. D. E. Gann of Millsaps College in Jackson, Mississippi, and results are discussed in the Clay Mineralogy section of this report. That section also includes petrographic analyses of sedimentary rocks encountered in the subsurface and at the surface of Tishomingo County. Physical properties of clays sampled during this study were analyzed by the Alabama Mineral Resources Institute at the Tuscaloosa research center in Alabama, and results are discussed in the Economic Geology Section of this report.

The ground-water resource investigation of Tishomingo County was conducted by Steve Jennings, and the results are described in the Ground Water Section of this report. This investigation includes chemical testing and ground-water aquifer evaluation.

ACKNOWLEDGMENTS

The writer is grateful to the residents of Tishomingo County for their cooperation during the field investigation and test hole drilling program necessary in the completion of this report. Dr. Ernest E. Russell supplied much helpful information; his previous research and professional experience in Tishomingo County were freely shared and very instructive. Frederic F. Mellen provided very useful information concerning the deeper subsurface of Tishomingo County.

This study was greatly enhanced by test well data gathered during drilling programs and geologic studies performed by the U.S. Army Corps of Engineers, the U.S. Geological Survey, and the Tennessee Valley Authority. The writer is very grateful to those institutions for their interest and cooperation and for the vast amounts of geological data they freely shared.

The staff members of the Mississippi Bureau of Geology were very helpful throughout the course of this study. Special gratitude is extended to Conrad A. Gazzier, Bureau Director, for his continual support and assistance. David T. Dockery provided professional assistance during the drilling program and in the paleontological aspects of this study. Very special gratitude is extended to Michael B. E. Bograd and David T. Dockery for editing the manuscript and sharing their many very helpful professional suggestions and assistance. The author is also grateful to Charlotte Davidson for her excellent job of typing the manuscript.

DESCRIPTION OF AREA

Location and Size

Tishomingo County is in the northeastern corner of Mississippi, within the parallels 34 degrees 25 minutes and 35 degrees 00 minutes north latitude and the meridians 88 degrees 05 minutes and 88 degrees 25 minutes west longitude. It adjoins Hardin County, Tennessee, to the north and Itawamba County, Mississippi, to the south. Franklin, Colbert, and Lauderdale counties, Alabama, adjoin Tishomingo County to the east and it is bounded to the west by Prentiss and Alcorn counties, Mississippi (Figure 1). The county is

Figure 1 - Location of Tishomingo County.

elongate in outline, attaining a maximum length of 38.6 miles in a north-south direction, and 15.3 miles in an east-west direction. The total land area is approximately 279,640 acres, or 436 square miles (Miller, 1983).

Brief History and Prehistory

The record of human inhabitation in the Tishomingo County area extends to the close of the Ice Age, soon after man first entered the North American continent via the Bering Land Bridge. Radiocarbon dates of 9,640 ± 450 and 8,920 ± 400 years B.P. (Before Present) secured from the Stanfield-Worley Bluff Shelter in neighboring Colbert County, Alabama, (DeJarnette et al., 1962) indicate that Paleo Indians occupied the Tishomingo County area. Paleo Indians were a nomadic people who collectively hunted large animals for food and skins and supplemented their diet with berries bark, nuts, and fruits. They occupied naturally occurring habitation sites, such as caves or overhanging rocks near streams, lakes and springs in the Tennessee Valley area (Fundaburk and Foreman, 1957). The Paleo Indians produced a variety of tools, including points, scrapers, gravers, knives, and choppers, crafted from flint and similar stone materials. Weapons included spears, clubs, and stone, and the late Paleo Indian utilized the throwing stick (Fundaburk and Foreman, 1957).

The Archaic Culture Period spans the time period between 5000 and 2000 years B.C. Significant cultural developments of this period include long distance trade and increased variety and craftsmanship of stone weapons and tools (Fundaburk and Foreman, 1957). Big game hunting continued as late as 4000 B.C. in the Great Plains, and extinctions of large game animals necessitated adaptation to small game hunting and the practice of gathering plant foods during the Paleo Indian-Archaic transition period (Stuart, 1972). Archaic natives constructed temporary huts of poles, hide, and brush, and dug outdoor fire pits for cooking. Mussels and bivalves became an important food source for Archaic natives (Fundaburk and Foreman, 1957).

Many of the Archaic burials were by means of circular graves, and the bodies were often flexed or placed in a sitting position. Material possessions such as stone pipes, bowls, and ornaments were placed with the bodies in Late Archaic burial sites (Fundaburk and Foreman, 1957).

Ceremonial burial techniques involving earthen funerary monuments, cord- and fabric-marked potteries, and the appearance of the bow and arrow, characterize the Woodland Stage, which occupies the time period between 1000 B.C. and A.D. 1100. This period of time is also referred to as the Burial Mound Period, in reference to the appearance of ceremonial burial mounds in the archaeological record (Stuart, 1972). Dwellings were composed of round or oval, dome-shaped, timber-frame structures covered with grass, bark, or animal hides (Jenkins and Krause, 1986). The small, conical burial mounds comprising Bynum, Miller, and Pharr Mounds in northeastern Mississippi were constructed during the Middle Woodland (100 B.C. to A.D. 650) (Jenkins and Krause, 1986).

The Mississippian Stage is named after the Mississippi Valley, wherein an agricultural-based people resided in substantial communities during the time period between A.D. 1100 and A. D. 1540 (Jenkins and Krause, 1986). The shape of burial mounds changed from round, conical forms to flattened, rectangular forms by the beginning of the Mississippian culture period. The mounds were surrounded by the village area, and served as foundations for important buildings such as temples, council houses, and dwellings of tribal leaders (Fundaburk and Foreman, 1957). The use of human and natural resources was organized and directed by chiefs and other functionaries, who directed construction, regulated trade, and conducted war activities. Elaborate fortifications indicate regular threat of war (Jenkins and Krause, 1986). Bear Creek Mound, located on the Natchez Trace 0.1 mile west of the Alabama state line, is of the truncated platform shape typical of the Mississippian culture period. Elaborate pottery forms, rectangular thatch-roofed houses, and flat topped mounds arranged around open plazas characterize this time period, also referred to in the literature as the Temple Mound Period (Stuart, 1972).

The Late Mississippian, or Historic, culture period is marked by frequent hostilities and open war among tribes as indicated by reports of explorers who traversed the Southeast in the middle and late sixteenth century. As France, England, and Spain fought for a foothold in the New World, the decline of Mississippian culture continued as those countries took advantage of the natives and provoked them into war and intrigue. Rapid depletion of wild game, epidemics of disabling diseases, treachery, colonial rum, and European trade goods, caused the native Indians to become increasingly dependent upon trade with the Europeans and Colonials (Fundaburk and Foreman, 1957).

The natives never again captured the remarkable levels of skill and craftsmanship characteristic of prehistoric cultures; objects of native craftsmanship were replaced by such things as brass bells, mirrors, cloth, glass beads, and metal tools. The Chickasaw Indians occupied northern Mississippi, western Tennessee, and northern Alabama when the arrival of the Spanish explorer Hernando DeSoto marked the initial Indian-European contact on December 16, 1540. DeSoto arrived at the Chickasaw Long Town on Pontotoc Ridge one day later, and maintained friendly and successful relations with the Chickasaw Indians until March of 1541, when he demanded hundreds of Indian slaves to accompany and serve his exploratory expedition (Williams, 1976). A short time later the Indians attacked the nearby Spanish camp, and DeSoto barely escaped death.

The Chickasaws frequently attacked the boats of French voyagers on the Mississippi and Tennessee rivers, as the French and English invaded their territory and tried to force their retreat. In 1771, their grounds extended from middle Mississippi northward to the mouth of the Ohio River, and eastward into Tennessee and Alabama (Cochran, 1969).

The Chickasaw Indians became increasingly restricted as treaties with the United States government defined boundaries of lands upon which the Chickasaw Nation was allowed to live and hunt. The Hopewell Treaty, concluded with the Chickasaw Indians on January 10, 1786, defined in a general way the boundaries of lands occupied by the Chickasaws in portions of what is now Tennessee, Alabama, and Mississippi. The Mississippi Territory was established on April 7, 1798. This territory occupied a large area of what is now Alabama and Mississippi, and was bounded on the north by the Yazoo River, on the west by the Mississippi River, on the east by Georgia, and on the south by Spanish West Florida (Cochran, 1969). In March of 1817, the Mississippi Territory was divided into an eastern half (Alabama Territory) and a western half that was admitted to the Union as the State of Mississippi on December 10, 1817 (Cochran, 1969). A treaty made with the Chickasaw Indians the following year relinquished their claim to all lands within the boundaries of Tennessee, limiting the Chickasaw Nation to Alabama and Mississippi. The Pontotoc Treaty between the U.S. Government and the Chickasaw Indians was concluded on October 22, 1832, wherein the Chickasaw Indians ceded to the U.S. all land they owned east of the Mississippi River, and provided that the Chickasaw Nation select a reservation west of the Mississippi River (Cochran, 1969).

Chief Tishomingo was the last of full-blooded warriors and counselors of the Chickasaw Nation. He migrated westward with his people in response to the Pontotoc Treaty. After crossing the Arkansas River, a smallpox epidemic broke out among his party, and the chief died in the spring of 1839 (Williams, 1976). The first capital of the new Indian Territory was named after the chief, and is now the thriving city of Tishomingo, Oklahoma.

On February 9, 1836, the Mississippi State Legislature passed an act dividing Mississippi into 10 counties, and on February 14, 1836, Tishomingo County was organized and named after the renowned Chief Tishomingo (Cochran, 1969). Tishomingo County included areas presently recognized as the counties of Alcorn, Prentiss, and Tishomingo, and was often referred to as the State of Tishomingo or Old Tishomingo County. Article 15 of the Treaty of Pontotoc provided that the Choctaw Indians were not to be disturbed while they and the U.S. Government were involved in selecting new lands for the Indians west of the Mississippi River (Cochran, 1969). This provision was ignored by squatters too impatient to wait for the U.S. Government to survey the land ceded by the Choctaw Indians, or for the final removal of Choctaws from Mississippi lands. Hundreds of families of white squatters had already arrived in Tishomingo County when it was defined by the Mississippi Legislature in February of 1836 (Williams, 1976). These squatters hastened to purchase the title to lands they had illegally occupied when the federal land office opened at Pontotoc, Mississippi. The first official land patent issued in Tishomingo County was dated January, 1836 (Williams, 1976).

Rueben H. Boone is considered by historians to be the first white settler to make a home in Tishomingo County. In 1834, he sold his holdings in Tennessee and moved his family southward to settle in Tishomingo County (Cochran, 1969). The population increased rapidly following the opening of the federal land office, and by 1840 the population had grown to 2,468 whites and 181 slaves. The population of Tishomingo County grew to 13,528 whites and 1,961 slaves by 1850 (Williams, 1976). In the fall of 1854, the town of Cross City was established at the crossing of the Memphis and Charleston and the Mobile and Ohio Railroad lines. This city grew rapidly and was renamed Corinth by the Mississippi Legislature on March 12, 1856.

The Civil War had a profound impact in Tishomingo County. The famous Battle of Corinth took place on October 3, 4, and 5, 1862, and victorious Federal forces took control. General Grant arrived in Corinth and established headquarters in the town until July, when he took possession of the plantation home of F. E. Whitfield. Grant confined Mr. Whitfield to prison in Alton, Illinois, on the false charges of attempting to "subvert the Federal Government." Mr. Whitfield's house and property were subsequently destroyed, except for the gatepost, a portion of the original trees that occupied the land, and a few fence posts. Details of the destruction appear in a letter written by Mr. Whitfield, and reproduced in Williams (1976).

During reconstruction, efforts of Tishomingo County residents to rebuild were hampered by carpetbaggers, scalawags, bands of horse thieves, outlaws, and rustlers, and starvation and poverty prevailed in what was once a prosperous area.

Alcorn and Prentiss counties were established and set apart from the area occupied by Old Tishomingo County in 1870, and Iuka became the seat of the present Tishomingo County (Williams, 1976).

Population

Tishomingo County had a population of 18,434 according to the 1980 census count. The 1970 census count reported 14,940, giving a population increase of 23 percent, or 3,494 persons, from 1970 to 1980. The 1980 population density was 42.3 persons per square mile. According to the 1980 census count, Iuka is the largest town in the county, with a population of 2,846. Belmont had a population of 1,420 and Burnsville, 889. Tishomingo, Golden, and Paden had populations of less than 400 persons according to the 1980 census count.

Accessibility

Figure 2 and Plate 1 illustrate the areal distribution of roadways and railways in Tishomingo County. State Highway 25 is the major north-south roadway in the county, and U.S. Route 72 is the major east-west trending roadway. U.S. Route 72 is the only four-lane roadway in Tishomingo County. State Highways 350, 364, 30, and 4 traverse Tishomingo County in a east-west direction with access from State Highway 25. State Highway 350 runs approximately

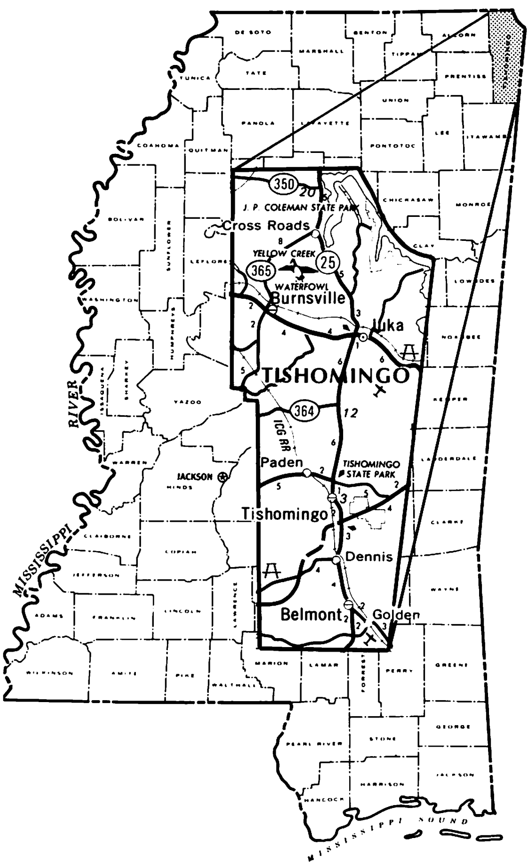


Figure 2 - Major roadways and railways in Tishomingo County.

one mile south of and parallel to the northern county boundary. U.S. Route 72 trends east-west and crosses State Highway 25 at Iuka. State Highway 365 intersects Highway 25 at Cross Roads, continues southwest to intersect U.S. Route 72 at Burnsville; it continues southward into Prentiss County and intersects State Highway 30 about 16 miles to the south. State Highway 364 runs east-west between Holcutt and State Highway 25. The portion of 364 traversed by the Tennessee-Tombigbee Waterway at Holcutt is closed, but west of the waterway the highway intersects State Highway 365 in Prentiss County. State Highway 30 runs east-west and crosses State Highway 25 one half mile north of Tishomingo. State Highway 4 intersects State Highway 25 at Dennis, and continues westward into Prentiss County. State Highway 366 crosses the southeast corner of Tishomingo County, offering access from its intersection with State Highway 25 at Golden to Red Bay, Alabama. Many of the county roads are paved, although rural areas are served mainly by gravel-surfaced dirt roads (Plate 1).

The Natchez Trace Parkway crosses the southern portion of Tishomingo County, and offers the most direct route from Natchez, Mississippi, to Nashville, Tennessee. The Natchez Trace Parkway is a beautifully preserved and landscaped National Park, and commercial traffic is not permitted.

Tishomingo County is served by the Corinth and Counce Railroad Company, the Southern Railway System, and the Illinois Central Gulf Railroad Company. The Corinth and Counce Railroad crosses the northwest portion of Tishomingo County, and terminates at Yellow Creek Port. The Southern Railway crosses the western county boundary approximately one mile north of U.S. Route 72, and continues eastward through Iuka and into Alabama. The Illinois Central Gulf Railroad crosses the western Tishomingo County boundary approximately two miles southwest of Burnsville, and continues southeast through Tishomingo, Belmont, Golden, and across the northeast corner of Itawamba County into Alabama.

Barge traffic is accommodated by the northernmost section of the Tennessee-Tombigbee Waterway, the Divide Section, with an 84-foot lift lock at Bay Springs Lock and Dam (Figure 3). The waterway has a navigation channel 12 feet deep and 280 feet wide in Tishomingo County. The Tennessee-Tombigbee Waterway was opened to commercial and recreational traffic on January 16, 1985 (Green, 1985), completing an inland transportation route connecting the Ohio River with the Gulf of Mexico. Figure 13 and Plate 1 show the areal distribution of the waterway and Bay Springs Lock and Dam in Tishomingo County.

Climate

Tishomingo County has a warm, temperate climate, with slightly cooler and less humid conditions than most of Mississippi. During the summer season, the average temperature is 78° and the average daily maximum temperature is 90° Fahrenheit. The highest recorded temperature in the area was 108° F, recorded at nearby Booneville, Mississippi, on July 28, 1952 (Miller, 1983). The average temperature is 42° during the winter season, with an average minimum temperature of 31° F. The lowest recorded temperature (-12° F) was recorded at Iuka on January 21, 1985 (Table 1). Coldest recorded temperatures generally occur in January.

The average rainfall for the period 1978 through 1986 was 56.3 inches, reported at the Iuka station (Table 1). Figure 4 illustrates the general rainfall trends for the State of Mississippi. Climatological data for Tishomingo County were compiled from the U.S. Weather Bureau's annual and monthly reports for a 10 year time period and results are given in Table 1. Climatological data were not reported from Tishomingo County prior to 1978.

Freezing precipitation occurs during the coldest months (January and February), although accumulations rarely exceed a few inches. The average wind speed (11 miles per hour) is highest during the winter (Miller, 1983), occasionally pushing the chill factor to below 0° F.

State Parks and Recreation

Tishomingo County is the site of the most beautiful landscape and two of the finest state parks in Mississippi. J. P. Coleman State Park is located on the western shore of Pickwick Lake near the mouth of Indian Creek, and includes the

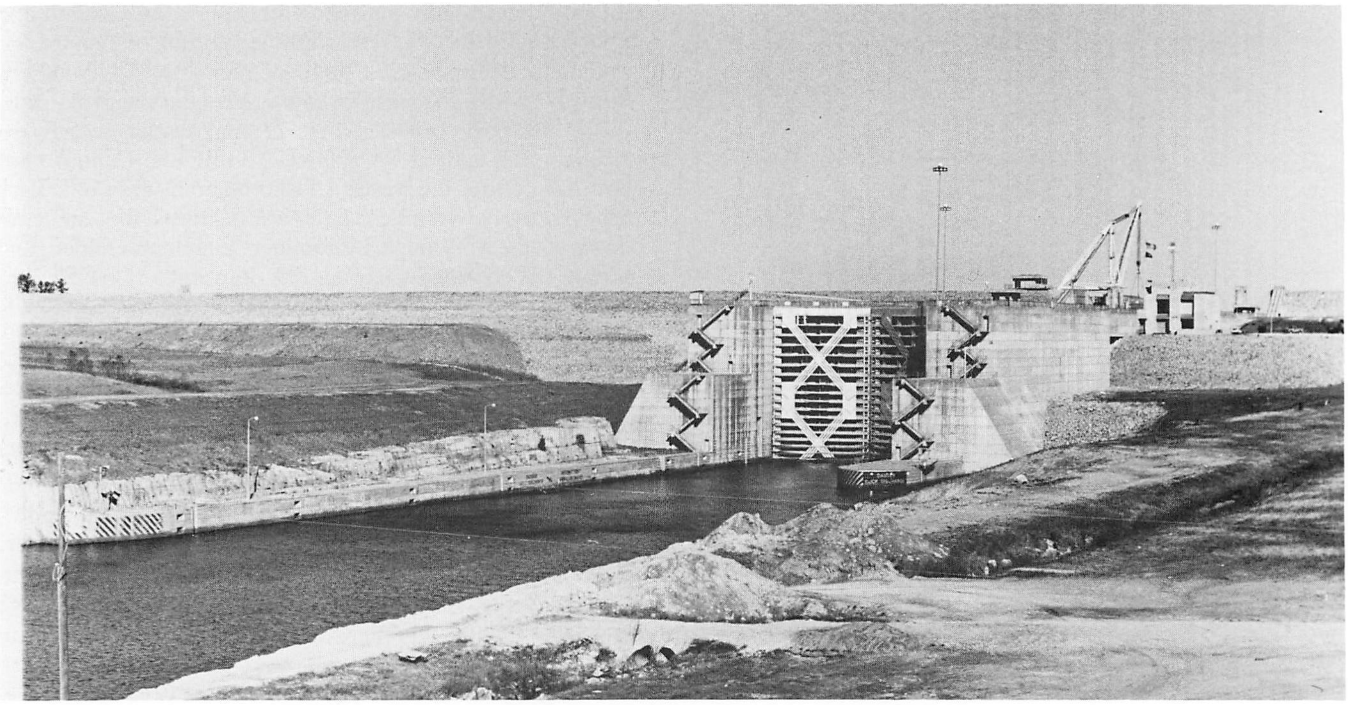


Figure 3 - Bay Springs lock and dam facility on the Tennessee-Tombigbee Waterway, looking northward from the State Highway 4 bridge. Location: SE/4, SE/4, SW/4, Sec. 26, T.6S., R.9E.

	1978		1979		1980		1981		1982		1983		1984		1985		1986		1987	
	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P
January	29.6	5.20	30.9	10.37	41.9	3.76	35.8	1.51	36.0	10.10	38.1	3.01	33.4	2.50	30.1	3.42	38.1	.32	38.9	2.69
February	31.0	.80	36.2	4.31	36.0	3.10	42.5	4.86	40.2	4.28	42.3	5.46	44.6	3.19	37.5	4.76	46.3	4.44	44.6	6.97
March	46.7	5.02	50.9	6.63	46.8	13.48	....	4.01	53.8	5.11	48.9	5.10	47.7	4.45	53.1	3.70	50.5	4.04	52.8	3.17
April	61.9	2.70	60.2	9.56	56.9	4.40	65.3	3.85	55.6	6.37	53.4	13.78	57.8	8.82	60.9	4.49	60.8	.69	57.2	2.26
May	66.8	13.24	66.6	5.84	67.8	4.62	65.2	4.25	70.3	3.59	64.8	11.15	65.5	8.25	67.8	4.36	....	7.36	73.1	1.52
June	75.8	3.70	73.7	3.00	75.8	4.51	78.1	4.02	72.4	2.10	72.6	2.20	75.9	1.80	75.0	2.94	....	5.86	76.5	4.07
July	80.0	2.21	78.2	4.85	82.7	4.30	79.5	5.23	79.1	4.31	79.1	1.59	76.4	5.67	77.3	3.97	80.3	2.72	79.3	1.79
August	78.5	3.66	76.9	4.35	81.3	2.99	76.5	4.11	76.6	2.72	79.7	4.96	76.3	1.34	....	6.59	75.5	5.18	81.5	1.39
September	74.7	1.31	69.8	8.48	75.0	5.21	68.5	2.14	69.0	3.01	70.0	1.89	69.6	.34	....	1.50	73.2	1.43	71.3	3.20
October	57.0	.92	59.5	....	56.7	2.59	58.8	4.30	59.3	2.60	61.4	3.18	65.7	9.34	63.4	8.41	60.3	4.40	53.3	.77
November	55.5	5.11	48.2	7.43	47.6	5.05	51.4	2.54	50.2	6.02	49.8	7.21	47.9	6.77	56.8	5.03	51.3	11.48	53.1	6.81
December	42.0	7.61	42.0	5.25	41.0	.93	39.2	3.30	47.7	17.78	33.6	10.16	49.4	2.34	35.9	1.63	40.9	8.91	43.8	7.15
Year	58.3	51.48	57.7	....	59.12	54.94	....	44.12	59.2	67.99	57.8	69.69	59.2	54.81	....	50.80	....	56.83	60.5	41.79
Highest F°	99		95		103		96		96		100		98		....		....		102	
Date	7-31		8-2		7-17		6-25		7-23		8-26		6-20		....		....		8-26	
Lowest F°	9		5		7		3		-4		15		2		-12		6		17	
Date	1-27		1-9		3-3		1-12		1-17		1-16		1-21		1-21		1-28		2-10	

Table 1 - Average yearly and monthly temperature and precipitation data; January 1978 through December 1987. Compiled from Climatological Data - Mississippi, January 1978 through December 1987.

area surrounding Indian Creek and adjoining areas along the western shores of the impounded Tennessee River (Plate 1, sheet 1). Tishomingo State Park is located in lands surrounding the Horseshoe Bend area of Bear Creek, beginning approximately one mile southeast of the town of Tishomingo, and extending southward as far as one mile upstream from Horseshoe Bend (Plate 1, sheet 2). The general locations of the parks are shown in Figure 2. Accurate locations and the geologic settings are shown on Plate 1.

Lands occupied by J. P. Coleman State Park were donated to the Park Commission by the Tennessee Valley Authority in 1958, and named in honor of James Plemon Coleman, Governor of Mississippi from 1956 to 1960. The park occupies 1400 acres of pine and hardwood forests, and offers facilities for camping, picnicking, water sports, and a variety of special and seasonal activities. Covered boat docks, rental boats, and a marina complete with a concrete boat launching ramp provide easy access and accommodations for boating activities upon beautiful Pickwick Lake (Figure 5).

Weathering and erosion of Paleozoic sedimentary rocks has sculptured steep bluffs and waterfalls along the Tennessee River (Figure 11) and the very hilly terrain affords a beautiful setting for inland areas of the park. Limestone and

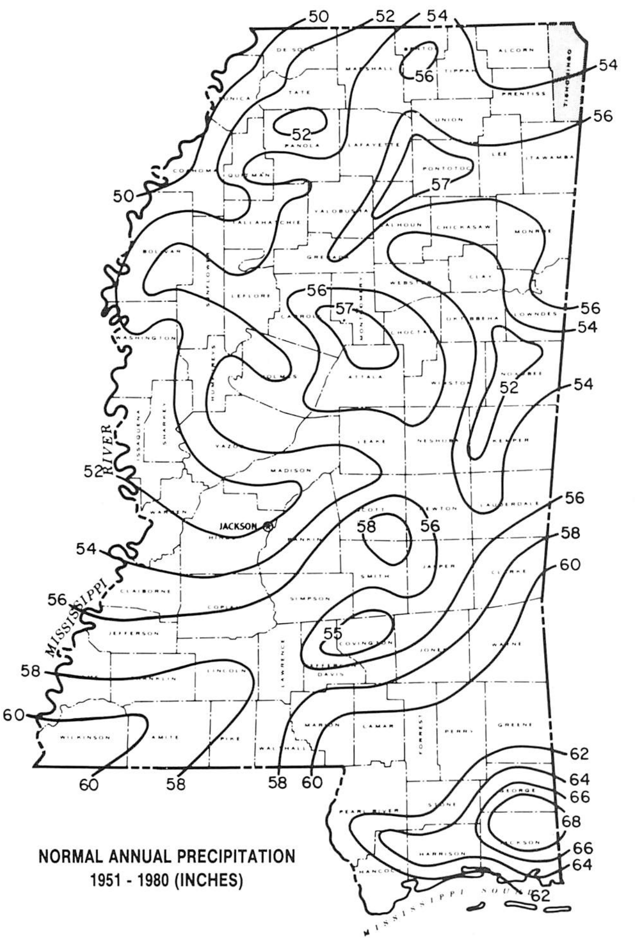


Figure 4 - Mean annual precipitation in inches. From U. S. Weather Bureau, Jackson, Mississippi. Based on the 30-year period 1951-1980. Tishomingo County is shown as the shaded area.

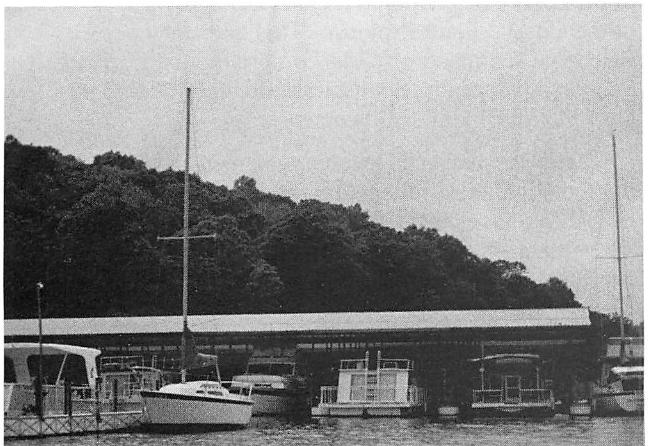


Figure 5 - The marina at Cooks Landing, in J. P. Coleman State Park. Location: NW/4, SE/4, SE/4, Sec. 5, T.2S., R.11E.

chert strata exposed in and around the park area, and along waterfront areas outside the park, are shown on Plate 1 (sheet 1) as portions of the Fort Payne Formation. Smooth, rounded hilltops are developed on softer Coastal Plain strata, which overlie Paleozoic rocks exposed in the valley walls. This hilly terrain comprises the southwestern limit of the Interior Low Plateaus Physiographic Province in Mississippi (Figure 7). Tishomingo State Park is also located along this transition zone, shown as the Paleozoic Bottoms Physiographic District in Figure 8. The geologic setting of J. P. Coleman State Park appears on Plate 1 (sheet 1) in the area surrounding impounded portions of Indian Creek and the western shore of the Tennessee River, along the northeastern border of Tishomingo County. Camping facilities offered by J. P. Coleman State Park include 45 primitive camping pads furnished with grills, picnic tables, and hookups for electricity and running water. More luxurious accommodations include 10 furnished duplex cabins, three motel suites, a fast food restaurant, and catering services.

Tishomingo State Park is one of the 10 original parks in the State Park System. The park was constructed in the late 1930's by the Civilian Conservation Corps. The cabins were constructed from the beautiful sandstone of the Hartselle Formation (Highland Church Sandstone of Morse, 1930), which occurs naturally in and around the park area. The park, as well as Tishomingo County and the nearby town of Tishomingo, is named in honor of the leading chief of the Chickasaw Indians, Chief Tish-o-mingo. Tishomingo State Park occupies lands adjacent to Bear Creek which extend to the north and south of Horseshoe Bend, including southern portions of T.5S. and northern portions of T.6S., in easternmost R.10E. and westernmost R.11E. Plate 1 (sheet 2) illustrates the location and geologic setting of the park. The park is located at the southernmost extension of the Interior Low Plateaus Physiographic Province (Figure 7) into Mississippi. This transition zone comprises the Paleozoic Bottom Physiographic District in Figure 8, and is informally termed the Appalachian foothills.

Tishomingo State Park contains cliff-forming sandstones of the Hartselle Formation (Highland Church Sandstone of Morse, 1930). Nearly vertical sandstone cliffs exposed along Bear Creek valley are the result of downcutting of the stream through zones of weakness imposed by fracture systems in the Paleozoic sequence. Bear Creek has eroded through the entire thickness of the Hartselle sandstone, exposing shales and thin beds of limestone comprising uppermost portions of the Pride Mountain Formation (Plate 1). Large blocks of sandstone have broken off and moved down the valley walls of Bear Creek, leaving vertical exposures of the cliff-forming Hartselle sandstone that pose a challenge to beginning rock climbers (Figure 6). The park offers an 8-mile canoe trip down Bear Creek, and a 13-mile nature trail system, affording great opportunities for visitors who wish to observe a magnificent landscape sculptured by the natural influences of rock, weathering, and time. The geology and botany of Tishomingo State Park were described in Morse (1936).

Tishomingo State Park accommodates a broad range of outdoor activities and offers many recreational facilities. The

Figure 6 - Jeans Overhang, sculptured by weathering of cliff-forming sandstones comprising the Hartselle Formation, offers a challenge to beginning rock climbers who visit Tishomingo State Park.

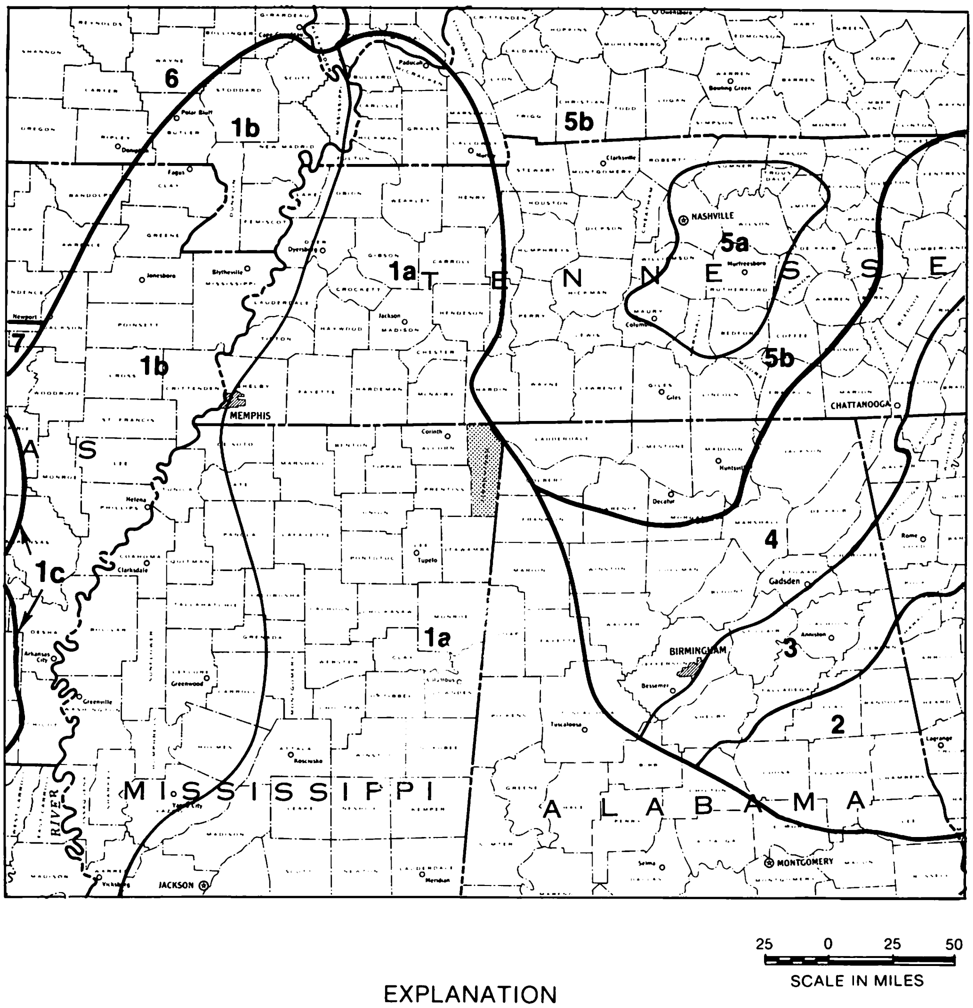
picturesque Haynes Lake is well stocked with catfish, bream, and bass, and rental boats are available to visitors. The park offers six stone vacation cottages, six modern group cabins, six rustic group cabins, and 62 camping pads. Picnic tables and grills are conveniently located throughout the park, and a large playing field (softball, volleyball, etc.), playground (complete with equipment), and swimming pools are available. The historical Natchez Trace Parkway, the major route between Natchez and Nashville in the early 1800's, traverses portions of the park.

Both Tishomingo and J. P. Coleman State Parks are located in the most picturesque and rugged terrain in Mississippi. The splendors of nature are well preserved there, in the foothills of the Appalachian Mountains.

Physiography

The boundary between the Coastal Plain and Interior Low Plateaus Provinces occurs in northeastern Tishomingo County. The remainder of Mississippi lies entirely within the Coastal Plain Province (Figure 7). The northeastern portion of Tishomingo County adjoins the Highland Rim Section of the Interior Low Plateaus Province, and the remainder of the county lies within the East Gulf Coastal Plain Section of the Coastal Plain Province. This boundary occurs where Paleozoic sedimentary rocks comprising the Highland Rim Section dip beneath unconsolidated Upper Cretaceous, East Gulf Coastal Plain sediments.

Mississippian and Devonian sedimentary rocks comprising the Highland Rim Section are recognized at the surface in Tishomingo County as the Ross, Chattanooga, Fort Payne, Tuscumbia, Pride Mountain, and Hartselle formations. Upper Cretaceous sediments comprising the East Gulf Coastal Plain Section are recognized at the surface in Tishomingo County as the Tuscaloosa Group and McShan, Eutaw, and Coffee formations. Paleozoic strata younger than the Middle Mississippian Hartselle Formation were removed by erosion prior to and during deposition of Upper Cretaceous Coastal Plain sediments. The landward boundary of the Coastal Plain Province in Tishomingo County is marked by a transition zone in which streams have cut down into Paleozoic rocks characteristic of the Highland Rim Section,



EXPLANATION

1. Coastal Plain Province
   1a. East Gulf Coastal Plain Section
   1b. Mississippi Alluvial Plain Section
   1c. West Gulf Coastal Plain Section
2. Piedmont Province
3. Valley and Ridge Province
4. Appalachian Plateaus Province
5. Interior Low Plateaus Province
   5a. Nashville Basin Section
   5b. Highland Rim Section
6. Ozark Plateaus Province
7. Ouachita Province

Figure 7 - Regional physiographic map.

with stream divides capped by Upper Cretaceous sediments. The dominant influence of Paleozoic strata upon the topography produces very rugged terrain adjacent to the Tennessee River and its tributaries in Tishomingo County. This area represents the southwestern limit of the Highland Rim-East Gulf Coastal Plain transition zone, or the Paleozoic Bottoms District (Figure 8). Fenneman (1938) divided the East Gulf Coastal Plain into several physiographic belts that extend northward into Tennessee, through Mississippi, and eastward across Alabama and Georgia. The "Fall Line" is a term generally restricted to the Embayed Section of the Coastal Plain Province although the term is sometimes used in the unrestricted sense to describe the overall landward boundary of the province. The Embayed Section includes coastal areas along the eastern seaboard, north of Cape Lookout, North Carolina (Fenneman, 1938, and Murray, 1961).

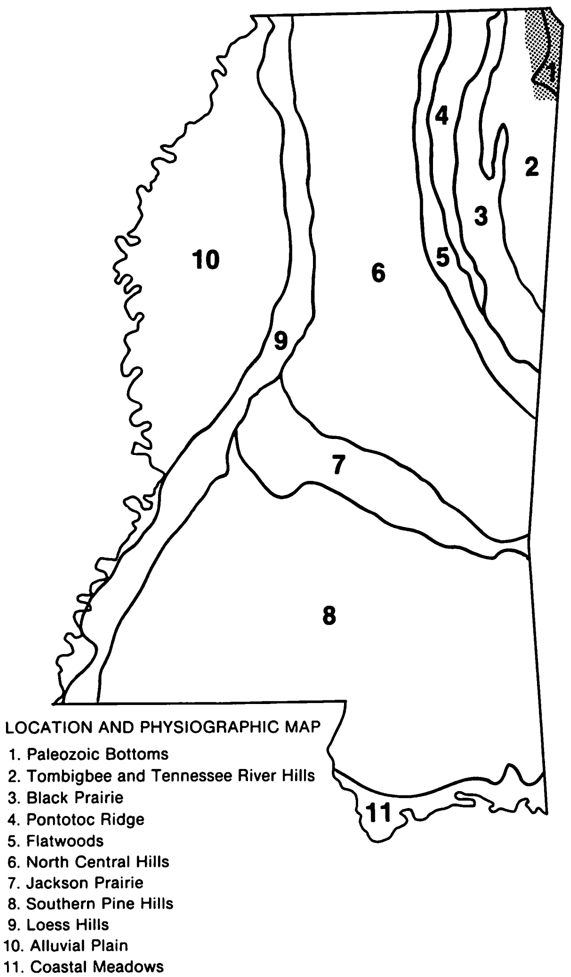


Figure 8 - Physiographic map of Mississippi.

The first state-wide physiographic subdivisions appeared in Crider and Johnson (1906) and Lowe (1915). Subsequent subdivision and adoption of new terms generated the map of Physiographic Districts in Mississippi shown in Figure 8. The Paleozoic Bottoms District applies to areas of Paleozoic rock exposure, which are limited primarily to areas of low elevation where stream erosion has cut down into bedrock. The remainder of the land area of Tishomingo County lies within the Tennessee and Tombigbee River Hills District, which is equivalent to the Tennessee River Hills Physiographic District described by Crider and Johnson (1906) and Lowe (1915), and the Fall Line Hills belt of Fenneman (1938). Stephenson and Monroe (1940) described this area as the Tombigbee and Tennessee River Hills District because the Tombigbee River drains the majority of the land area of the district.

Topography

Complete seven and one half minute quadrangle coverage is available for Tishomingo County. Figure 9 gives the areal distribution and names of each of the thirteen quad-

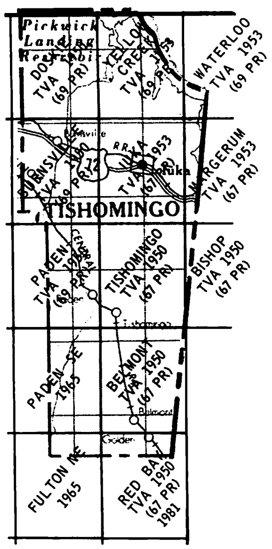


Figure 9 - Topographic map coverage of Tishomingo County.

rangles. The Fulton Northeast and Paden Southeast quadrangles were published in 1965 with field checked information. The remaining eleven quadrangles were published, with field checked information,from 1950 to 1953, with photorevisions (not field checked) from 1967 to 1969. Most of the remaining quadrangles were subsequently photorevised between 1970 and 1984 (not field checked). Areas of Tishomingo County affected by the Tennessee-Tombigbee Waterway and Bay Springs Lake and Dam have not been updated on the quadrangles since construction.

Tishomingo County is the site of the highest elevation in Mississippi. Woodall Mountain, located 2.2 miles southwest of Iuka (SW/4, Sec. 27, T.3S., R.10E.), attains a maximum elevation of 806 feet (Figure 10). The lowest elevation, 320, occurs near the confluence of Rock Creek and Red Bud Creek (Sections 2 and 11, T.7S., R.9E.), giving a countywide relief of 486 feet. The most rugged terrain in Mississippi occurs in northeastern Tishomingo County, where Paleozoic strata are exposed. This area represents the southwest limit of Highland Rim terrain. These areas of Tishomingo County are characterized by steep valley walls (frequently vertical) with local relief often in excess of 250 feet between stream valleys. Waterfalls and rapids occur where streams encounter resistant Paleozoic rock (Figure 11). This Highland Rim-Coastal Plain transition zone is sometimes referred to as the Fall Line, a zone characterized by waterfalls and steep valleys. Highly resistant Fort Payne limestone and chert strata form steep bluffs along the Tennessee River (Figure 12) that continue southward up Bear Creek valley and eastward into Alabama. Farther south, the Horseshoe Bend area of Bear Creek valley is beautifully landscaped by the cliff-forming sandstones of the Hartselle Formation. Removal of the less resistant upper Pride Mountain shales by stream erosion often results in shallow caves and overhanging cliffs (Figure 6). Vertical sandstone cliffs result as large blocks of Hartselle sandstone break along essentially vertical planes and move slowly downslope. This process of undercutting by Bear Creek has produced steep valley walls with sand-

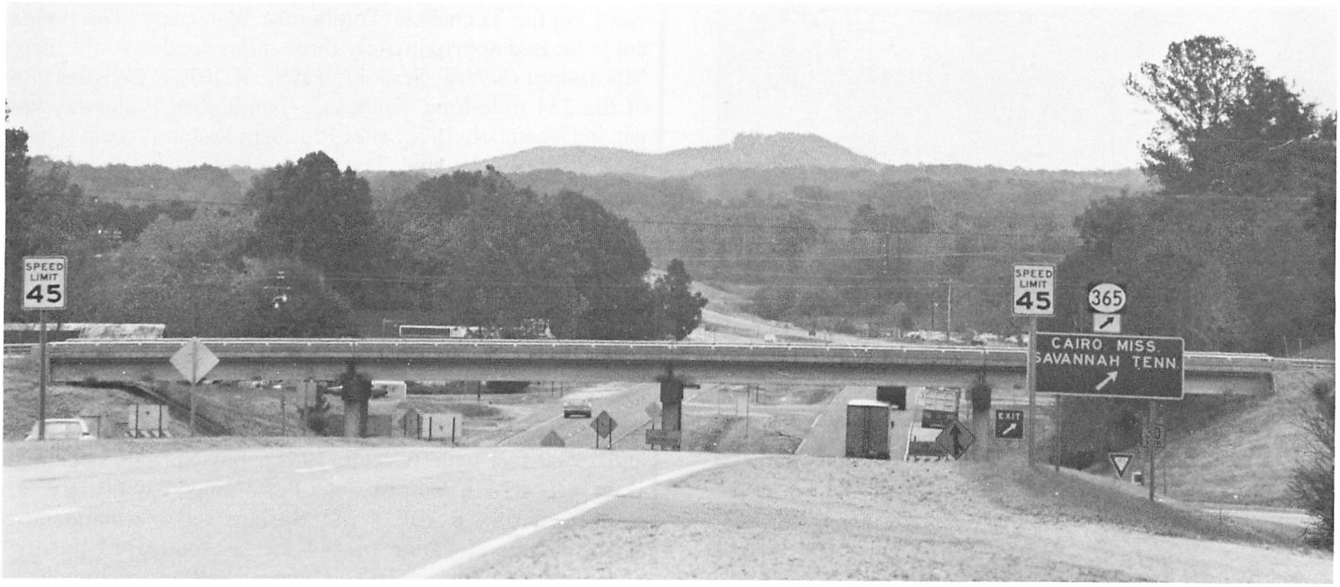


Figure 10 - Woodall Mountain, the site of the highest elevation in Mississippi (806 feet). Location: N/2, SW/4, Sec. 27, T.3S., R.10E.

stone cliffs along portions of Bear Creek and its main tributaries. Valley walls sometimes exceed 60 feet in height, with a maximum local relief of approximately 220 feet in the Horseshoe Bend area. This Paleozoic Bottoms terrain occurs frequently within areas of Paleozoic surface exposure shown in detail on Plate 1 and Plate 5.

The generally unconsolidated Coastal Plain strata are more easily eroded, and give rise to a less rugged terrain. Vertical or steep slopes are unstable in gravel and sand lithology and the absence of resistant ridge-forming strata on hilltops has allowed downward erosion to proceed more rapidly. Weathering of these strata through time has sculptured a hilly and smooth terrain, with rounded hilltops, moderately steep valley walls, and wider floodplains. This hilly topography is characteristic of the Tombigbee and Tennessee River Hills Physiographic District, which comprises most of the land area of Tishomingo County.

The northeastern portion of Tishomingo County contains numerous hilltops capped with gravels and sands comprising Tennessee River terrace deposits, which lie at elevations sometimes in excess of 700 feet above sea level. Hilltops in northwestern and west-central portions of the county are capped by unconsolidated sands and clays of the Coffee Formation. Resistant ironstones in the Coffee Formation have preserved hilltops comprising the highest elevations in the county. A north-south trending series of isolated hills occurs west of Iuka, with hilltops frequently exceeding 700 feet in elevation. The highest of these, Woodall Mountain, reaches 806 feet elevation. The Coffee Formation comprises the upper portions of Woodall Mountain, with the lower portion developed on the underlying sands of the Eutaw Formation. A similar geologic setting occurs on most of the isolated higher elevations of Tishomingo County. Bonds Mountain, Harwell Mountain, and Barnett Knob exceed 700 feet in elevation, as do several unnamed hills and ridges in the area west of Iuka.

A distinct change of valley slope occurs where gently sloping hillsides underlain by the Eutaw Formation grade upward into steeper slopes developed on the sands and clays of the Coffee Formation. For example, a distinct change in slope occurs above elevation 680 on the east side of Woodall Mountain, and exposures show the contact between the Eutaw and Coffee formations to be at similar elevations. This topographic expression (bench) is especially pronounced in the Burnsville quadrangle, where the contact could be predicted with little adjustment upon field checking. Southward, near the towns of Paden and Tishomingo, the Tennessee Valley divide lies at elevations averaging about 650 feet. South of Tishomingo, the divide occupies slightly lower elevations, averaging about 600 feet. Portions of Tishomingo County within the Tombigbee River drainage basin contain the lowest elevations, and hilltops rarely attain 600 feet in elevation.

The lowermost elevations in northeastern Tishomingo County are concealed beneath the floodwaters of Pickwick Lake, where the water level averages 414 feet in elevation. The largest areas occupied by flat terrain are contained within the flood plains of Yellow Creek, Bear Creek, and Mackeys Creek and their main tributaries. The Bear Creek flood plain attains a maximum width of 1.5 miles in southeastern Tishomingo County. Flood plains of other Tishomingo County streams rarely exceed one mile in width. The flood plain of Mackeys Creek and its main tributaries are concealed beneath the floodwaters of Bay Springs Lake (414 feet average elevation).

Drainage

Tishomingo County is drained by two major river systems. The northward flowing Tennessee River serves approximately 75 percent of Tishomingo County via several large tributaries. Mackeys Creek and its tributaries flow in a

Figure 11 - Waterfalls over the lower Fort Payne Formation at Cooper Hollow, type locality of the Carmack Limestone of Morse (1928). The waterfalls descend over about 35 feet of thinly bedded limestone. Lower portions of the 60-foot-thick sequence described in Morse (1930) are now covered by floodwaters of Pickwick Lake. Location: SW/4, NW/4, NW/4, Sec. 30, T.1S., R.11E.

southerly direction and drain the southwestern portion of the county. These river systems are separated by the Tennessee Valley divide, which occurs as a narrow ridge ranging from about 580 to 700 feet in elevation. Figure 13 illustrates the distribution of the drainage basins within Tishomingo County.

Yellow Creek and its tributaries represent the southern limits of the Tennessee River system in western Tishomingo County. Mackeys Creek and its tributaries represent the northward limit of the Tombigbee River. The linking of the Ohio River with the Gulf of Mexico was accomplished by excavation of the Tennessee River divide where it separated Yellow Creek and Mackeys Creek. Present flow is southward via the Tennessee-Tombigbee Waterway. The divide cut is located approximately three miles southeast of Cairo, Mississippi (NW/4, Sec. 30, T.4S., R.10E.). Construction of the 234 mile long Tennessee-Tombigbee Waterway began in December, 1972, after President Richard Nixon signed the Public Works Bill. The project was completed in December, 1984, by the U. S. Army Corps of Engineers. The waterway was opened to commercial and recreational traffic on January 16, 1985 (Green, 1985). The northernmost portion of the waterway is termed the Divide Section, and represents the portion of the waterway that lies within Tishomingo County boundaries. The Divide Section is 39 miles long with a navigation channel 12 feet deep and 280 feet wide. The maximum cut through the divide separating the Tennessee and Tombigbee River basins is 175 feet deep and 1,500 feet wide (Green, 1985). Bay Springs Lock and Dam is located in southwestern Tishomingo County (SW/4, Sec. 26, T.6S., R.10E.). Bay Springs Lake is maintained at an average elevation of 414 feet as southward flowing water from the Tennessee-Tombigbee Waterway is impounded by the 2750 foot long and 120 foot high earth and rock filled Bay Springs Dam (Green, 1985). The waterway passes through approximately 60 feet of sandstones and shales comprising the Hartselle and Pride Mountain formations at Bay Springs Lock and Dam (Figure 3). The excavated sandstone was utilized for riprap to prevent erosion along the valley walls in the the Bay Springs area.

Plate 1 illustrates the route and location of the waterway and Bay Springs Lake with respect to the surrounding surface geology. The northward flowing Tennessee River is impounded and maintained at an average water level of 414 feet elevation by Pickwick Dam, located approximately 5 miles upstream from the Tishomingo County-Hardin County, Tennessee, boundary. Flooded portions of the Tennessee River and its tributaries (Pickwick Lake) accommodate barge and recreational boat traffic. Pickwick Lake extends into the northeastern portion of Tishomingo County, where flood waters occupy the lower reaches of Bear, Indian, and Yellow creeks near their confluence with the flooded Tennessee River. Plate 1 illustrates the areal distribution of Pickwick Lake. Yellow Creek is now the northern tributary included in the route of the Tennessee-Tombigbee Waterway, thus flow is to the south. The remaining portions of the Tennessee River system in Tishomingo County flow northward. Paleozoic sedimentary rock exposures of the Tennessee River valley create a very esthetically pleasing setting for Pickwick Lake. Waterfalls and rapids result where meandering of the Tennessee River has, in the past, eroded the valley walls in such a manner that the mouths of small tributaries have been eroded back (upstream) from their original confluence with the Tennessee River (Figure 11). Subsequent downward erosion by the main stream proceeded more rapidly than downcutting by small tributaries, producing waterfalls and steep bluffs.

The process of stream development is largely determined by the nature of the underlying strata. The main streams in Tishomingo flow generally parallel to strike of the Cretaceous Coastal Plain strata. All have dendritic drainage, and

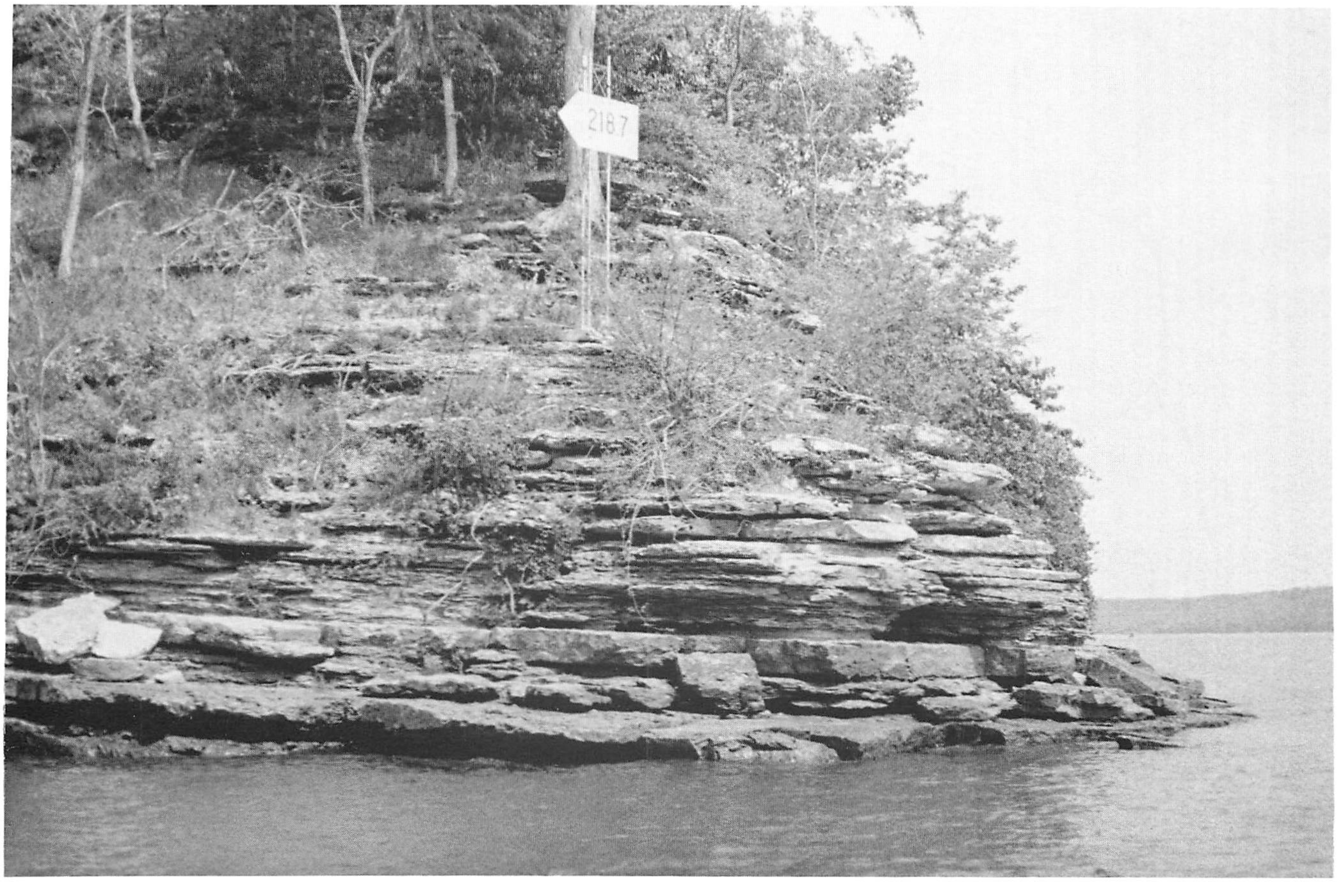


Figure 12 - Steep bluffs formed in Fort Payne chert on the Tennessee River. Location: NE/4, SE/4, NE/4, Sec. 31, T.1S., R.11E.

upper reaches of the stream systems often flow in oblique directions with respect to strike of the underlying strata. Portions of the Tennessee River Basin within Tishomingo County are drained by three major streams, Bear Creek, Indian Creek, and Yellow Creek (Figure 13), which flow generally parallel to strike of the Cretaceous Coastal Plain sediments. The lower reaches of these streams penetrate Paleozoic rocks. Bear Creek flows entirely on Paleozoic strata, except in southeastern Tishomingo County, where the Paleozoic surface dips under Cretaceous Tuscaloosa gravels. Local influence of the Paleozoic rocks upon the route of a particular stream is largely determined by rock characteristics. Horseshoe Bend is a feature of Bear Creek created by structural control of the stream course imposed by fractures in the Hartselle sandstone. Each leg of Bear Creek in the Horseshoe Bend area is incised in a direction parallel to a plane of fracture in the joint system developed in the Paleozoic rocks. The steep valley walls and sandstone cliffs at Horseshoe Bend are the result of downcutting of Bear Creek through the fractured Paleozoic rocks, with the stream course influenced by lines of weakness offered by the joint system. Structural control diminishes rapidly about six miles upstream from Horseshoe Bend, where Bear Creek meanders on Tuscaloosa sands and gravels. Plate 1 shows the distribution of geologic units along stream valleys. Bear Creek and lower reaches of its main tributaries have downcut into Mississippian age limestones, cherts, sandstones, and shales. Major tributaries of Bear Creek are, from north to south, Eastport Branch, Mill Creek, Clear Creek, Pennywinkle Creek, Cripple Deer Creek, and Cedar Creek. Flooded portions of Bear Creek extend southward from the Tennessee River to about the latitude of U. S. Route 72 at the Mississippi-Alabama boundary. Floodwaters extend only a short distance up main tributaries of Bear Creek.

Indian Creek flows northward from the town of Iuka to its confluence with the Tennessee River (Figure 13). Floodwaters of Pickwick Lake extend about three miles upstream. The upper reaches of Indian Creek are developed on Coastal Plain sediments, the lower reaches on Fort Payne chert. Indian Creek is fed by many small tributaries.

Yellow Creek extends northward from the Tennessee Valley divide (where it now joins Mackeys Creek) to its confluence with the Tennessee River. Streamflow is to the south, into Mackeys Creek and ultimately the Tombigbee River (Figure 13). Floodwaters of Pickwick Lake extend up Yellow Creek valley to approximately one mile south of the town of Cross Roads, where streamflow continues south in the waterway canal to Bay Springs Lake and Dam. The upper reaches of Yellow Creek are developed on Coastal Plain sediments, the lower reaches on Fort Payne chert (Plate 1). The major tributaries of Yellow Creek in Tishomingo County are,

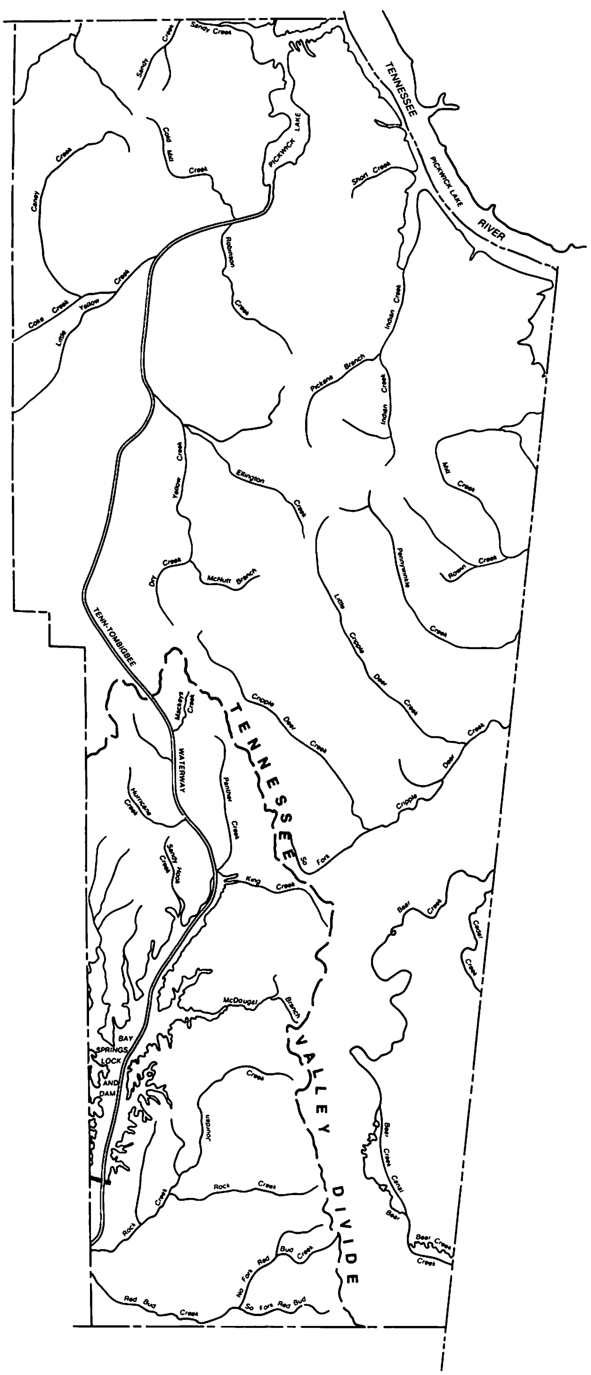


Figure 13 - General distribution of major streams of the Tennessee River and Tombigbee River drainage basins in Tishomingo County. The southwestern portion of Tishomingo County is occupied by the Tombigbee River basin, and the rest of the county is drained by the Tennessee River drainage basin.

from north to south: Caney Creek, Coke Creek, Little Yellow Creek, Berea Creek, Pigeon Roost Branch, and Clausel Creek. Sevenmile Creek crosses the northwest corner and joins the Tennessee River northward in Tennessee.

Mackeys Creek and its tributaries drain the southwestern portion of Tishomingo County. This stream system represents the northeastern limit of the Tombigbee River basin (Figure 13). Most of the land area within the Mackeys Creek drainage system is covered by floodwaters of Bay Springs Lake. The main tributaries of Mackeys Creek are, from north to south: Panther Creek, Hurricane Creek, Black Branch, Pollard Mill Branch, King Creek, Sandy Hook Creek, McDougal Branch, Riddle Creek, Rock Creek, and Red Bud Creek. Paleozoic strata underlie portions of Mackeys Creek, King Creek, McDougal Branch, Rock Creek, and Red Bud Creek. The southwesternmost exposure of the Hartselle sandstone occurs near the mouth of Red Bud Creek at Moors Mill.

The upper reaches of King Creek extend into the town of Tishomingo, where it flows on thinly bedded Mississippian sandstone. Floodwaters of Bay Springs Lake now cover most Paleozoic rocks in McDougal Branch. Rock Creek flows on Mississippian sandstones throughout most of its course, especially near its confluence with Mackeys Creek valley. Jourdon Creek flows on Mississippian sandstones near its confluence with Rock Creek. None of these streams are as deeply incised into Paleozoic rocks as is Bear Creek at Horseshoe Bend and structural control is not as pronounced. The Hartselle sandstone supports steep to vertical valley walls in the lower reaches of Rock Creek in NW/4, Sec. 1, T.7S., R.9E. Bay Springs Lake covers a similar area of exposure described by Morse (1930) developed by downcutting of Mackeys Creek through Hartselle sandstone strata leaving high, vertical rock walls with small waterfalls and rapids. Morse (1930) recommended that this area be set aside as a state park. Plate 1 illustrates the distribution of the sandstone (Hartselle Formation) along the valley walls of Mackeys Creek (south of Bay Springs Dam) and Bear Creek. Steep bluffs occur in resistant Fort Payne cherts and limestones along the Tennessee River in northeastern Tishomingo County (Figure 12).

Soils

Soils develop as parent earth materials are acted upon by physical, chemical, and biological agents produced by weathering processes. Characteristics and distribution of particular soil types are strongly affected by the parent material upon which they develop. The process of weathering produces distinct soil horizons in unconsolidated sediments. The uppermost, or A horizon, is generally referred to as surface soil or topsoil. It is the most extensively weathered horizon and contains the majority of organic material in the soil profile. In sandy soils, easily weathered minerals and finely textured particles are leached from the A horizon by downward movement of water through the soil. The underlying layer, or B horizon, is generally referred to as the subsoil. It contains some organic matter and is the site of accumulation of clay, iron, and aluminum leached from the overlying A horizon. The C horizon is the zone least affected by weathering and contains some residual geologic parent material. All three horizons are not necessarily present in a given soil type. Information contained in the latest Tishomingo County Soil Survey (Miller, 1983) offers much insight into county-wide distribution, characteristics, and uses of the various soils.

Figure 14 shows the areal distribution of the five major soil groups that occur in Tishomingo County. Miller (1983) also gives site specific information as major soil groups are subdivided on aerial photographs to show local distribution in detail. Soil occurrences are directly related to the local topography and parent materials upon which they develop.

Mantachie-Kirkville soils occur primarily in the flood plains of streams in Tishomingo County. These soils are used primarily for row crops and pastureland, although many areas are wooded. Areas in which these soils occur are occasionally flooded. Major occurrences are in areas designated as Qal on Plate 1.

Mantachie-Savannah-Jena soils occur on flat to gently sloping terrain. The loamy and poorly drained Mantachie soils occur on lower portions of flood plains and away from stream channels (Qal on Plate 1). The silty, moderately well drained Savannah soils occur on terraces adjacent to flood plains (Qtl on Plate 1). Well drained, silty Jena soils occur on higher portions of flood plains (Qal on Plate 1). These soils are used primarily for crops and pastureland.

Ruston-Ora-Savannah soils occur primarily on broad, gently sloping ridgetops and strongly sloping hillsides. These soils are mainly used for row crops and pasture plants. The parent materials for these soils are primarily unconsolidated sands comprising the Eutaw Group (Plate 1). Well drained, loamy Ruston soils occur on ridges and upper portions of hillsides. The moderately well drained loamy Ora and well drained, silty Savannah soils occur primarily on broad hilltops and terraces (Qth and hilltops underlain by Cretaceous units on Plate 1). These soils are used primarily for row crops and pastureland, except where erosion is a problem on the steeper slopes.

Smithdale-Ruston-Ora soils occur on uplands of hilly terrain on ridgetops and hillsides. The well drained Smithdale soils mainly occupy hillsides, with Ruston and Ora soils on ridgetops and upper portions of hillsides. These soils occur primarily in the western half of Tishomingo County (Figure 14), which is underlain by Cretaceous marine sands of the Selma and Eutaw groups (Plate 1). Most of the acreage occupied by this soil group is utilized for woodland. Areas occupying narrow valleys and ridgetops are used for pasture and cropland.

Saffell-Smithdale soils occur in areas occupied by steep, hilly terrain (Figure 14). These well drained, gravelly and loamy soils occur primarily in very hilly terrain underlain by terrace and Tuscaloosa gravels of eastern Tishomingo County (Plate 1). The well drained, gravelly Saffell soils occupy middle and lower portions of hillsides, and well drained, loamy Smithdale soils occupy hilltops. These soils are utilized mainly for woodland, with very small acreages in pasture or cropland. Hazards of erosion due to steepness of slope limit the use of these soils for row crops or pasture.

SURFACE STRATIGRAPHY

General Statement

Stratigraphic units that occur at the surface of Tishomingo County represent diverse times and environments of deposition. Marine shelf sedimentary rocks of Lower Devonian (Helderbergian Series) through Middle Mississippian (Chesterian Series) are preserved below a thick (up to 600 feet) blanket of Upper Cretaceous Coastal Plain sediments (gravels, marine sands, and clays) comprising the Tuscaloosa, Eutaw, and Selma groups. The oldest stratigraphic interval exposed in Mississippi comprises uppermost portions (10 feet) of the 100+ foot-thick sequence of Lower Devonian (Helderbergian) fossiliferous limestones, cherts, and shales of the Ross Formation. The Ross Formation occurs at the surface in Tishomingo County as a fossiliferous, very porous, highly weathered chert, exposed along the shoreline of Pickwick Lake at Island Hill, located in the NW/4, Sec. 22, T.1S., R.10E., and the smaller islands in the W/2, Sec. 15, T.1S., R.10E. Intermittent exposures occur on the north valley wall of Yellow Creek.

The distribution of geologic units at the surface of Tishomingo County is shown on Plate 1, sheets 1 and 2. Subsurface stratigraphic intervals included in this study consist of limestones, cherts, shales, dolomites, and calcareous siltstones comprising the Ordovician, Silurian, and Devonian systems. These intervals are shown on the three cross sections in Plates 2, 3, and 4. Correlations of stratigraphic intervals in the deep subsurface of Tishomingo County are based on samples, descriptive logs, and other available subsurface data from petroleum test wells drilled in Tishomingo County. These deeper wells are widely spaced, and correlations between them are general in nature. Marine shelf sediments of Ordovician age overlying the Knox Group occur in the deep subsurface of Tishomingo County as an approximately 800 foot-thick sequence of limestones, cherts, dolomites, calcareous siltstone, and shale. The Ordovician sequence above the Knox Group attains a maximum thickness of about 3,000 feet to the south in the Black Warrior Basin of Mississippi (Thomas, 1972a). Dolostones and limestones comprising uppermost intervals in the Knox Group occur at about 770 feet below sea level in the subsurface of northern Tishomingo County. This interval occurs at the base of cross section A-A' (Plate 2) at well number 2 (T.V.A. Core Hole no. 51-C-3), and dips southward below the sequence depicted. This interval occurs at about 1160 feet below sea level in the subsurface of central Tishomingo County, about 400 feet below the base of cross section A-A' (Plate 2) at well number 5 (Levane Akers, no. 1 Whitaker, petroleum test well).

Post-Knox Ordovician limestones, cherts, shales, and calcareous siltstones comprising the Stones River and Nashville groups are illustrated in Plate 2 along a north-south line of cross section through Tishomingo County. Overlying the Ordovician sequence are Silurian limestones, cherts, and calcareous shales comprising the Wayne and Brownsport groups. These units are shown on cross sections given in

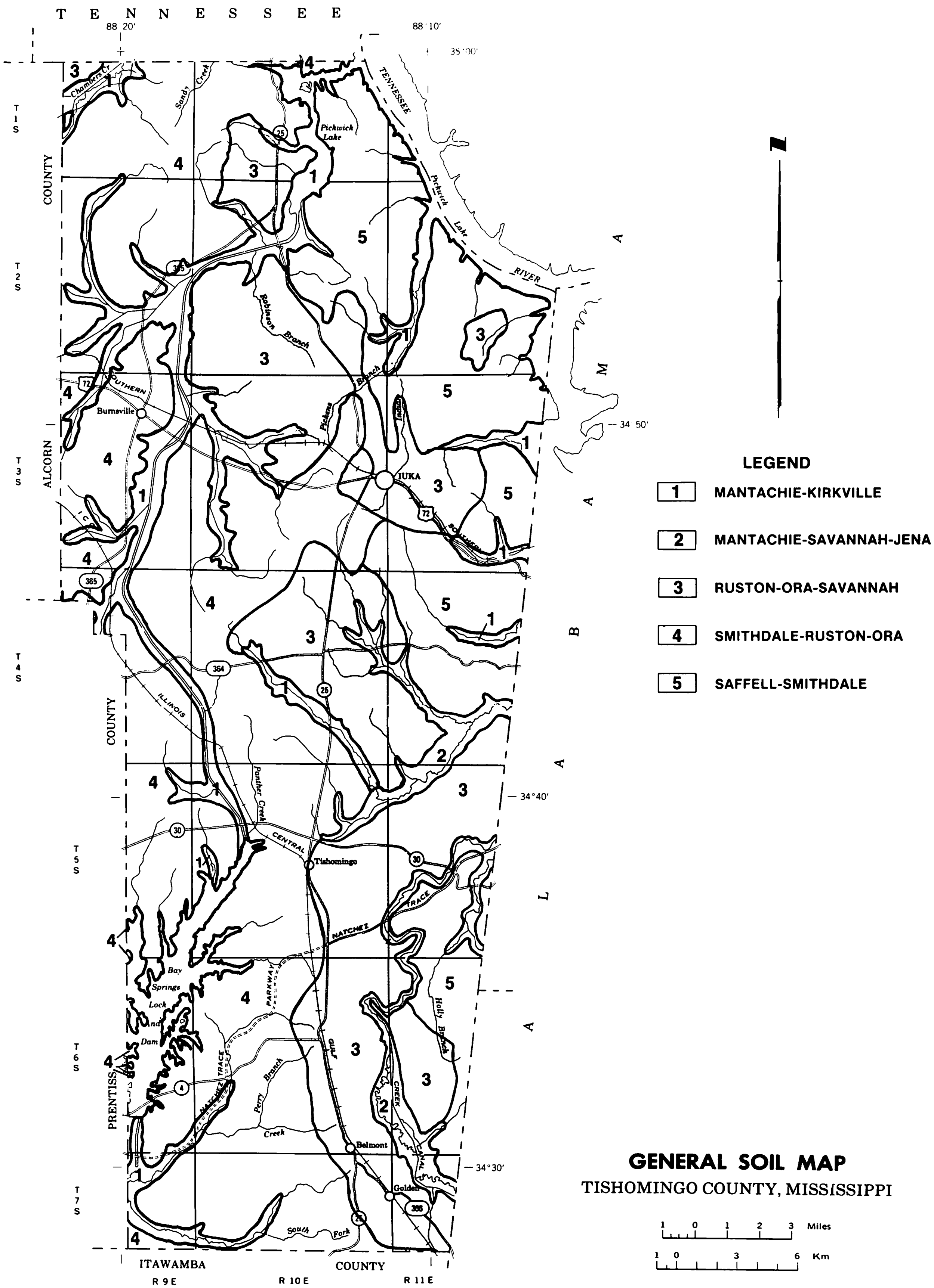


Figure 14 - General soil map of Tishomingo County, after Miller (1983).

Plates 2, 3, and 4. The Silurian System is about 240 feet thick in the subsurface of northern Tishomingo County, and thickens southward to over 350 feet thick in the county's southern part (Plate 2). Overlying the Silurian are Devonian limestone and shale lithologies comprising the Ross Formation and other stratigraphic units of the Linden Group. These units are illustrated as the Devonian undifferentiated in the cross sections shown on Plates 2, 3, and 4. The Linden Group is approximately 100 feet thick in the shallow subsurface of northern Tishomingo County, and thickens southward to over 250 feet thick in southern Tishomingo County.

The Ordovician and younger Paleozoic units that occur in the subsurface of Tishomingo County dip to the south-southwest with a regional dip of less than 100 feet per mile, and local dip, or changes in local dip, rarely exceed 1°. Vertical exaggeration is utilized in the cross sections (Plates 2, 3, and 4) in order to enhance the low relief of undulations and very gentle folds in the nearly flat lying Paleozoic strata that underlie Tishomingo County. Vertical exaggeration also enhances the surface topography so that the cross sectional distribution of geologic units occurring at the surface can be illustrated in more detail.

The uppermost 10 feet of the Ross Formation comprise the oldest stratigraphic interval, and the only interval in the Linden Group, exposed in Tishomingo County. Marine shelf sedimentary rocks comprising upper intervals of the Linden Group (Flat Gap Formation) and Middle Devonian strata (Harriman, Camden, and Pegram formations) described to the north in Tennessee in Wilson (1949) are absent from the Paleozoic stratigraphic sequence exposed in Tishomingo County, although portions of this sequence are preserved locally in the subsurface. Sedimentary rocks of Middle Devonian age that overlie the Ross Formation to the north in Tennessee were removed during a major interval of erosion prior to deposition of the carbonaceous shales of the Chattanooga Formation. Late Devonian shales comprising basal portions of the Chattanooga Formation overlie early Devonian limestones of the Ross Formation unconformably.

Widespread deposition of carbonaceous marine shales of the Chattanooga Formation occurred on a tectonically stable interior platform, which occupied the Mississippi-Alabama-Tennessee boundary area in the Devonian Period. Maximum accumulations (over 10,000 feet) of Middle and Late Devonian sedimentary rocks accumulated in a geosynclinal basin extending northeastward from eastern Tennessee through Virginia, West Virginia, Pennsylvania, and into New York (Conant and Swanson, 1961). Much thinner accumulations (about 100 feet or less) of Late Devonian sediments (mainly shale) occurred in areas (including Tishomingo County) located on the interior platform, near the southwest margin of the Chattanooga Sea. In Late-Middle through the remainder of Devonian time, the epicontinental sea again transgressed slowly onto this interior platform. By the close of the Devonian Period, black shales comprising the Chattanooga Formation and similar, correlative strata were deposited throughout much of the eastern and central United States (Conant and Swanson, 1961). Rise in sea level continued worldwide in Late Devonian and Early Mississippian time, and a global sea level highstand occurred in Osagean and earliest Meramecian time (Vail et al., 1977). These Early Mississippian marine waters covered the Devonian muds of the Chattanooga, and extended beyond areas previously flooded by the Chattanooga Sea (Conant and Swanson, 1961).

The local absence of a well preserved, identifiable, time definitive fauna in the Chattanooga Formation complicates age determinations and correlation of the unit over large areas. The age and broad-range correlation of the Chattanooga Formation have attracted a great deal of controversy in the geological literature. The present report includes the Chattanooga Formation in the late Devonian (Bradfordian) through Early Mississippian (Kinderhookian) time stratigraphic interval in keeping with current established nomenclature concerning the area of study. No paleontological evidence that would clearly define the exact age of the Chattanooga-Fort Payne boundary, was encountered in outcrop or subsurface samples observed during the present study. The Chattanooga Formation is absent locally at the surface and in the shallow subsurface of northern Tishomingo County, and the unit attains a maximum thickness of about 35 feet locally in the deep subsurface of central and southern Tishomingo County. The unit is exposed along the shore of Pickwick Lake in northernmost Tishomingo County, as shown on Plate 1 (sheet 1). The Chattanooga interval may contain thin beds and laminae of sandstone, but generally occurs as a dark-gray to black, carbonaceous, sometimes calcareous, laminated and very thinly bedded shale. Thicknesses of exposed Chattanooga intervals do not exceed 10 feet at any given outcrop in the study area. Many exposures of the Chattanooga interval described from Tishomingo County in earlier literature (Morse, 1928) are presently covered by floodwaters of Pickwick Lake. A very thin (up to 2½ feet thick), discontinuous interval of shale and claystone (Maury Formation) is included as a basal interval in the overlying Fort Payne Formation.

The disconformable contact between the Chattanooga and the overlying Fort Payne Formation is undulatory and lithologically distinct in outcrop except when weathered. The contact with the overlying Maury Formation, where present locally in the subsurface of Tishomingo County, is difficult to discern in well samples. The exact nature of the Chattanooga-Maury formational contact is uncertain where the interval is exposed, to the north in Tennessee, but no physical evidence of an unconformity is reported in Conant and Swanson (1961). A break in sedimentation is indicated by a change in conodont assemblages reported from the Chattanooga-Maury contact interval in Tennessee (Hass, 1956).

The limestone and chert sequence comprising the Fort Payne and Tuscumbia formations was deposited on a tectonically stable marine continental shelf, as sea level continued to rise from Late Devonian through Early Mississippian time. Thomas (1979) described various facies relationships and depositional environments of the marine carbonate shelf lithologies comprising the Fort Payne and Tuscumbia formations. The Fort Payne-Tuscumbia stratigraphic sequence (Iowa Group) of limestones, cherts, and cherty limestones becomes less distinct westward in the subsurface of Tishomingo County, as bioclastic limestone lithologies of the Tuscumbia grade westward into chert lithologies similar to those comprising the Fort Payne Formation. Deposition of this sequence occurred on a broad, shallow marine shelf on the East Warrior Platform of northern Alabama and Mississippi. The sequence thins to the southwest in the Black Warrior Basin, from over 300 feet thick in north-central Alabama to less than 150 feet thick in the Alabama-Mississippi border region (Thomas, 1979). The basinward (westward) thinning of the Fort Payne-Tuscumbia sequence in Mississippi from the East Warrior Platform of northern Alabama is probably due to the unconformity at the top of the Tuscumbia Formation described in Welch (1959), as well as less rapid accumulation of bioclastic sediments in the deeper marine environments of the Black Warrior Basin (Thomas, 1979). The Fort Payne-Tuscumbia sequence thins westward in the subsurface of Tishomingo County, from about 420 feet thick in western Colbert County, Alabama (Plate 3), to approximately 250 feet thick in the subsurface of central Tishomingo County (Plate 2). This sequence is undifferentiated in the subsurface of western Tishomingo County. The distribution of these units at the surface of Tishomingo County is shown on Plate 1. The outcrop belt is restricted to the northern half of the county.

The Fort Payne Formation consists primarily of two distinct lithologies: a lower interval of thin- to massive-bedded, micritic and occasionally bioclastic limestone, which varies between 70 and 115 feet in thickness, and an upper interval of thinly bedded chert, which varies between 0 (where truncated by Tuscaloosa gravels) and 150 feet in thickness (Table 2). The overall thickness of the Fort Payne Formation varies between about 230 feet in the subsurface of northern Tishomingo County and about 130 feet in the subsurface of southern Tishomingo County (Plates 2, 3, and 4). The Fort Payne and Tuscumbia formations are generally differentiated on the cross sections, although lithologies of these units often are indistinct in well cutting samples; thus, intervals included in the Tuscumbia Formation may belong in the Fort Payne. For such wells, the Fort Payne-Tuscumbia boundary is indicated by a dashed line on the cross sections.

The Fort Payne Formation is unconformably overlain by the micrites and bioclastic limestones of the Tuscumbia Formation. The Tuscumbia Formation attains a maximum thickness of about 240 feet in the subsurface of eastern Tishomingo County, and grades westward in the subsurface into a sequence of light gray chert, undifferentiable from the Fort Payne chert sequence (Plates 3 and 4). The maximum exposed thickness of the Tuscumbia Formation is 201.4 feet in the Vulcan Materials Company limestone quarry in easternmost Tishomingo County (Figure 44). Upper portions of the Tuscumbia limestone are truncated westward in the subsurface of Tishomingo County by the erosional surface at the base of the Tuscaloosa fluvial sequence (Plate 3). Exposures of the Tuscumbia Formation at the surface of Tishomingo County are limited primarily to the lower reaches of Cripple Deer Creek (Plate 1).

Carbonates of the Tuscumbia Formation were deposited in open marine waters of moderate to high energy on a tectonically stable continental shelf. Bedding thicknesses and grain sizes increase upward, from thin-bedded micritic, cherty limestones in lower portions, to thick-bedded, often cross-bedded, coarse-grained, bioclastic limestones (wackestone, packstone, and grainstone) in upper portions. These limestones vary in color from light-gray in upper intervals to medium and dark gray in lowermost intervals. Occasional oolitic limestones are restricted to middle and upper intervals of the unit. The contact of the Tuscumbia Formation with the underlying Fort Payne Formation is gradational, as the light-colored bioclastic limestone, micrite, and chert sequence comprising the Tuscumbia Formation grades downward into darker colored intervals of thin-bedded black cherts, siliceous limestone, and fine-grained limestones of uppermost intervals in the Fort Payne Formation. The contact of the Tuscumbia Formation with the overlying Pride Mountain Formation is erosional in areas of northeastern Mississippi and northwestern Alabama according to Welch (1959). The Tuscumbia Formation is absent west of south-central Itawamba County (Welch, 1959) and western Tishomingo County (Plate 3). The erosional contact between the Tuscumbia and Pride Mountain formations is subdued in weathered outcrop, and the magnitude of this erosional interval is uncertain. The westward truncation of the Tuscumbia Formation in northeastern Mississippi by downdip Pride Mountain equivalent strata (Floyd Shale) along the line of section described in Welch (1959) indicates that the contact is erosional in the subsurface of northeastern Mississippi and northwestern Alabama. The Tuscumbia Formation is thickest (over 200 feet) in east-neighboring Colbert, Walker, Winston, and Blount counties in Alabama (Thomas, 1972b). The thick grainstone sequences present in Tishomingo County are replaced to the southwest by less energetic, open marine lithologies in the Black Warrior Basin of northeastern Mississippi. The shallow-water carbonate shelf lithologies of the Tuscumbia Formation in Tishomingo County represent the western extension of the shelf sediments described in northern Alabama in Thomas (1972b). Tishomingo County occupies the southwestern limit of the ancient continental shelf, and the southwestern limit of thickest accumulations of shallow shelf Tuscumbia lithologies as described in Fisher (1987).

The overlying Pride Mountain Formation represents the earliest interval of a regressive clastic facies that grades northeastward in Alabama onto the carbonate shelf facies comprising the Monteagle Limestone (Thomas, 1972b). The Pride Mountain and Hartselle formations comprise a tongue of shale, sandstone, and thin intervals of limestone, which extends northeastward from the prodelta shales (Floyd Shale) and delta front sandstones (Parkwood Formation) present in the Black Warrior Basin of north-central Mississippi. Sandstone units in the Pride Mountain Formation and the overlying Hartselle sandstone represent linear sandstone bodies formed as offshore shallow marine bars or barrier islands in a high energy, marine environment on the shelf edge, parallel to the ancient (Chesterian) shoreline (Thomas,

SYSTEM	SERIES/GROUP	STRATIGRAPHIC UNIT		THICKNESS	LITHOLOGIC CHARACTER
QUATERNARY	HOLOCENE SERIES	ALLUVIUM		5'-30'	Sand, medium- to brownish-gray, very fine- to very coarse-grained, subangular to subrounded quartz, silty, clayey; commonly contains organic matter; chert and quartzite pebbles common at base.
QUATERNARY	PLEISTOCENE SERIES	LOW ELEVATION TERRACE DEPOSITS		5'-35'	Sand, light-gray to dark reddish-brown, very fine- to very coarse-grained, subangular to subrounded quartz, silty, clayey; lower portions contain layers and lenses of flattened quartzite and quartz pebbles interspersed with rounded chert pebbles; iron staining common on pebbles. Distributed adjacent to present stream courses, at and above flood plain elevation.
QUATERNARY	PLEISTOCENE SERIES	HIGH ELEVATION TERRACE DEPOSITS		35'-56'+	Gravel, moderate reddish- to dark yellowish-brown, very well rounded chert and smooth, flattened quartzite pebbles; iron staining common on outer surfaces; beds and lenses of sand, silt, and clay occur frequently in upper portions. Irregular bedding, occasional cross-bedding; ironstone cementation common. Includes Tennessee River terrace deposits in northern part of study area. Mainly occur at elevations above 600 feet. Erosional contact at base.
CRETACEOUS	SELMA GROUP	COFFEE FORMATION		150'	Sand, light- to medium-gray, very fine- to medium-grained, subangular quartz, glauconitic, micaceous; frequently interbedded with silt, light- to medium-gray, clayey; thinly bedded with occasional intervals of irregular- to massive-bedded sand; occasional lenses and stringers of small chert gravel at base. Frequent thin ironstone beds; weathers to shades of reddish-brown. Unconformity at base.
CRETACEOUS	EUTAW GROUP	EUTAW FORMATION	TOMBIGBEE SAND MEMBER	70'-100'	Sand, medium light- to olive-gray, very fine- to medium-grained, subangular to subrounded quartz, well sorted, massive-bedded, glauconitic, micaceous, silty, clayey; weathers to various shades of reddish-brown. Frequent occurrence of ferruginous cemented sand molds of Callianassa sp. burrows.
CRETACEOUS	EUTAW GROUP	EUTAW FORMATION	LOWER EUTAW	70'-100'+	Sand, medium- to olive-gray, fine- to medium-grained, subangular to subrounded quartz, glauconitic, micaceous, horizontal- and cross-bedded; commonly thinly interbedded and interlaminated with clay, medium-gray, locally carbonaceous; isolated occurrences of petrified wood in lower portions. Weathers to various shades of reddish-brown. Frequent occurrence of ferruginous cemented sand molds of Callianassa sp. burrows. Unconformity at base.
CRETACEOUS	EUTAW GROUP	McSHAN FORMATION		20'-70'	Sand, pale yellowish-brown to very light-gray, very fine- to fine-grained, well sorted, subangular quartz, glauconitic, micaceous, silty; thinly interbedded and interlaminated with silt, light-gray to grayish orange-pink, micaceous, clayey. Horizontal- and ripple-laminated; frequent zones of massive- to cross-bedded, fine- to coarse-grained sand; frequent chert pebble lenses and stringers. Weathers to various shades of reddish-brown to yellowish-gray; local occurrences of ferruginous cemented sand molds of Callianassa sp. burrows; common occurrence of petrified wood; occasional occurrence of carbonaceous clays, dark-gray, micaceous, containing carbonized wood fragments. Unconformity at base.
CRETACEOUS	TUSCALOOSA GROUP	TUSCALOOSA UNDIFFERENTIATED		0 -350'+	Gravel, chert, white to dark-gray, very well rounded; frequent silt and clay matrix; sand, light- to moderate reddish-brown, very fine- to very coarse-grained, subrounded to angular quartz and chert grains, poorly sorted, with frequent gravel lenses and stringers; clay, white- to medium-gray with occasional occurrences of carbonaceous dark-gray clays; zones of multi-colored chert gravel; isolated occurrences of quartzite; frequent well-cemented chert pebble conglomeratic zones. Laterally traceable silt and clay intervals occur most frequently in uppermost and lowermost intervals. Unconformity at base.
MISSISSIPPIAN	CHESTERIAN SERIES	HARTSELLE FORMATION		25'-64'	Sandstone, light gray to light brownish-gray, fine- to medium-grained, well cemented quartz arenite, thin- to massive-bedded; contains thin intervals of thinly bedded and laminated siltstone and shale, medium- to dark-gray; local ferruginous staining.
MISSISSIPPIAN	CHESTERIAN SERIES	PRIDE MOUNTAIN FORMATION		300'-349'	Shale, olive- to dark-gray, calcareous, sandy; limestone, light- to brownish-gray, thin-bedded grainstones, wackestones, and mudstones, fossiliferous, occasionally oolitic, sandy, silty; sandstone, very light- to brownish-gray, thin- to massive-bedded, fine- to medium-grained, sparingly fossiliferous. Unconformity at base.
MISSISSIPPIAN	OSAGEAN-MERAMECIAN SERIES IOWA GROUP	TUSCUMBIA FORMATION		0-240'	Limestone, light- to dark bluish-gray, fossiliferous, bioclastic grainstone, wackestone, and mudstone, thin- to thick-bedded, occasionally massive-bedded; some calcareous shale interbeds. Lowermost strata contain beds of chert, very dark-gray to black; uppermost strata contain grainstone, very light-gray, cross-bedded; local occurrences of nodular chert.
MISSISSIPPIAN	OSAGEAN-MERAMECIAN SERIES IOWA GROUP	FORT PAYNE FORMATION	UPPER FORT PAYNE	80'-150'	Chert, very light- to dark-gray, thin-bedded; locally weathered to clay, silty, white to very light-gray, and tripolitic silt, white to very light-gray; locally stained shades of brown.
MISSISSIPPIAN	OSAGEAN-MERAMECIAN SERIES IOWA GROUP	FORT PAYNE FORMATION	LOWER FORT PAYNE	70'-115'	Limestone, medium- to dark bluish-gray, finely crystalline wackestone, and mudstone, thin- to massive-bedded, occasional shaly texture when weathered; occasionally glauconitic. Isolated occurrences of very thin interval of grayish-green shale (Maury Shale) at base. Contains isolated lenses of chert.
MISSISSIPPIAN	KINDERHOOKIAN SERIES	CHATTANOOGA FORMATION		0 -35'	Shale, brownish-gray to grayish-black, carbonaceous, silty, sandy, calcareous, very thinly bedded and laminated; isolated occurrences of thin sandstone laminae; absent locally; unconformity at base.
DEVONIAN	BRADFORDIAN SERIES	CHATTANOOGA FORMATION			
DEVONIAN	LINDEN GROUP	ROSS FORMATION		105' (upper 10 feet exposed)	Limestone, light- to medium bluish-gray, light brownish-gray when weathered; contains intervals of grainstone, mudstone, and shale; sparsely glauconitic; thin- to massive-bedded. Uppermost exposed portions consist of chert, light brownish-gray, granular, fractured, fossiliferous, and thin bedded.

Table 2 - Generalized column of exposed strata in Tishomingo County.

1972b). These sandstone bodies parallel the regional northwest-southeast trending facies strike, and are aligned with the southwestern edge of the East Warrior Platform, which extends through north-central Mississippi (Thomas, 1972a). Depositional environments of Chesterian strata in the Black Warrior Basin of Mississippi and Alabama are discussed in Broussard (1978), Cleaves and Broussard (1980), and Cleaves (1983).

The sandstone units of the Pride Mountain Formation are bounded laterally by and interbedded with bioclastic limestone and calcareous shale. The shale sequence may be lagoonal, although much of the Pride Mountain sequence is of marine shelf or back barrier marine origin as described in northern Alabama by Thomas (1972b).

The Pride Mountain Formation ranges from about 300 to 350 feet thick where the entire thickness of the unit is preserved beneath the Cretaceous cover in Tishomingo County. The subsurface distribution of the Pride Mountain Formation is illustrated on Plates 2, 3, and 4. The unit is primarily composed of laterally discontinuous intervals of partly calcareous, sparingly petroliferous sandstone and fossiliferous limestone within a thick sequence of partly calcareous marine shale. The thin intervals of sandstone and limestone within the shale sequence are discontinuous, and the thin members described in Morse (1928 and 1930) and Welch (1958 and 1959) are primarily limited in areal extent to Tishomingo County and Colbert County, Alabama. The classification of Welch (1958) is utilized in this report, and the interval is described in the subsurface and at the surface of Tishomingo County as the Pride Mountain Formation (undifferentiated). The Pride Mountain and Hartselle formations are continuous in the shallow subsurface of Tishomingo County, except where truncated by the erosional surface at the base of the Tuscaloosa fluvial sequence. The Pride Mountain and Hartselle lithologies grade southwestward into the Floyd Shale sequence through a zone approximated by a line extending northwestward from the Alabama state line and eastern portions of Itawamba County (Welch, 1959), through easternmost portions of Prentiss County, and northwestward through Alcorn County. The contact of the Pride Mountain Formation with the overlying Hartselle Formation is erosional locally, although the contact interval probably does not represent a significant interval of geologic time. The Hartselle Formation is primarily composed of thin- to thick-bedded, fine- to medium-grained, well-cemented quartz sandstone (quartz arenite). Ripple bedding and cross-bedding occur occasionally, although the Hartselle sandstones are most frequently horizontally bedded, and thicker individual bed sets frequently appear massive (homogeneous or unbedded) in outcrop. The unit locally contains poorly preserved fossil impressions in lower portions. The Hartselle Formation rarely exceeds 30 feet in thickness where exposed in southern and east-central Tishomingo County (Plate 1, sheet 2). The sandstone unit attains a maximum observed thickness of 64 feet where encountered in continuous sample core holes, bored in southwestern Tishomingo County by the U. S. Army Corps of Engineers during geologic foundation studies concerning Bay Springs Dam.

The Hartselle Formation is the youngest Paleozoic rock unit that occurs in the subsurface or at the surface of Tishomingo County (Table 2). Overlying Mississippian and Pennsylvanian age strata were eroded away prior to and during deposition of Tuscaloosa fluvial sediments.

The Paleozoic sedimentary rocks exposed in Tishomingo County are separated from overlying Coastal Plain sediments by an unconformity of significant geologic duration, produced through long periods of erosion during which thick accumulations of in situ, residual clays developed on the Paleozoic surface. This residual clay interval (Little Bear Residuum of Mellen, 1937) is preserved locally beneath the Cretaceous cover, and the remainder of the original volume of clay is incorporated as matrix material in the overlying Tuscaloosa fluvial sediments.

Before and during Late Cretaceous time, a structural dome (Pascola Arch) occupied the northern Mississippi Embayment. Rocks of Cambrian, Ordovician, Silurian, and Devonian ages were exposed by removal of at least 8,000 feet of Paleozoic strata from the crest of this dome in Missouri and northwestern Tennessee prior to Tuscaloosa deposition (Stearns and Marcher, 1962). Mississippian chert gravel in the Tuscaloosa fluvial sediments was derived locally, while Devonian chert gravel was transported from the Pascola Arch (Marcher and Stearns, 1962). These chert gravels were transported into northeastern Mississippi and northwestern Alabama by a system of southeast-flowing streams. A second system of southwest-flowing streams contributed quartz sand, quartzite pebbles, and chert (Russell, 1987). Devonian and Mississippian age chert comprises the great majority of gravel in the Tuscaloosa Group. Occurrences of quartzite pebbles and quartz sand in Tuscaloosa fluvial sediments are limited to southeastern Tishomingo County. Tuscaloosa fluvial sediments that occur in Tishomingo County are continental in origin, and consist primarily of well-rounded, cross-bedded chert gravel (small pebbles to cobbles), sand, and clay. Clay beds are most abundant in the uppermost and lowermost intervals of the Tuscaloosa. Intervals of trough- to planar cross-bedded sand occur throughout the unit, and usually contain gravel in varying proportion. Chert gravels frequently possess a silty clay matrix, probably derived from residual clays developed on the Paleozoic rocks prior to Tuscaloosa deposition. A contour map of the highly eroded Paleozoic surface that developed prior to and during Tuscaloosa deposition is shown on Plate 5. Large thicknesses of Tuscaloosa fluvial sediments occupy a deep, westward opening paleovalley in central Tishomingo County, wherein the unit attains a maximum (isolated) thickness of 418 feet. Maximum county-wide thicknesses of the Tuscaloosa Group generally do not exceed 350 feet. Tuscaloosa fluvial sediments are thin to absent locally in areas of the county that are underlain by Paleozoic ridges. The Tuscaloosa is overlapped northward in Tishomingo County by marine sands and chert gravels of the Eutaw Formation. The distribution of the Tuscaloosa Group at the surface of Tishomingo County is illustrated on Plate 1.

The unconformity at the base of the Tuscaloosa Group has considerable local relief. Plate 2 illustrates the highly irregular, erosional nature of the contact of the Tuscaloosa Group with successively younger Mississippian rocks southward in the subsurface of Tishomingo County. The Fort Payne Formation is the lowermost (oldest) unit that is overlain by Tuscaloosa strata within Tishomingo County, while the Hartselle Formation is the uppermost (youngest) Paleozoic unit. Only upper intervals of the Tuscaloosa Group (Gordo Formation - equivalent strata) occur in Tishomingo County.

The Tuscaloosa Group is disconformably overlain by the McShan Formation. The McShan is the lowermost formation in the Eutaw Group (Table 2), and represents the earliest interval of upper Cretaceous marine sedimentation in the study area. The McShan Formation is composed primarily of interlaminated and thinly interbedded, fine-grained, glauconitic, micaceous sand and silty clay. Bedding in the unit is characteristically very thin to laminated, and bedding planes are essentially horizontal. Lenses of medium-grained, cross-bedded, and massive-bedded glauconitic sand occur locally. Occasional thin beds and stringers of small chert pebbles are primarily limited to lowermost intervals. Petrified wood and occasional ferruginous molds of *Callianassa* sp. burrows occur throughout the unit. The thickness of the McShan varies between 20 and 70 feet.

The McShan Formation was deposited in a shallow sea that transgressed across the northwestern edge of Tuscaloosa fluvial sediments in northeastern Mississippi, northwestern Alabama, and western Tennessee. Fine-grained, glauconitic sands, silts, and clays of this formation are evidence of a nearshore marine origin (Russell and Parks, 1975). The McShan Formation overlies Paleozoic strata in southern Tishomingo County where the Tuscaloosa pinches out over Mississippian ridges preserved below Upper Cretaceous strata and exposed locally at the surface. The surface exposure of the McShan Formation is illustrated on Plate 1. Subsurface distribution of the McShan is shown in cross section on Plates 2, 3, and 4.

Sea level continued to rise worldwide in Late Cretaceous time, and global highstands occurred during the Turonian and Campanian ages, although sea level generally remained high worldwide throughout the Late Cretaceous (Vail et al., 1977). Transgressive cycles are reflected in the transition from the continental fluvial deposits comprising upper intervals in the Tuscaloosa Group to the shallow marine lithologies of the McShan Formation. Upper Tuscaloosa strata and overlying marine sands comprising the McShan Formation are of latest Coniacian and early Santonian age in the Tishomingo County area (Russell et al., 1983). The worldwide relative rise in sea level reached a global highstand in Campanian time (Vail et al., 1977). This global change is reflected in the stratigraphic record preserved in Tishomingo County, as increasingly deeper marine depositional environments are indicated by the lithologies, sedimentary structures, and fossil fauna preserved in the Eutaw Formation.

The erosional surface separating the McShan and overlying Eutaw formations is the result of a brief period of emergence following a post-McShan marine regression. Downwarping of the Pascola Arch, which extended into northern Mississippi, and subsequent development of the Mississippi Embayment syncline commenced in Late Cretaceous time (Stearns and Marcher, 1962). This structural movement probably affected the Late Cretaceous depositional environments locally in northeastern Mississippi, although major structural development of the syncline, in areas occupied by the northern Mississippi Embayment, did not take place until Eocene time (Stearns and Armstrong, 1955).

The Eutaw Formation overlies the McShan Formation disconformably. The Eutaw Formation consists primarily of two distinct lithologies, and is separated into a lower, cross-bedded marine sand interval (Lower Eutaw) and an upper interval of bioturbated, massive-bedded marine sand (Tombigbee Sand Member) as shown on Table 2. The fossiliferous marine sands and clays comprising the Eutaw Formation are assigned to the early Campanian Age in Russell et al. (1983). The Eutaw Formation is generally 200 feet thick in Tishomingo County. Thicknesses of the Lower Eutaw interval vary locally between 70 and 100 feet, with an isolated maximum thickness of about 125 feet encountered in the subsurface of central Tishomingo County. The Lower Eutaw interval consists primarily of cross-bedded, ripple bedded, and horizontal-bedded, medium-grained, sparingly fossiliferous, glauconitic sand, interbedded and interlaminated with gray silt and carbonaceous clay. A shallow water, energetic marine environment is indicated by the various types of bedding (trough and planar cross-bedding, ripple bedding) as well as by occasional occurrences of ferruginous molds of burrows (*Ophiomorpha nodosa* Lundgren) of the decapod crustacean *Callianassa* sp. described in Weimer and Hoyt (1964) as geologic indicators of littoral and shallow neritic environments. These burrow molds are limited primarily to uppermost intervals of the Lower Eutaw, and are much more abundant in the conformably overlying Tombigbee Sand Member.

The Tombigbee Sand Member varies between 70 and 100 feet of thickness in Tishomingo County, and is primarily composed of massive, bioturbated, fine-grained, glauconitic, fossiliferous, silty, clayey sand. The Tombigbee interval is more fossiliferous than the underlying Lower Eutaw and McShan intervals, although fossil preservation is poor throughout the Upper Cretaceous sequence exposed in Tishomingo County. Glauconite in the Eutaw Formation is pelletal in form and is attributable to rod-like fecal pellets of the decapod crustacean *Callianassa* sp. (Russell and Parks, 1975), which probably altered to glauconite in the marine environment. The greater diversity of the Tombigbee faunal assemblage indicates a more open and deeper (subtidal) marine depositional environment than that of the underlying Lower Eutaw interval. Bioturbation by decapod crustaceans is much more pronounced in the Tombigbee interval than in underlying Cretaceous strata, and may be the primary factor responsible for the massive character of the Tombigbee sands.

The Eutaw Formation overlies Paleozoic strata where the Tuscaloosa Group and McShan Formation are absent in northern Tishomingo County. The distribution of the Lower Eutaw and Tombigbee Sand intervals at the surface of Tishomingo County is illustrated on Plate 1. The distribution of these intervals in the subsurface of the county is shown on cross sections presented on Plates 2, 3, and 4.

The Eutaw Formation is disconformably overlain by the Coffee Formation. This formational boundary is also the group boundary between the Eutaw and Selma groups (Table 2). Erosion of uppermost intervals of the Eutaw Formation followed regression of Eutaw seas from western Tennessee (Russell and Parks, 1975) and adjoining areas of Mississippi and Alabama. This interval of erosion produced the disconformity at the top of the Tombigbee Sand interval. Subsequent marine transgression deposited the marine sands and clays of the Coffee Formation in protected lagoonal and barrier beach environments, which spread northward into western Tennessee (Russell and Parks, 1975). Clays and plant detritus were deposited in portions of the lagoonal environment less affected by current action, and shifting currents deposited uniformly bedded layers of fine-grained sands, transported by tidal action through low-lying marshes in western Tennessee (Russell and Parks, 1975). Portions of the Coffee Formation (lowermost 150 feet) preserved in Tishomingo County indicate deposition in an energetic marine environment as sands dominate over lagoonal clays (muds) and abundant plant remains characteristic of the Coffee Formation in other areas of the Coastal Plain are rare. The Coffee Formation occurs at the surface of northwestern and west-central Tishomingo County as a 150-foot maximum thickness of thinly interbedded, fine- to medium-grained, finely glauconitic, micaceous sand and silty clay. Zones of cross-bedded and massive bioturbated sands occur locally in exposures of the Coffee Formation observed in Tishomingo County. Lithologies similar to those comprising Lower Eutaw and Tombigbee intervals occur locally near the base of the unit. The uppermost interval of the Coffee Formation, as well as overlying strata comprising the Selma Group, have been removed by erosion.

Uplift and erosion in late Paleogene and Neogene times exposed Cretaceous gravels (Tuscaloosa) in the Tennessee and Tombigbee river drainage systems. During the subsequent development of these systems, a series of widespread gravel-bearing terrace deposits was deposited on the Upper Cretaceous, Coastal Plain sediments. Small portions of the Tennessee River terrace gravel deposits are preserved in Tishomingo County. These deposits occupy larger areas in western Kentucky and western Tennessee (Russell, 1987). The Tennessee River terrace deposits are preserved at elevations at and above 600 feet in northern Tishomingo County and occupy hilltops adjacent to the Tennessee River as shown on the geologic map (Plate 1). Most of the high level fluvial terrace deposits that occur southward in Tishomingo County are probably related to the ancestral Tennessee River system, although some deposits along the Tennessee-Tombigbee drainage divide may be related to the ancestral Tombigbee River system. High elevation fluvial deposits located southward from the immediate vicinity of the present course of the Tennessee River, and the Tennessee River terrace deposits, are combined into the unit described in this report as High Elevation Terrace Deposits (Table 2). The distribution of these deposits at the surface of Tishomingo County is illustrated on Plate 1.

High Elevation Terrace Deposits consist primarily of quartzite and chert gravels, cross-bedded sands, and occasional intervals of silt and clay in a generally fining upward sequence. The maximum observed thickness of this unit occurs in northernmost Tishomingo County (Test Hole AP-6; well no. 1 on Plate 2) as a 56 foot-thick interval of coarse chert and quartzite gravel in a quartz sand matrix. High elevation fluvial deposits may be in part Pliocene in age; however, a precise age determination is difficult due to a lack of age-diagnostic fossils and the inability to correlate these deposits with units of known age. Rather than questionably extend the age of the fluvial terrace deposits to Pliocene time (Pliocene? - Pleistocene), the unit is included entirely within the Pleistocene Series.

Low Elevation Terrace Deposits are restricted to stream valleys of present-day drainage systems of Tishomingo County. These terraces primarily occupy portions of the valley walls adjacent to the present flood plains at elevations above the present flood plain and below the older, high elevation fluvial terraces. Low elevation terraces are composed of thin intervals (less than 35 feet thick) of cross-bedded quartz sand, silt, and clay, with intervals of quartzite bearing chert gravels primarily concentrated in lower portions. Basal terrace gravels occupy valley walls adjacent to streams and slope toward the present flood plain, truncating underlying beds. Sediments comprising low elevation terraces are derived primarily from High Elevation Terrace Deposits, Tuscaloosa gravels, and unconsolidated Upper Cretaceous marine sands. These deposits formed subsequent to the older, high elevation fluvial terraces. Low Elevation Terrace Deposits generally range between 5 and 30 feet in thickness.

Alluvial deposits of Quaternary age comprise the low, flat-lying areas (flood plain) that occupy the floor of stream valleys, adjacent to present stream courses. These sediments represent Recent and present stream development, deposited as the stream migrated between valley walls. Alluvial deposits that occur in Tishomingo County consist primarily of a fining upward sequence of gravel, sands, and silty clays that attains a maximum thickness of about 30 feet. Alluvial deposits are thicker in the lower reaches of the streams and become thinner and narrower in areal extent as the upstream limits are approached.

Lithologic descriptive terms are not utilized in the titles of geologic units described in the present report, unless followed by formation or member designations. For example, the stratigraphic interval described as the Tuscumbia Limestone in Welch (1959), Bicker (1979), and Thomas (1979), is referred to herein as the Tuscumbia Formation in order to clarify the stratigraphic rank of the unit. Lithologic descriptive terms such as limestone, chert, or sandstone are usually applied to members of formations. This report, however,

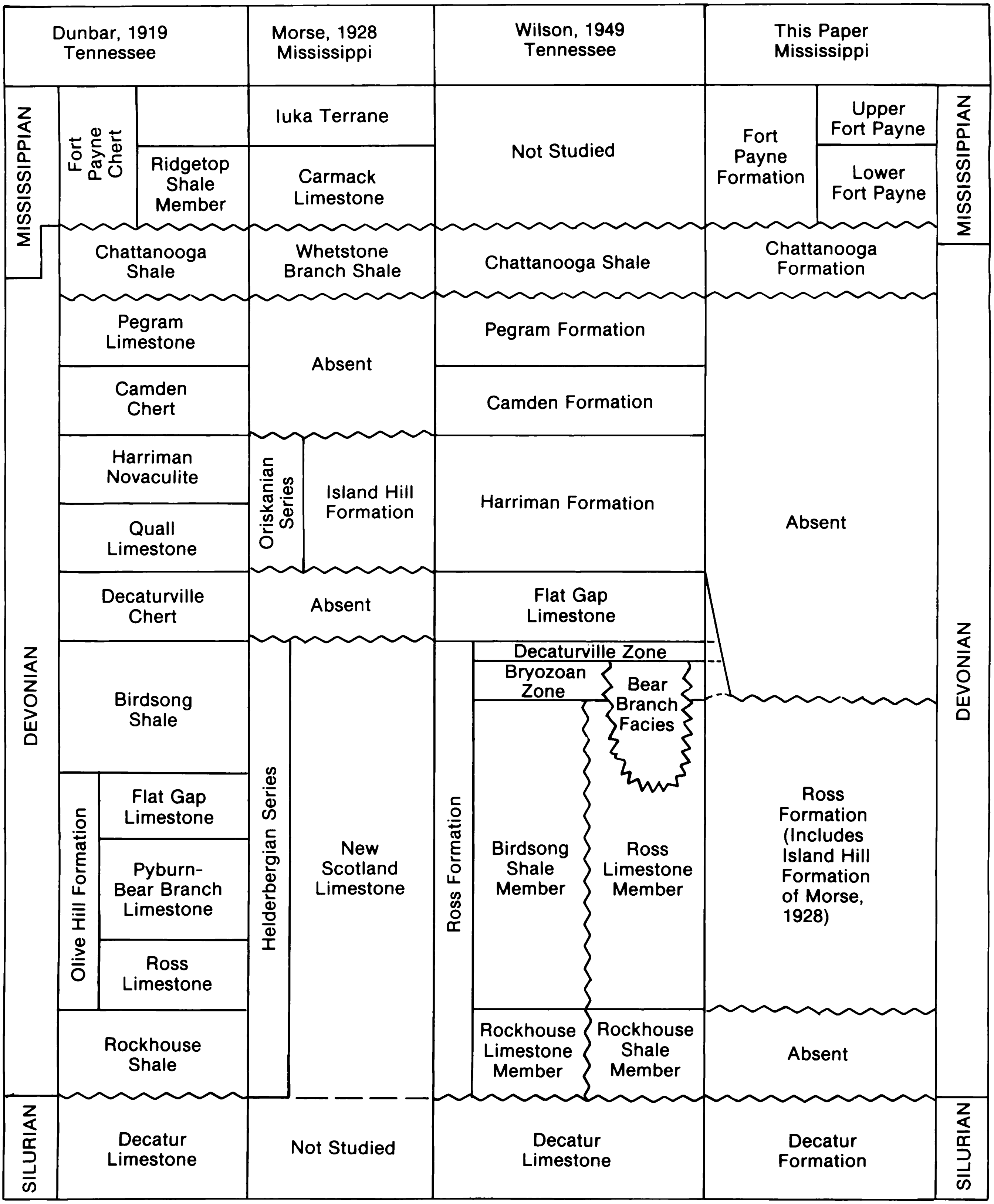


Figure 15 - Classifications utilized in previous literature concerning pre-Chattanooga stratigraphy in the Mississippi-Tennessee region.

does not attempt to propose or describe any new classifications for any of the geologic units described in Tishomingo County, only to utilize the most widely accepted titles and boundaries of the units as prescribed in the existing nomenclature, for the particular study area.

Several test holes were drilled during the field work for the present study in order to determine thickness and lithologic character of geologic units in the subsurface of Tishomingo County. Descriptions of test hole samples collected at 10-foot intervals are given in the Test Hole Records section of this report. All strata observed at the surface of Tishomingo County are discussed individually below.

PALEOZOIC ERATHEM

DEVONIAN SYSTEM

HELDERBERG SERIES

Linden Group

The term Linden was initially utilized in the literature by Safford and Killebrew (1876) in reference to the Helderbergian age, bluish-gray, fossiliferous, thinly bedded limestone sequence exposed at Linden, Perry County, Tennessee. Safford and Killebrew (1876) defined this sequence as the Linden Limestone, in which they included all strata of lower Devonian (Helderbergian) age that underlie the Black Shale (present Chattanooga Formation) and overlie Silurian rocks (Clifton Limestone in that classification; present Brownsport Group). Foerste (1903) divided the Linden Limestone of Safford and Killebrew (1876) into the Ross and Pyburn limestones and assigned formational rank to the Ross and Pyburn intervals of the Linden Group. The present report recognizes the Linden Group as including the Ross Formation and the Flat Gap Limestone (of formational rank) described in Wilson (1949). The Ross Formation is the only portion of the Linden Group represented at the surface of Tishomingo County. The overlying Flat Gap Limestone (assigned formational rank in Wilson, 1949) occurs in isolated synclinal basins in the subsurface of Tishomingo County.

Ross Formation

The Ross Formation was originally described in the literature by Foerste (1903) in reference to exposures on the Ross farm, where lower Devonian (Helderbergian) limestone beds formed steep bluffs along Horse Creek at Chalybeate Spring in Hardin County, Tennessee. Foerste (1903) included the Ross Limestone as the lowermost formation in the Linden Group. The Ross Limestone was subsequently reduced in rank by Dunbar (1919), who included the Ross Limestone as the lowermost member of the Olive Hill Formation. Morse (1930) included lower Devonian strata exposed in Mississippi (described as the Olive Hill Formation in Dunbar, 1919) in the New Scotland Limestone and Island Hill Formation. Morse (1930) used the term New Scotland Limestone of Clarke and Schuchert (1899) for the oldest rocks that occur at the surface of Tishomingo County, and named the overlying Island Hill Formation for exposures at Island Hill (now) in Pickwick Lake, located in the NW/4, Sec. 22, T.1S., R.10E. Morse (1930, p. 17) assigned the Island Hill Formation to the Oriskanian Series. The name Ross as used in this publication includes the New Scotland and Island Hill of Morse and all strata above the Decatur Limestone and below the Flat Gap Limestone, as well as a member of the Ross Formation of Wilson (1949) (Figure 15).

The Ross Formation of western Tennessee includes several facies and thin stratigraphic zones (Wilson, 1949) that are absent in Mississippi (Figure 15). The lowermost limestone sequence, which comprises the Rockhouse Limestone Member in western Tennessee, is replaced southward by the Rockhouse Shale Member, which is exposed in Hardin County, Tennessee (Wilson, 1949). These units are absent in core and test holes penetrating this stratigraphic interval in Tishomingo County. The stratigraphic interval comprising the Ross Limestone Member as described in Hardin County, Tennessee, in Wilson (1949) is probably the only portion of the Ross Formation represented at the surface of Tishomingo County (Figure 15). Uppermost intervals of the Ross Formation, described from Tennessee exposures as the Bear Branch Facies, Bryzoan Zone, and the Decaturville Zone of Wilson (1949), are missing in Tishomingo County. Thin, isolated occurrences of the Flat Gap and Harriman formations, in southern Hardin County, Tennessee, are due to preservation in small, local synclinal basins, where the unit remained protected during subsequent periods of erosion (Wilson, 1949). The Flat Gap Limestone was not observed at the surface of Tishomingo County during field investigations concerning the present report. Thin, isolated subsur-

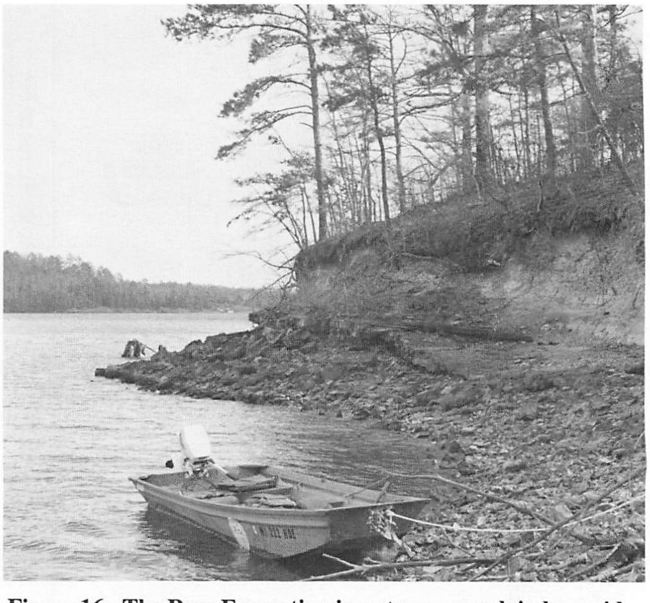


Figure 16 - The Ross Formation in outcrop, overlain by residual beds formed by weathering of the Chattanooga and Fort Payne formations. The resistant chert bed at the top of the Ross Formation is terraced by weathering of less resistant, overlying strata. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

face occurrences are reported in two of the closely spaced test holes drilled during geologic investigations regarding the Yellow Creek Nuclear Plant Preliminary Safety Analysis Report (Russell, 1975). The lateral discontinuity of the Flat Gap Limestone is illustrated by its absence in descriptions of the remainder of closely spaced core holes drilled in and around the site area (Russell, 1975). The Flat Gap Limestone occurs at the surface of Hardin County, Tennessee, as light- to pinkish-gray, massive, crystalline, stylolitic limestone (Jewell, 1931). The Flat Gap Limestone is described from the subsurface of Tishomingo County in Mellen (1947). The Ross Limestone Member is reported to be from 60 to 90 feet thick in exposures in Hardin County, Tennessee (Wilson, 1949). At the type locality, the member consists primarily of dark-blue to dark-gray, thinly bedded, dense, argillaceous, fossiliferous, cherty limestone, with occasional thin beds of dark blue or black dense chert (Wilson, 1949). These lithologies are replaced northward by the Birdsong Shale Member, which is composed primarily of bluish- to greenish-gray marine shale, with thin beds and lenses of medium-gray, fine- to coarse-grained limestone (Wilson, 1949).

Floodwaters of Pickwick Lake now cover all but the uppermost 15 feet (at low water level) of the Devonian age fossiliferous strata described by Morse (1930) as the New Scotland Limestone and Island Hill Formation. This thin stratigraphic interval represents the only portion of the Ross Formation, described to the north in Tennessee (Wilson, 1949), which occurs at the surface of Mississippi. Surface exposures of the Ross Formation are limited to northernmost portions of Tishomingo County, in NE/4, NW/4, Sec. 22 at Island Hill, and to the north in SW/4 and NW/4, SE/4, Sec. 15, T.1S., R.10E. Plate 1 (sheet 1) shows the areal distribution of the Ross Formation at the surface of northernmost Tishomingo County. The Ross Formation is elevated to the surface by a shallow anticlinal fold, which trends N-NW to S-SE in northernmost Tishomingo County. The Ross Formation dips southward into the subsurface of Tishomingo County. The strike is essentially east-west, with minor variations imposed by gentle folding in the essentially flat-lying Paleozoic beds; the dip is to the south at about 1 degree or less. The Ross Formation is 102.5 feet thick in the Tennessee Valley Authority, Yellow Creek Nuclear Plant Core Hole 51-C-3, located in NE/4, NE/4, NW/4, Sec. 35, T.1S., R.10E., on the south valley wall of Slick Rock Branch, shown on Plate 2 (sheet 1) as hole number 2. The Ross Formation occurs in a core from this hole as light- to dark-gray, fossiliferous mudstone, wackestone, and bioclastic grainstone, with thin zones of light pinkish-gray, bioclastic grain-

Figure 17 - Fracture pattern in the Ross Formation. The most prominent fractures trend N. 55° W. and N. 40° E., with minor variations of up to 5°. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

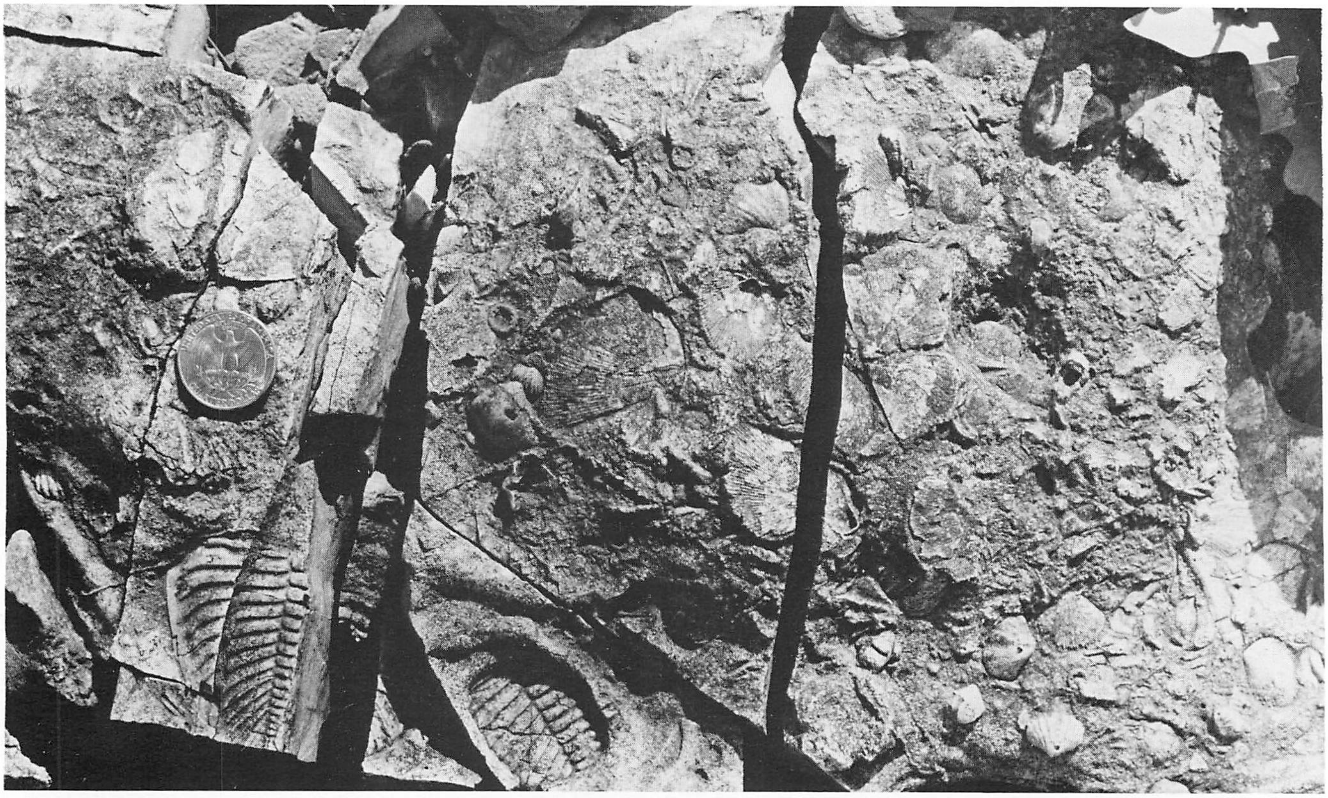


Figure 18 - Outcrop appearance of the fractured and fossiliferous beds comprising the Ross Formation. Quarter for scale. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

stone and coarsely crystalline calcarenite. The Ross Formation is separated from underlying Silurian age limestones of the Decatur Formation by a thin (6 to 10 inches thick) shale interval that probably represents the southernmost extension of the Rockhouse Shale Member of the Ross Formation described in Hardin County, Tennessee, in Wilson (1949). The Ross Formation is included in the Devonian Undifferentiated in cross sections shown on Plates 2, 3, and 4 due to lack of closely spaced, accurate test hole sample data necessary for the accurate correlation of the Flat Gap and Harriman formations.

The maximum thickness of the Devonian sequence known from the subsurface of Tishomingo County occurs in the Cities Service, Number 1 Allen Test Well, shown on Plate 2 (sheet 2) as hole number 11. This 275-foot thick sequence of fossiliferous limestones, cherts and cherty limestones separates the underlying Silurian limestones of the Decatur Formation and the overlying carbonaceous shales of the Chattanooga Formation. The general subsurface distributions of the underlying Silurian and Ordovician systems are shown on Plate 2 (sheet 2). The general distribution of the Devonian System in the subsurface of Tishomingo County is illustrated in cross sections shown on Plates 2, 3, and 4.

The Ross Formation occurs at the surface of Tishomingo County as a highly weathered, porous, sandy, dark brownish-gray, very fossiliferous, thinly bedded chert. The chert is highly leached and granular in appearance. The uppermost portion of the Ross Formation locally contains an 8 to 10 inch thick bed of very dense fossiliferous chert. The best exposure of the Ross Formation is at Island Hill, a small island in Yellow Creek, although all but the uppermost por-

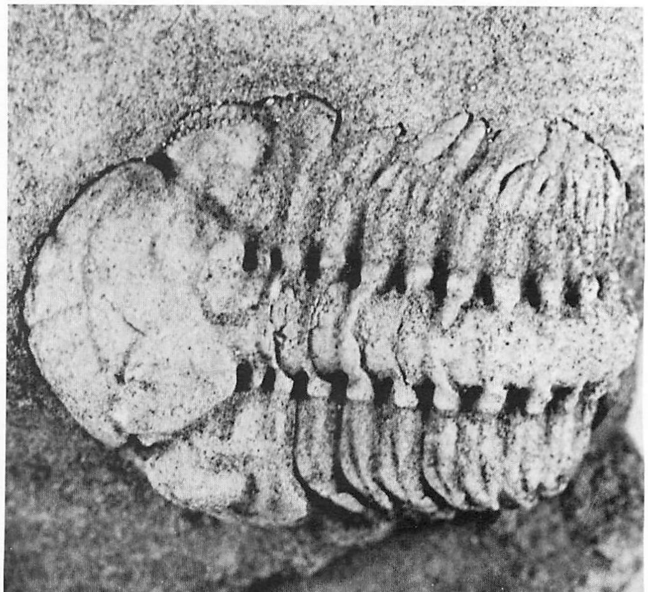


Figure 19 - Complete specimen of *Paciphacops (Paciphacops) birdsongensis* (Delo, 1940) in slightly coiled position. Scale in centimeters. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

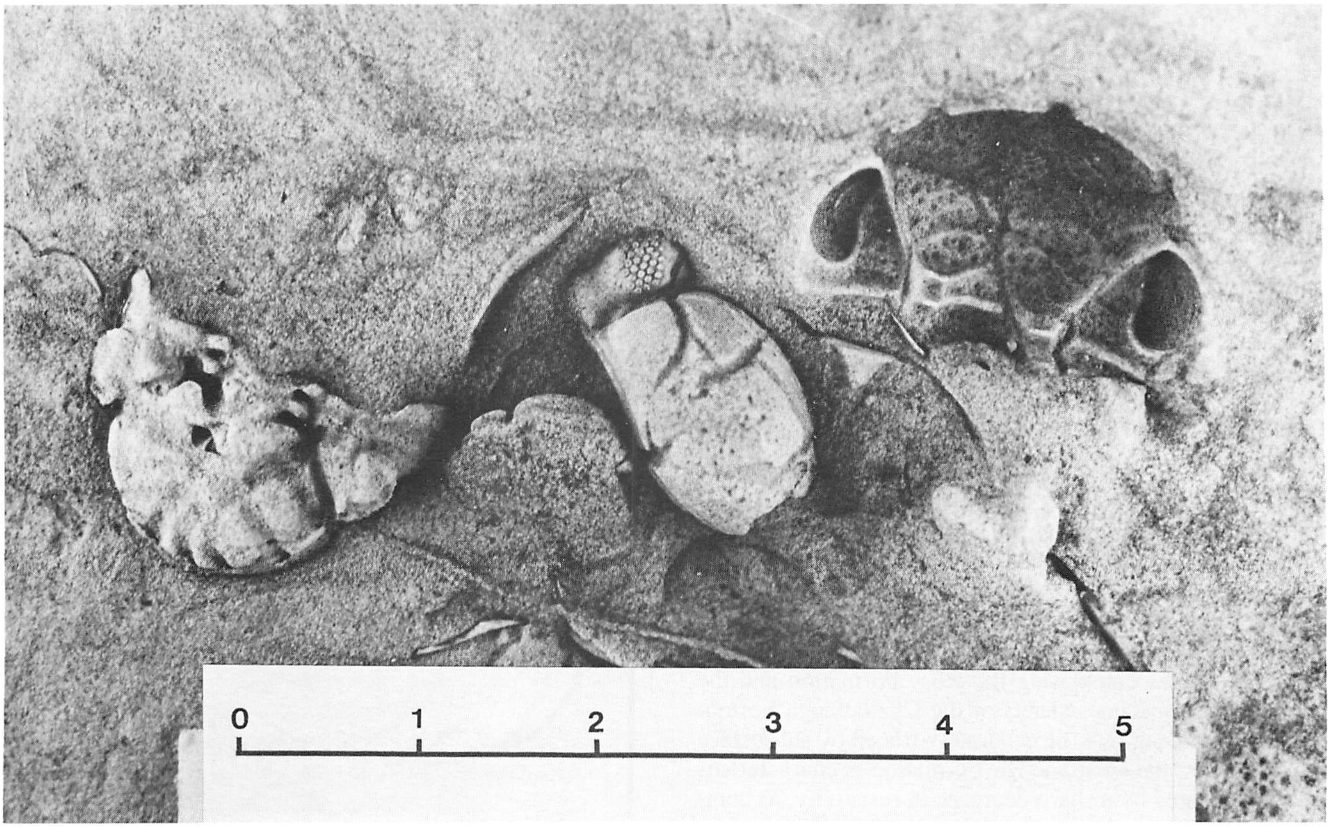


Figure 20 - Cephalons of *Paciphacops (Paciphacops) birdsongensis* (Delo, 1940) collected from the Ross Formation. Scale in centimeters. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

tion of the unit is covered by floodwaters of Pickwick Lake. This island occupies the NE/4, NW/4 of Sec. 22, T.1S., R.10E. The Ross Formation is exposed along the shoreline in western and southern portions of the large island (Figure 16) and, at low water stages of Pickwick Lake, the two very small islands to the northwest in SE/4, NW/4, NW/4, and NE/4, NW/4, SW/4, Sec. 15, T.1S. R.10E.

The Ross Formation is locally overlain by a thin interval of sandstone (1.5 to 2 feet thick) in the Chattanooga Formation. The black, carbonaceous shaly intervals that characterize the Chattanooga Formation elsewhere in Tishomingo County are absent or weathered beyond recognition at the Island Hill locality.

The beds comprising the Ross Formation are fractured due to a prominent joint system; the main fractures trend N. 55° W. and N. 40° E., with local variations of up to 5° (Figure 17). Silicified fossils are well preserved in the Ross Formation at the Island Hill exposure. Figure 18 illustrates the general appearance of the fossiliferous, fractured, porous cherts comprising the portions of the Ross Formation exposed at the surface of Tishomingo County. Morse (1930) described in detail the fauna of the Ross Formation. Fragmental remains of trilobites occur frequently in the form of molds in the porous cherts, although one complete specimen of *Paciphacops (Paciphacops) birdsongensis* (Delo, 1940) was collected during the present study (Figure 19).

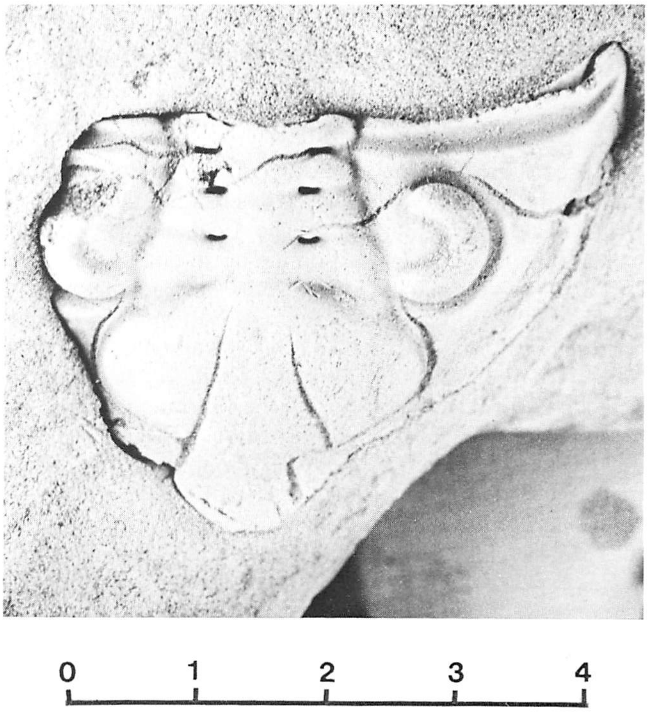


Figure 21 - Cephalon of *Huntonia (Huntonia) purdei purdei* (Dunbar, 1919) collected at the Island Hill locality. Scale in centimeters. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

Figure 20 illustrates three cephalons (heads) of this same species. A cephalon and pygidium of *Huntonia (Huntonia) purdei purdei* (Dunbar, 1919) are illustrated respectively in Figures 21 and 22. This species is also common in lower portions of the exposure at Island Hill. These trilobite specimens are described in Dockery and Merrill (1984). The fossil fauna at the Island Hill locality also includes numerous brachiopods, bivalves, gastropods, bryzoans, crinoids, and corals. Figure 23 illustrates a specimen of the brachiopod *Spirifer* cf., *S. murchisoni*, delicately preserved among fragmental faunal remains of various other brachipods described in Morse (1930). Figure 24 illustrates a well-preserved specimen of the tabulate coral *Favosites helderbergiae* and fragmental remains of *Schuchertella becraftensis*, as classified in Morse (1930). Figure 25 shows a brachiopod fauna typical of the Ross Formation at the Island Hill locality (NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

The Ross Formation disconformably underlies the Chattanooga Formation at the surface of Tishomingo County and at the surface of Hardin County, Tennessee. This disconformity is indicated in the subsurface by the sharp lithologic boundary between the fossiliferous limestones, cherts, and calcareous shales comprising the Ross Formation and the overlying carbonaceous shales of the Chattanooga Formation. This boundary can be accurately traced by subsurface electrical logs; the Chattanooga Formation is characteristically represented by a sharp decrease in resistivity, as compared to the underlying Devonian limestone and chert sequences (Plate 2, sheet 2, Plate 4, test hole number 11, and Plate 3, test hole number 13).

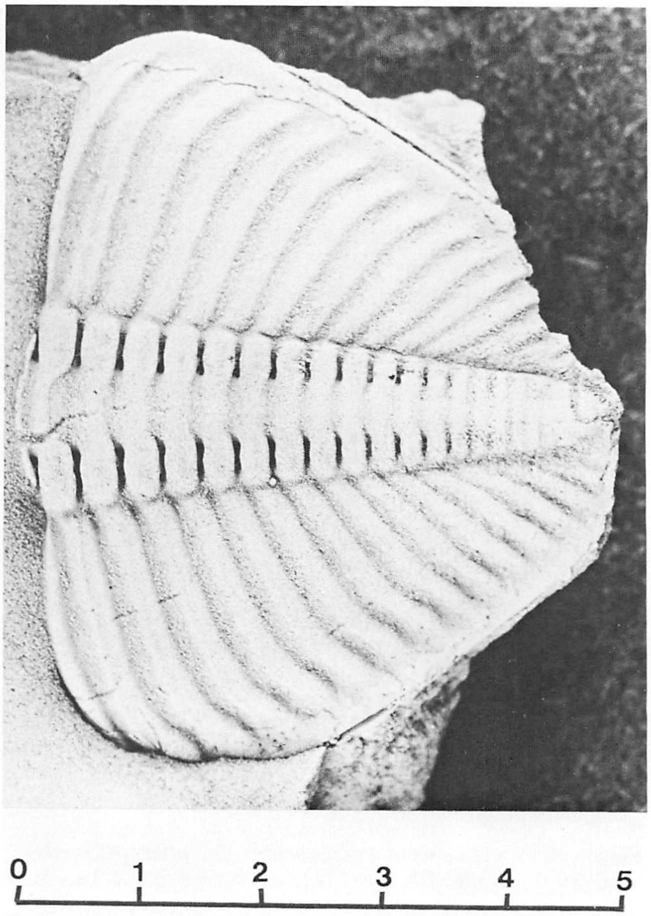


Figure 22 - Pygidium of *Huntonia (Huntonia) purdei purdei* (Dunbar, 1919). Scale in centimeters. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

BRADFORDIAN-KINDERHOOKIAN SERIES

Chattanooga Formation

The original reference to the Chattanooga Formation in the literature appears in Hayes (1891) as the Chattanooga Black Shale (formation). The The Chattanooga Shale is named for exposures located on the north end of Cameron Hill in the town of Chattanooga, Tennessee, and previously included in the Black Shale Group of Safford (1869). The Safford (1869) and Hayes (1891) reports assigned the Black Shale Group or Chattanooga Black Shale to the Devonian System. Hayes (1891) included in the Chattanooga Shale all strata between the Rockwood Formation of Silurian age and the overlying Fort Payne chert of Carboniferous (Mississippian) age. Safford and Killebrew (1900) named the uppermost intervals of the Black Shale Group of Safford (1869) the "Maury Green Shale," in reference to Mississippian-age shales exposed at the surface in Maury County, Tennessee. They placed the Chattanooga Formation in the Devonian System and included the following units in ascending order: the Hardin Sandstone, Swan Creek Phosphate, and the Black Shale Member (Figure 26).

Dunbar (1919) described occurrences of the Chattanooga sequence exposed in western Tennessee and northernmost Tishomingo County, Mississippi, and divided the Chattanooga Shale Formation into a lower Hardin Sandstone Member and an upper Black Shale Member. He also placed the Chattanooga Shale in the Devonian System. Swartz (1924) determined that the Chattanooga Shale was in part Devonian and in part Mississippian in age, based on intervals exposed at the type locality. Morse (1928) correlated the Chattanooga Shale with the Whetstone Branch Formation, which he named for exposures near the mouth of the stream in NE/4, Sec. 31, T.1S., R.11E, Tishomingo County. In north-neighboring Hardin County, Tennessee, Jewell (1931) assigned a Mississippian age to the Chattanooga Formation. The difficulty encountered in age determination of the Chattanooga Formation is due primarily to the lack of an identifiable fossil assemblage that can be widely correlated, complicated by stratigraphic correlation of the overlying Maury Shale in central and western Tennessee. Swartz (1924) described an unconformity separating the Chattanooga Shale from the overlying Maury Shale. Jewell (1931) included the Maury Shale as the uppermost member of the Chattanooga Formation, in conformable contact with underlying Chattanooga beds. Born and Burwell (1939) followed Jewell's stratigraphic divisions and age designation of the Chattanooga Formation in Clay County, located in north-central Tennessee. Both studies described the Chattanooga Formation to

Figure 23 - Delicately preserved specimen of *Spirifer* cf. *S. murchisoni* (left of quarter) and the tabulate coral *Favosites helderbergiae* (far upper left). These specimens were initially described from this (Island Hill) locality in Morse (1930). Quarter for scale. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

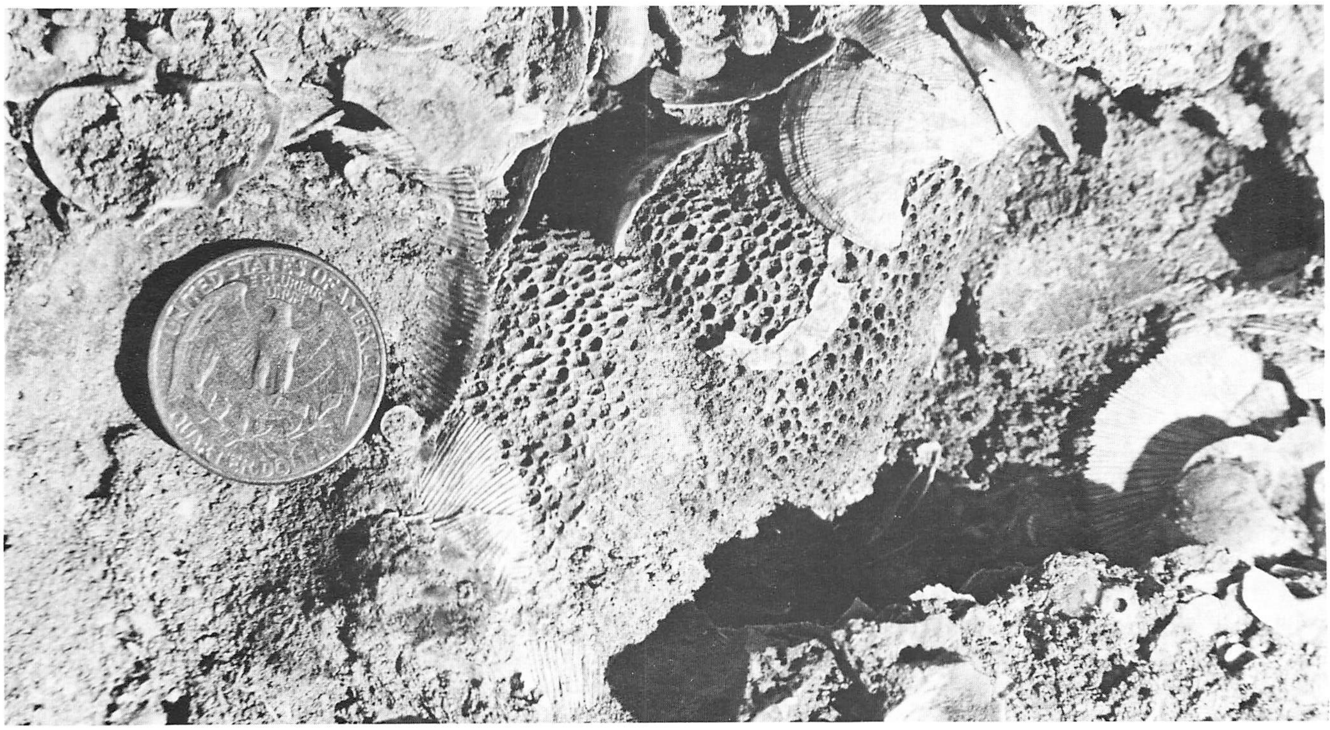


Figure 24 - The tabulate coral *Favosites helderbergiae* (center of picture) and fragmental remains of the brachiopod *Schuchertella becraftensis*. These specimens were initially described from this (Island Hill) locality in Morse (1930). Quarter for scale. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

Figure 25 - Brachiopods preserved in the Ross Formation. Quarter for scale. Location: NE/4, NE/4, NW/4, Sec. 22, T.1S., R.10E.

include the basal Hardin Sandstone, Black Shale, and upper Maury Shale, with a gradational contact between the Black Shale and Maury Shale members.

Campbell (1946) correlated the Chattanooga Shale of Tennessee with the New Albany Shale in Indiana and Kentucky. He concluded that stratigraphic relationships, lithologic characteristics, and time divisions of the New Albany Shale are duplicated in the Chattanooga, and that the terms New Albany and Chattanooga could be used interchangeably. Further, Campbell determined that the Chattanooga Shale of central Tennessee is in part Devonian and in part Mississippian in age, and that the Chattanooga shale (of formational rank) is separated from the overlying Maury Shale by a disconformity. Campbell described the New Albany Shale in Indiana and Kentucky, the Black shales in Ohio, and the Chattanooga Shale in Tennessee as part of a continuous terrane of carbonaceous shale deposited in an interior sea extending from New York to Oklahoma, and from Canada to Alabama, during Tully to Kinderhookian (late Devonian to early Mississippian) time. Correlations of the Chattanooga Shale (Formation) are based primarily on the floral and faunal content of the units.

Hass (1956) proposed a new type locality for the Chattanooga Shale to replace the exposure on Cameron Hill in Chattanooga, Tennessee. This proposed locality is a cut on Tennessee state Highway 26, at the east approach to the Caney Fork bridge, 7.1 miles east of the courthouse at the town of Smithville, DeKalb County, Tennessee. Hass included the Chattanooga Shale of central Tennessee in the Devonian, and the overlying Maury Formation in the late Devonian and early Mississippian systems. The Chattanooga Shale according to Hass is comprised of a lower Dowelltown Member and an upper Gassaway Member. Cobb and Kulp (1960) reported a true age date (U^{238}-Pb^{206}) of 350 million years for the uppermost Chattanooga Shale interval in central Tennessee.

The Chattanooga Formation is 20 to 35 feet thick in the Chattanooga district (Campbell, 1946). Jewell (1931) reported a maximum thickness of 47 feet in Hardin County, Tennessee, although the upper 6 feet of that interval comprised the Maury Member, which is not included in the Chattanooga Formation of more recent classifications (Hass, 1956). The Chattanooga shale is uniformly thin and locally absent, generally ranging between 2 and 10 feet in thickness where exposed in western Tennessee, with a maximum thickness of 22 feet reported from Wayne County (Dunbar, 1919). The Chattanooga Formation attains a maximum local thickness of 34 feet in northeast-neighboring Lauderdale County, and 35 feet in Tishomingo County and in east-neighboring Colbert County, Alabama (Harris, Moore, and West, 1963). Milici et al. (1979) estimated that the Chattanooga might be as much as 2,000 feet thick in the Greendale Syncline along Clinch Mountain in Hawkins County, Tennessee. The area including Monroe, Cumberland and Clinton counties, Kentucky, and Pickett, Overton, Clay, Jackson and Macon counties, Tennessee, is known as the Upper Cumberland District, and Chattanooga thicknesses vary between 15 and 25 feet (Born and Burwell, 1939). The Chattanooga Formation attains a thickness of over 200 feet where it has filled pre-Mississippian depressions in an area of Jackson County, Tennessee, 6 miles south of the town of Gainesboro (Wilson and Born, 1936).

The outcrop belt of the Chattanooga Formation extends from Allen, Monroe and Cumberland counties of southern Kentucky, through Sumner, Macon and Clay counties of northern Tennessee, encircles the Highland Rim Section, continues southward through portions of Hardin, Wayne, Lawrence, Giles and Lincoln counties of southernmost Tennessee, and extends southward through northern Alabama to Birmingham (Campbell, 1946). Figure 7 shows the location of the counties in these areas, and the areas occupied by the Highland Rim Section. Tishomingo County is located at the western edge of the outcrop belt of the Chattanooga Formation. The distribution of the Chattanooga Formation at the surface of northernmost Tishomingo County is shown on Plate 1 (sheet 1).

Stockdale (1939) observed that the lower Mississippian Chattanooga, Maury, and Fort Payne formations in Tennessee are progressively younger southward, as a result of time-transgressive deposition in a southward transgressing sea. This concept was supported by Klepser (1937), who described the Chattanooga and Maury in Tennessee and Alabama as transgressive shoreward phases equivalent in part to the New Providence and Fort Payne formations to the north. Klepser (1937) concluded that the Chattanooga Shale was a time transgressive unit ranging from Kinderhook to Keokuk in age, from southern Kentucky southward into Tennessee and Alabama, based on the stratigraphic relationships with overlying units. Stockdale (1948) stated that conodonts could be facies as well as time indicators and that the Chattanooga assemblage could be time transgressive.

The Chattanooga Formation is correlated over broad areas, based on recognizable fauna and flora that occur in the shales in the form of inarticulate brachiopods, arthropods, fish remains, conodonts, plant fragments, and spores, although conodonts are the best fossils present for correlation and age determination. Hass (1956) determined that the Chattanooga Shale is Devonian in age based on conodonts present in exposures at and near the type locality in central Tennessee. If the Chattanooga Formation is progressively younger southward from northern Tennessee as proposed in Klepser (1937) and Stockdale (1939), a Mississippian age is possible for uppermost portions of the Chattanooga Formation in northern Mississippi. Most reports describing the Chattanooga Formation point out the fact that the age of the unit is highly controversial. Dunbar (1919) described the fauna of the Chattanooga Shale in western Tennessee and northern Mississippi as "very meager and of slight significance in correlation," and assigned a Devonian age to the unit in keeping with the accepted nomenclature of that time. Correlations and age determinations of the Chattanooga Formation in the Tennessee-northern Mississippi area are based on a sparse fossil assemblage. Morse (1930) described remains of *Tentaculites* sp. in a sandstone phase in lower portions of the Chattanooga Formation (Whetstone Branch Shale of that report) at Island Hill in northernmost Tishomingo County, which indicated a Devonian age. Worn fish plates and occurrences of the inarticulate brachiopod genus *Lingula* are not considered in Morse (1930) as time diagnostic. The unconformity described in Morse (1928, 1930) between the Whetstone Branch (Chattanooga) Formation and the overlying Carmack (lower Fort Payne) Formation of Mississippian age is the basis upon which Morse assigned a Devonian age for portions of the Chattanooga Shale exposed at the surface of Tishomingo County. Hass (1956) correlated the lowermost intervals of the Carmack Limestone of Morse (1928, 1930) (present lower Fort Payne) with the Mississippian age Maury Shale of Safford and Killebrew (1900). Hass separated the Maury Formation from the remainder of the Chattanooga Shale and determined the Chattanooga to be of Devonian age and the Maury Shale in central Tennessee to be of Mississippian age. Conant and Swanson (1961) followed this division and age assignment.

In the absence of time-diagnostic fossil assemblages, usage of the term Chattanooga Formation in the present report is in keeping with present nomenclature regarding the age of the unit in the northeastern Mississippi, southwestern Tennessee area. The Chattanooga Shale is mapped and described at the surface of northwestern Alabama and northeastern Mississippi as in part of Devonian and in part Mississippian age (Russell, 1975). Geologic studies of the Pickwick (Russell et al., 1972) and Counce (Russell, 1968) quadrangles in Tennessee also included the Chattanooga Shale in the uppermost Devonian-lowermost Mississippian time interval. The Pickwick and Counce quadrangles of southernmost Tennessee adjoin the Yellow Creek and Doskie quadrangles (respectively) of northernmost Tishomingo County. The Stratigraphic Column of Mississippi (Dockery, 1981) includes lower portions of the Chattanooga Shale in the Devonian System (Bradfordian-Conewango Series) and uppermost portions in the Mississippian System (Kinderhookian Series).

The distinctive lithologies and constant thickness of the Chattanooga Formation make the unit a useful datum for stratigraphic and structural studies in the Tennessee-Mississippi-Alabama area. The unit is variable in age and overlies sedimentary rocks of Ordovician to Devonian age in Tennessee, Kentucky, northwestern Georgia, and northern Alabama. The Chattanooga Formation overlies the Ross Formation (Helderberg Series) disconformably where exposed at the surface of Tishomingo County. Subsurface occurrences of very thin (up to 3 feet) intervals and thin shale partings comprising the Maury Formation are included in the overlying Fort Payne Formation as shown in the cross sections on plates 2, 3 and 4 due to the very thin and laterally discontinuous nature of the Maury interval in the subsurface of Tishomingo County. Very thin (up to 2.5 feet) intervals of the Maury Formation are reported from several core holes drilled during the course of geologic studies for the Yellow Creek Nuclear Plant. These intervals were included with the overlying Fort Payne Formation (Russell, 1975).

The Chattanooga Formation is poorly developed in the subsurface of northern Tishomingo County, as indicated by

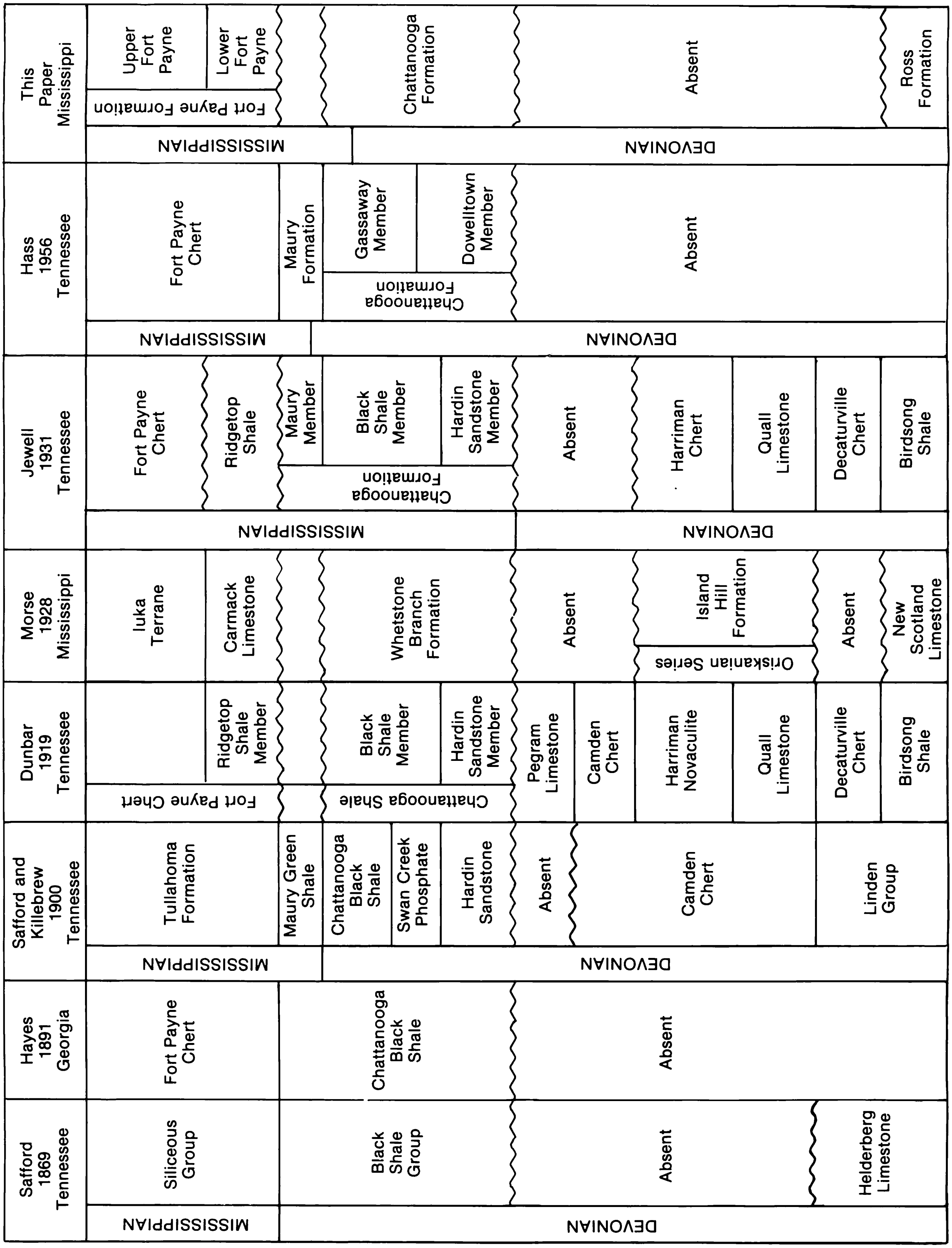


Figure 26 - Classifications utilized in previous literature concerning the Chattanooga Formation. Only major unconformities are shown.

continuous core samples from the T.V.A. core hole 51-C-3, wherein a 5-foot interval of dark gray, carbonaceous, sandy shale separates the underlying Ross limestones and the overlying Fort Payne limestones and cherts. The Chattanooga Formation continues southward in the subsurface of Tishomingo County as a 20 to 35 foot thick interval of dark gray to black carbonaceous shale, with occasional thin beds and laminae of sand and sandstone, which contain small amounts of glauconite and mica. The shaly portions of the unit are also micaceous in subsurface samples. Subsurface control on the Chattanooga Formation is sparse. The top of the unit dips southward in the subsurface of Tishomingo County and occurs at 355 feet below sea level in the Cities Service number 1 Allen petroleum test well (well number 11, Plates 2 and 4) in southernmost Tishomingo County. The Paleozoic sedimentary rocks that occur at the surface of Tishomingo County are gently folded, such that strike and dip vary locally. The regional strike of the Chattanooga Formation trends approximately N. 70° W., and regional dip is generally less than 1/2° (48 feet per mile) to the southwest, locally approaching 100 feet per mile (Plate 2).

The Chattanooga Formation continues downdip (southward) in the subsurface of Mississippi and Alabama, with an average thickness of about 20 feet and a maximum thickness of 36 feet (Welch, 1959). The unit is locally absent in the subsurface of eastern Calhoun, northwestern Chickasaw, northwestern Monroe, and southern Itawamba counties in Mississippi, and attains a maximum thickness of 36 feet in the subsurface of southern Franklin County, Alabama, and in outcrop near Blount Springs, Blount County, Alabama, along the line of section described in Welch (1959). Mellen (1947) described occurrences of the Chattanooga Shale in the subsurface of north-central Tishomingo County, Mississippi, and the continuation of the unit eastward in the subsurface of Lauderdale, Colbert and Limestone counties, Alabama.

The Chattanooga Formation has a very limited exposure at the surface of northernmost Tishomingo County, and many of the exposures described in Dunbar (1919) and Morse (1928, 1930) are presently concealed by floodwaters of Pickwick Lake. A sandstone phase of the Chattanooga Formation occurs at the surface of northernmost Tishomingo County, as originally described along portions of Yellow Creek (presently concealed) in central portions of Sec. 27, T.1S., R.10E., in Dunbar (1919). Morse (1928) described a similar, thin (up to 2.5 feet) interval of sandstone exposed at the Island Hill locality in NW/4, Sec. 22, T.1S., R.10E. Lowermost portions of the sandstone interval contain chert and quartzite pebbles and water-worn fish plates (Morse, 1928). Dunbar (1919) provisionally correlated this interval with the Hardin Sandstone Member of the Chattanooga Formation described to the north in Tennessee by Safford and Killebrew (1900). Morse (1928) named the Whetstone Branch Formation for the more typical carbonaceous, shaly phase of the Chattanooga exposed near the mouth of Whetstone Branch (Section 157 of Morse, 1930).

The Chattanooga Formation occurs at the surface of northernmost Tishomingo County along the shoreline of Pickwick Lake as isolated intervals of exposure indicated as MDc on Plate 1 (sheet 1). The unit is composed mainly of sandy, silty, fissile, carbonaceous shale, thinly interbedded and interlaminated with sandstone and siltstone. It is very thin and locally absent. Figure 27 illustrates the outcrop appearance of the Chattanooga Formation. The disconformable nature of the contact of the Chattanooga shale with the overlying Fort Payne Formation is subdued in outcrop due to the contact's low relief, although the sharp lithologic boundaries are evident in outcrop. Zones of contorted bedding occur in the Chattanooga Formation as a result of gliding of overlying beds along planes of weakness offered by the less competent shale (Figure 28). The gentle folding in otherwise horizontally bedded, sandy, carbonaceous shales is apparent in outcrop along the shoreline of the Whetstone Branch embayment and northward along the western shore of the Tennessee River, in NE/4, Sec. 31, SE/4 and NW/4, Sec. 30, T.1S., R.11E. (Figures 29 and 30). Small exposures of the Chattanooga Formation also occur along the shoreline of the Yellow Creek embayment of Pickwick Lake, in NW/4 and SE/4, Sec. 22, and NE/4, Sec. 27, T.1S., R.11E. (Plate 1, sheet 1). The Chattanooga Formation is disconformably overlain by the Fort Payne Formation.

Figure 27 - Carbonaceous shale and thin sandstone interbeds of the Chattanooga Formation, overlain by cherty lime mudstone and calcareous shale of the Fort Payne Formation. Pickax at the contact is 26 inches in length. Location: Western shore of the Tennessee River, in SW/4, SE/4, SE/4, Sec. 30, T.1S., R.11E.

Figure 28 - Contorted bedding in the carbonaceous shales of the Chattanooga Formation and overlying lime mudstones of the lower Fort Payne Formation occurs as a result of lateral movement along planes of weakness imposed by the less competent shales of the Chattanooga Formation. Location: North shore of the Whetstone Branch embayment on Pickwick Lake. Location: NW/4, SW/4, NE/4, Sec. 31, T.1S., R.11E.

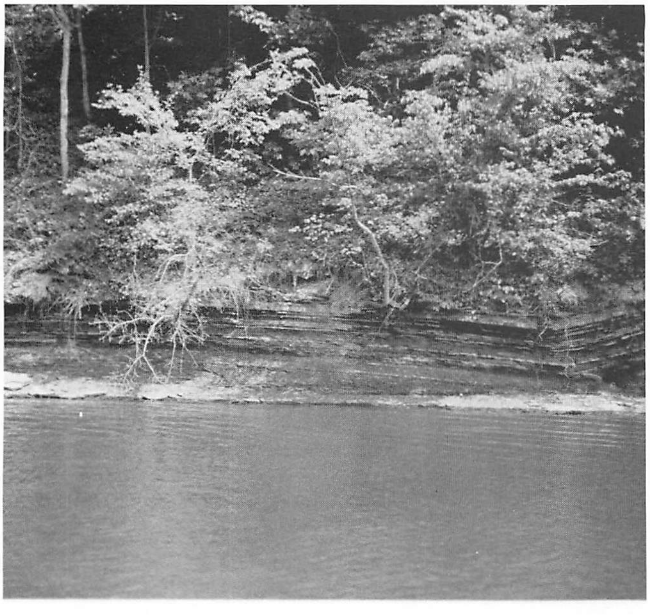


Figure 29 - Gentle folding in otherwise horizontally bedded carbonaceous sandy shales of the Chattanooga Formation exposed on the north shore of the Whetstone Branch embayment of Pickwick Lake. Location: NW/4, SW/4, NE/4, Sec. 31, T.1S., R.11E.

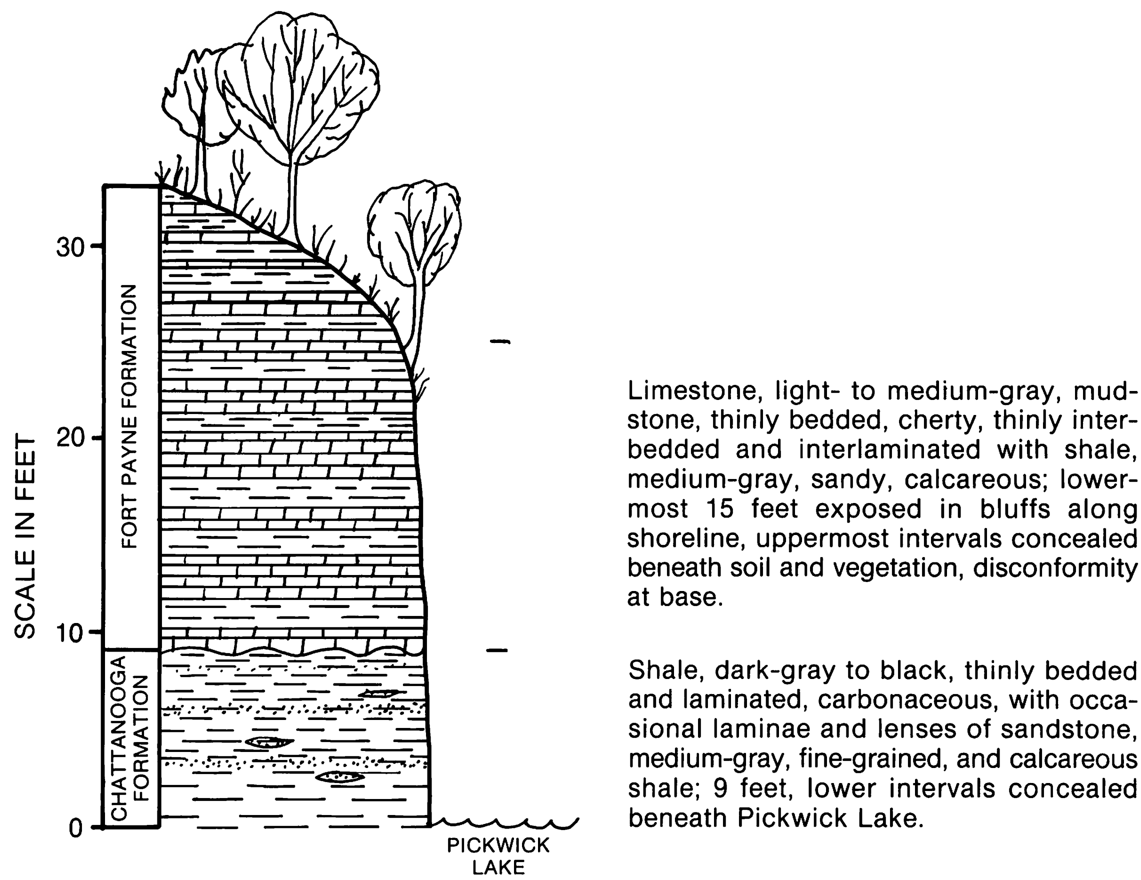


Figure 30 - Measured section describing the stratigraphic sequence exposed along portions of the western shore of the Tennessee River embayment of Pickwick Lake. Location: SW/4, SE/4, SE/4, Sec. 30, T.1S., R.11E.

MISSISSIPPIAN SYSTEM

OSAGEAN – MERAMECIAN SERIES

Iowa Group

The term Iowa is utilized in this report as a group name for all units included in the Osagean and Meramecian series that occur in Tishomingo County. The stratigraphic interval comprising the Iowa Group includes all strata above the Chattanooga Formation (Kinderhookian Series) and below the Pride Mountain Formation (Chesterian Series). This is in keeping with the nomenclature and stratigraphic classification presently recognized by the Mississippi Bureau of Geology (Dockery, 1981). The term Iowa was initially utilized in Illinois as a series designation to include the Kinderhook, Osage and Meramec groups in a regional study of Illinois stratigraphy by Weller (1920). The term Iowa was dropped and the Kinderhook, Osage and Meramec groups raised to the rank of series in Weller et al. (1948), although no new group name was proposed for the Osage-Meramec time-stratigraphic interval. The Iowa Group is represented in the subsurface and at the surface of Tishomingo County by the Fort Payne and Tuscumbia formations. The Iowa Group is bounded above and below by erosional surfaces (unconformities).

Fort Payne Formation

The original reference to the Fort Payne Chert is in Smith (1890), who described it as a sequence of limestone and chert at Fort Payne, Dekalb County, Alabama. That report included the chert and limestone sequence above the Devonian black shale (Chattanooga) and below the Bangor Limestone in the Fort Payne Chert. This interval is included in early literature in Mississippi as the Carboniferous Formation (Hilgard, 1860). Smith (1894) later divided the Fort Payne Chert into a lower interval, defined as the Lauderdale Chert, and an upper interval, defined as the Tuscumbia Limestone, and abandoned the use of the name Fort Payne Chert. Butts (1910) identified the Lauderdale Chert interval of Smith as the Fort Payne Chert and included in this unit all strata above the Chattanooga Shale and below the Tuscumbia Limestone. The interval that is included in the Fort Payne Chert as described in Alabama by Butts (1910 and

1926) is described in Tishomingo County as the Carmack Limestone and Iuka Terrane by Morse (1928) and Bicker (1979). Russell et al. (1972) recognized the Fort Payne at the surface of northeasternmost Tishomingo County and southernmost Tennessee and described it as having a lower siltstone and shale facies and an upper cherty facies. Very thin (up to 2 1/2 feet thick) intervals of olive gray, partially calcareous shale containing phosphatic nodules separate the Chattanooga and Fort Payne formations locally in the subsurface of Tishomingo County. Welch (1959) recognized this interval in the subsurface of northwestern Alabama and northeastern Mississippi as the Maury Formation and described it as a thin (1 to 3 feet thick) interval of greenish-gray, partially calcareous shale that commonly contains phosphatic nodules.

The Maury Shale (Maury Formation) occurs as a thin to locally absent interval of marine shale in boreholes drilled by the T.V.A. during the geologic study regarding the Yellow Creek Nuclear Plant (Russell, 1975). That study included the Maury Shale as the basal portion of the Fort Payne Formation. The Maury Formation is present in the subsurface of northwestern Alabama and continues westward into the subsurface of eastern Itawamba County, Mississippi (Welch, 1959). The Maury Formation is missing from test wells described west of south-central Itawamba County. Welch included the Maury in the lowermost portions of the Fort Payne and assigned it a Mississippian age. According to Hass (1956), the Maury Formation in central Tennessee ranges from uppermost Devonian to lowermost Mississippian in age. Figures 26 and 31 illustrate some of the classifications utilized in previous studies that described units occupying the upper Devonian-lower Mississippian time stratigraphic interval in Mississippi, Alabama, and Tennessee.

The Maury Formation is poorly developed in Tishomingo County, and is included with the Fort Payne Formation in the present report. The thin (less than 3 feet thick) shale interval is not continuous in the subsurface of Tishomingo County, and the entire sequence comprising the Chattanooga and Maury formations is absent locally in the subsurface.

The Fort Payne Formation occurs at the surface of northwestern Georgia, northern and eastern Alabama, central Tennessee, and northeastern Mississippi. The area of exposure of the Fort Payne Formation in Mississippi is contained entirely within the northern half of Tishomingo County. Plate 1 (sheet 1) illustrates the distribution of the Fort Payne Formation at the surface of Tishomingo County. The chert and limestone sequence comprising the Fort Payne Formation of northeastern Mississippi continues northward into Tennessee, where the unit grades northward and eastward into shales, siltstones, sandstones, and limestones of the Grainger and Borden formations (Milici et al., 1979).

The Fort Payne Formation contains several lithologies in the Tennessee - northeastern Mississippi - northwestern Alabama region. Morse (1928 and 1930) described the lower limestone interval as the Carmack Limestone (Figure 31). Jewell (1931) correlated the Carmack Limestone described in Tishomingo County in Morse (1928) with the Ridgetop Shale in north-neighboring Hardin County, Tennessee (Figure 26). The present report utilizes the classification of the Fort Payne Formation (or Chert) described in Alabama by Butts (1910 and 1926), Welch (1959), and Thomas (1972b and 1979), in Tennessee by Conant and Swanson (1961), Milici et al. (1979), Russell (1968), and Russell et al. (1972), and in Mississippi by Russell (1975) in preference to the terms Carmack Limestone and Iuka Terrane (Formation) of Morse (1928 and 1930) and Bicker (1979). The latter classifications have not been as widely utilized in the literature.

The Fort Payne Formation ranges from 70 to 130 feet in thickness in southeastern portions of the Highland Rim Physiographic Section (Figure 7) and thickens northeastward in Tennessee to more than 250 feet in northern Tennessee (Milici et al., 1979). The thickness of the Fort Payne Formation ranges from 200 to 300 feet in southwestern portions of the Highland Rim Section (Milici et al., 1979).

The sequence of limestone and chert comprising the Fort Payne Formation of northwestern Alabama attains a maximum thickness of 226 feet in Lauderdale County (Harris, Peace, and Harris, 1963) and 207 feet in Colbert County (Harris, Moore, and West, 1963). Lauderdale and Colbert counties in Alabama border Tishomingo County to the northeast and east, respectively. The Fort Payne Formation pinches out southward in Alabama along the Coosa deformed belt (Welch, 1959).

The Fort Payne Formation is divided into a lower limestone facies and an upper chert facies in northeasternmost Tishomingo County and southernmost Tennessee in Russell et al. (1972), and divided into lower and upper portions at the surface of northeastern Tishomingo County, Mississippi, northwestern Lauderdale County, Alabama, and southernmost Hardin County, Tennessee, by Russell (1975). The present report utilizes the classification of Russell (1975), wherein the Fort Payne Formation is divided into a lower portion and an upper portion (Plate 1, sheet 1). These intervals are discussed in the text as lower Fort Payne and upper Fort Payne, respectively (Figure 31).

The Fort Payne Formation is continuous in the subsurface of Tishomingo County as illustrated on Plates 2, 3 and 4. The thickness of the sequence of thinly bedded chert and thin- to massive-bedded limestone comprising the unit in the subsurface of Tishomingo County generally ranges from 125 to 200 feet. Intervals included in the Fort Payne Formation may represent a chert facies of the Tuscumbia Formation locally, as the Tuscumbia limestone grades laterally into chert, and loses its identity as a limestone unit west of well 8 (Plate 3) in the subsurface of western Tishomingo County. Occurrences of this lateral gradation from limestone to chert phases of the Tuscumbia Formation locally at the surface of Tishomingo County complicates the separation of the units, thus the upper Fort Payne chert and Tuscumbia intervals locally comprise the Iuka Terrane of Morse (1928) and Iuka Formation of Bicker (1979). Projection of the contact of the Fort Payne Formation with the underlying Chattanooga Formation between wells 3 and 5 (Plate 2, sheet 1) and exposures of the upper Fort Payne chert phase in the valley

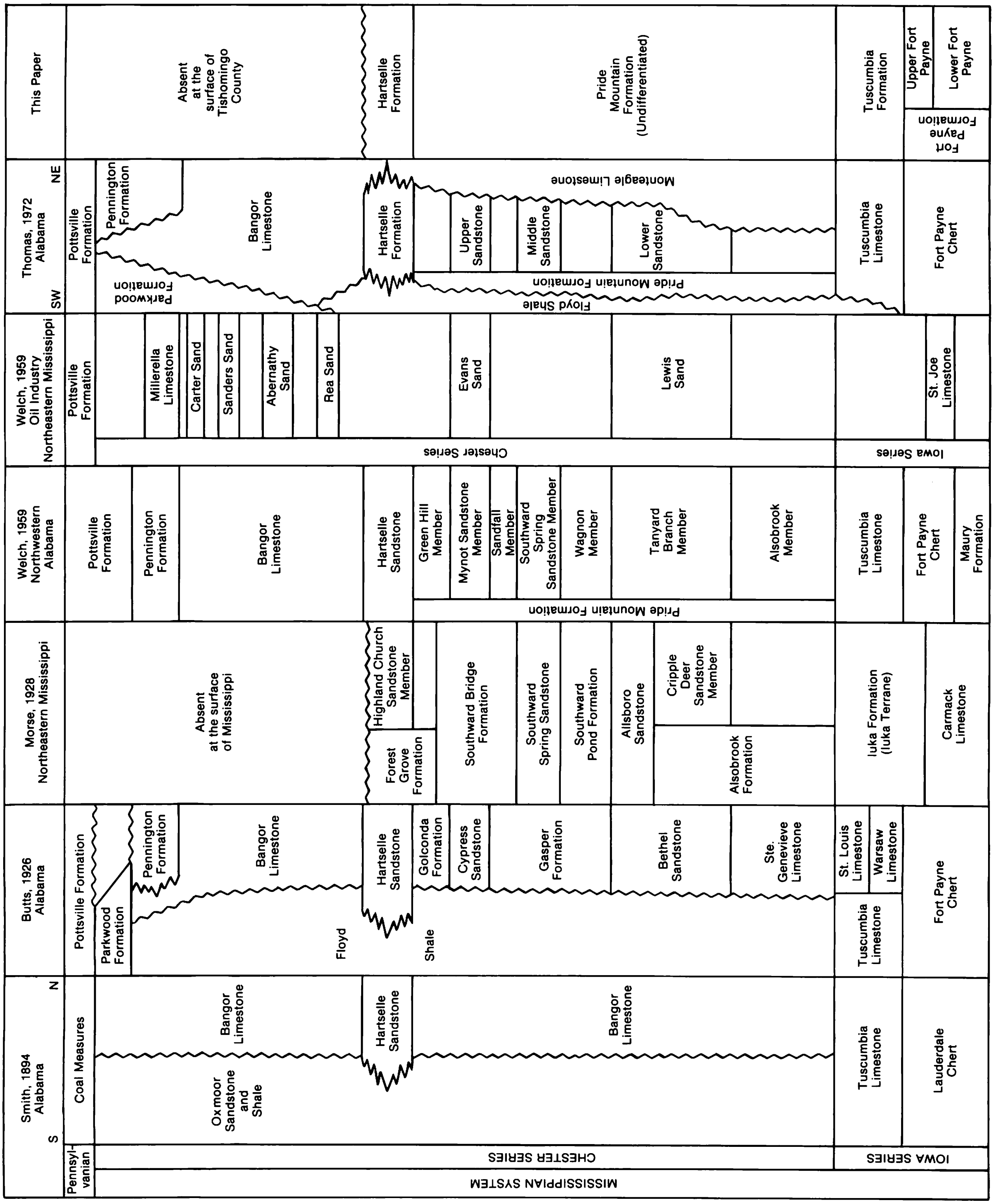


Figure 31 - Classification schemes utilized in previous reports concerning the Mississippian System in Mississippi and Alabama.

of Martin Branch results in a projected maximum subsurface countywide thickness of 235 feet for the Fort Payne Formation. The maximum observed thickness of the Fort Payne Formation occurs in wells 3 and 5 (Plate 2, sheet 1) wherein the unit is 190 and 210 feet thick, respectively. The lower Fort Payne limestone phase occurs in the subsurface of Tishomingo County as a sequence of medium-gray, thin- to massive-bedded, finely crystalline limestones, lime mudstones, chert, cherty limestones, and occasional thin intervals of bioclastic grainstones and crystalline limestone, containing glauconite in lowermost intervals. Core samples from a test well located in northernmost Tishomingo County (T.V.A. core hole 51-C-3; well number 2 on sheet 1 of Plate 2) reveal a 110 foot thick lower Fort Payne interval, composed of medium gray, massive-bedded, finely crystalline limestone and micrite, with occasional zones of sparite-filled voids up to 1 inch in diameter. Thin (less than one foot), irregular intervals of sparingly glauconitic bioclastic lime grainstone and crystalline limestone occur in the lowermost 30 feet. The underlying Chattanooga Formation is poorly developed in this well, and occurs as a 5 foot interval of dark-gray to black, calcareous, carbonaceous, glauconitic, sandy shale. The lower Fort Payne is only about 70 feet thick to the south, in well number 5 (Plate 1, sheet 1), and is overlain by approximately 140 feet of light- to medium-gray chert comprising the upper Fort Payne Formation and lowermost intervals of the conformably overlying Tuscumbia Formation. The Fort Payne Formation is not differentiated into upper and lower portions in the subsurface cross sections or on the surface maps of the present report. The limestone and chert sequence comprising the Fort Payne Formation continues southward in the subsurface of Tishomingo County (Plate 1, sheet 2), into Itawamba County. Welch (1959) described the Fort Payne Formation along a line of section extending through portions of Calhoun, Chickasaw, Monroe, Lee, and Itawamba counties in Mississippi, and eastward across northwestern Alabama. The Fort Payne occurs along this line of section as a 100 to 150 foot-thick sequence of light gray, partly siliceous, fine- to coarse-crystalline limestone, dark-gray, argillaceous, siliceous, finely crystalline limestone, and dense chert. The lowermost 5 to 40 feet of the Fort Payne Formation penetrated in wells described in Mississippi along the Welch (1959) line of section consist of grayish-red and light olive-gray, crinoidal limestone informally referred to in the oil industry as the St. Joe Limestone. The brightly colored St. Joe Limestone described from the Black Warrior Basin of Alabama and Mississippi is probably a color phase of basal intervals of the Fort Payne Chert (Welch, 1959). The Fort Payne Formation of Tishomingo County is only sparsely fossiliferous locally, whereas the Fort Payne described to the south in the subsurface of northeastern Mississippi and northwestern Alabama (Welch, 1959) becomes more fossiliferous, especially in lowermost portions (St. Joe Limestone). This interval is represented to the north in the subsurface of Tishomingo County as thin, irregular beds of medium-gray to grayish-red, bioclastic grainstone.

The Fort Payne Formation is conformably overlain by the Tuscumbia Formation. The Fort Payne-Tuscumbia contact interval is often difficult to discern in the subsurface, and is located only approximately on Plates 2, 3 and 4. The Tuscumbia Formation is generally less siliceous, contains less chert, and cherty intervals in basal Tuscumbia beds are lighter in color than those in the underlying Fort Payne Formation. Tuscumbia limestones and cherts are predominantly coarser in texture, containing an abundance of crinoidal grainstone, silicified grainstone, and coarse-crystalline limestone. The uppermost Fort Payne intervals are recognized at the surface of Alabama by the stratigraphically highest dark-colored, fine-grained limestone and uppermost occurrences of bedded chert (Thomas, 1972b). Many petroleum geologists do not attempt to differentiate the Fort Payne and Tuscumbia formations, and include both units as the Iowa Series (Welch, 1959). The stratigraphic sequence comprising the Tuscumbia and the upper chert phase of the Fort Payne Formation was initially described at the surface of Tishomingo County as the Iuka Terrane, in Morse (1928 and 1930).

The strike of the Fort Payne Formation trends about N. 70° W. and the dip is less than 1° to the south-southwest.

The lower Fort Payne limestone interval was initially described at the surface in Tishomingo County and named the Carmack Limestone by Morse (1928) (Figure 31) for the exposure at the waterfalls of the small stream in Cooper Hollow, which enters the Tennessee River in the SW/4, NW/4, NW/4, Sec. 30, T.1S., R.11E. Lower portions of the exposure have been inundated by floodwaters of Pickwick Lake since the Morse (1928 and 1930) reports. Presently over 50 feet of thinly bedded limestone is exposed at and above the waterfall in Cooper Hollow (Figure 32). The contact with the underlying Chattanooga Formation is now under water at this locality, but the contact is exposed immediately south of Cooper Hollow, along the western shore of Pickwick Lake, as shown in Figure 30 and on Plate 1 (sheet 1).

The Fort Payne Formation is exposed along the valley walls and beds of streams entering Pickwick Lake, and in the bluffs along the shores of Pickwick Lake in northeastern Tishomingo County (Plate 1, sheet 1). The thinly bedded, often shaly limestones of the lower portions of the Fort Payne Formation are well exposed in the vicinity of Cooks Landing at and near the mouth of Indian Creek and northward along the shoreline of the Tennessee River and northern portions of Yellow Creek Valley (Figure 32). Lower Fort Payne limestone and cherty limestone strata occur at the surface of Tishomingo County as a thinly bedded, partly argillaceous and silty, cherty mudstone, with frequent, thin intervals of calcareous shale. The limestone intervals are usually medium gray when fresh, and weather to various lighter shades of gray and brown. Shaly intervals are usually medium- to dark gray, and often occur as partings or thin intervals separating limestone beds. The limestone beds are between 4 inches and 2 feet in thickness (Figure 33). Limestones in the lower Fort Payne are generally thinly bedded in outcrop, although massive bedding is common in subsurface cores examined during the present study.

Weathering of the limestones enhances the appearance

Figure 32 - Lower Fort Payne interval exposed in the waterfall of the small stream in Cooper Hollow that enters Pickwick Lake in Sec. 30, T.1S., R.11E., the type locality of the Carmack Limestone of Morse (1928). Floodwaters of Pickwick Lake cover the lower half of the 60-foot waterfall described in Morse (1930). Location: SW/4, NW/4, NW/4, Sec. 30, T.1S., R.11E.

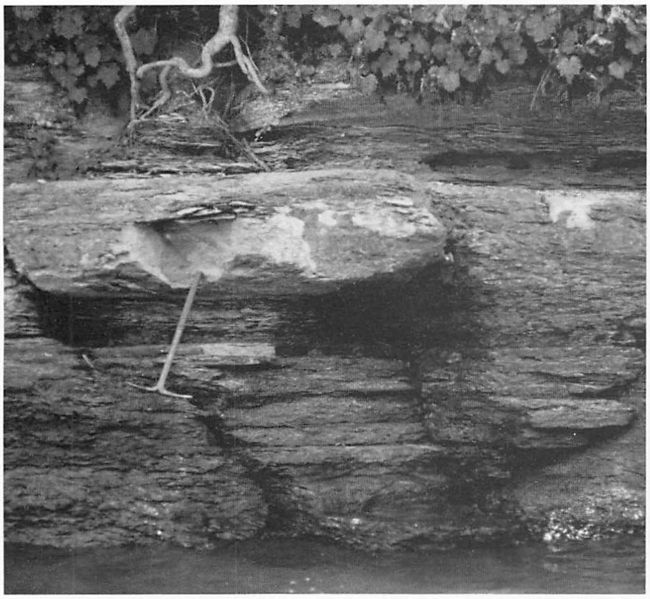


Figure 33 - Thinly interbedded, cherty lime-mudstone and calcareous shale, characteristic of the lower Fort Payne Formation in outcrop. Pickax is 26 inches in length. Location: NE/4, NW/4, SE/4, Sec. 24, T.1S., R.10E.

of the joint system present in the Paleozoic rocks exposed in Tishomingo County. Local slumping frequently occurs as a result of weathering and subsequent separation of the rocks along vertical planes of weakness imposed by the joint system. Figure 34 illustrates the outcrop appearance of the joint system in thinly bedded lower Fort Payne limestones and shales in the bluffs of Pickwick Lake. The two dominant directions of vertical fractures that comprise the joint system apparent in outcrops in that area (SW/4, Sec. 15, T.2S., R.11E.) trend N. 52° W. and N. 40° E.

Upper intervals of the Fort Payne Formation are composed primarily of very light-gray, thinly bedded chert in weathered exposures. Uppermost Fort Payne intervals contain dark gray to black chert beds when fresh. Near surface occurrences of the upper Fort Payne are composed of highly weathered, horizontally bedded chert that generally grades upward into zones wherein the chert has altered, in varying degrees, to clay. The clays, produced as a weathering product of the chert, are described in Mellen (1937) as the Little Bear Residuum. The residual clays occur in uppermost intervals of Paleozoic rocks as a result of weathering prior to deposition of Tuscaloosa fluvial gravels, sands, and clays. Much of the clay was eroded by Tuscaloosa fluvial systems and incorporated into lowermost intervals of the Tuscaloosa Group as matrix material for the coarse gravel (channel lag) deposits. A discussion of these residual clays appears in the Clay Section of this report. Intervals of residual clay observed during the present study contain varying amounts of fragmental unaltered chert. Many exposures of the residual clays described in Mellen (1937) have deteriorated to only small, thin (less than 5 feet) exposures of the very light gray to white, kaolinitic, massive in situ clay; these grade downward into zones containing variable amounts of unaltered chert.

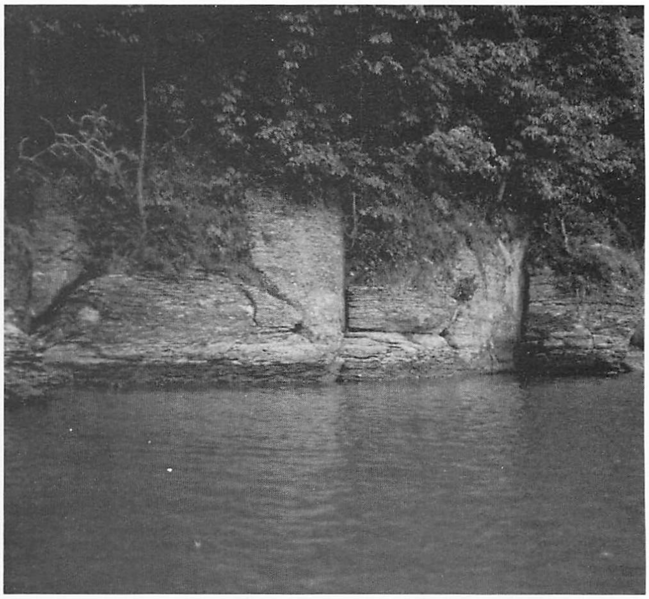


Figure 34 - Vertical fractures in lower Fort Payne limestone strata trend N. 52° W. and N. 40° E. in this vicinity. Weathering along vertical planes of weakness imposed by the joint system results in slumping of limestone blocks, leaving small vertical cliffs and bluffs along the Tennessee River. Location: SW/4, SW/4, SW/4, Sec. 15, T.2S., R.11E.

The residual clays are best developed beneath Tuscaloosa paleochannels, where thick (often in excess of 100 feet) intervals of white clay overlie the Fort Payne Formation. These clays contain variable amounts of unaltered angular chert fragments. Overlying Tuscaloosa fluvial deposits contain this clay as matrix material associated with well-rounded chert pebbles and cobbles.

A large percentage of the chert pebbles contained in the Tuscaloosa fluvial gravels are derived from the Fort Payne Formation. The contact between the Fort Payne and overlying Tuscaloosa formations is often masked in well cutting samples and electrical logs because the units are, locally, mineralogically equivalent across the contact interval. The boundary must often be located by the last downward occurrence of smooth, water-worn surfaces on the chert fragments, and the first occurrence of angular chert fragments within the clay-gravel sequence. Large Tuscaloosa fluvial paleovalleys (Plate 5) containing thick accumulations of fluvial sediments overlie deeply leached bedrock. The areal extent, local thicknesses, mineralogy and available tonnage of the residual clays developed on the Paleozoic rocks are described in detail in Mellen (1937). The residual clays are included with the parent geologic unit in the present report. The residual clays can be observed locally wherever the Paleozoic rocks are exposed at the surface of Tishomingo County (Plate 1). In surface exposures, the residual clays seem to be best developed on limestone and chert strata comprising the Fort Payne, Tuscumbia and Pride Mountain formations. In the subsurface, the Paleozoic regolith is best developed in uppermost Fort Payne and lowermost Tuscumbia cherts, wherein the clay intervals comprising the uppermost Paleozoic surface (Plate 5) are generally between 60 and 100 feet in thickness, and are frequently overlain by similar thicknesses of residual clay strata reworked as alluvial fill or matrix material for Tuscaloosa stream gravels.

Upper portions of the Fort Payne Formation have weathered to a pulverulent, siliceous phase generally referred to in the mining industry and in geologic reports as tripoli or silicastone. These deposits occur locally in a belt extending from northeastern Wayne County, Tennessee, southward into northwestern Alabama and northeastern Mississippi (Spain et al., 1938). The silicastone (tripoli) deposits of Tishomingo County are not included in the Little Bear Residuum clay unit of Mellen (1937), although the origin of the tripoli is discussed in that report and in Spain et al. (1938). Tripoli was mined from the south wall of Chalk Mine Hollow, in the NE/4, SW/4, SW/4, Sec. 26, T.2S., R.11E. The material was dug by hand, loaded onto tram cars and hauled on a tram down the valley of Chalk Mine Hollow to Bear Creek Valley, and transported by rail (Riverton branch of the Southern Railway) to Alabama for use in the making of glassware, abrasives, and other uses. Glassware made from washed tripoli compared favorably with finest quality Bohemian glassware at the Chicago Exposition of 1893 (Vestal, *in* Spain et al., 1938). The silicastone (tripoli) occurs as clay and silt size particles of pulverulent chert. The tripoli is banded in appearance due to iron staining of the otherwise brilliant white, powdery substance. Figure 35 illustrates the banded appearance of the tripoli (silicastone) inside the abandoned tripoli mine in Chalk Mine Hollow. The hollow is, of course, named in reference to this mine. The mine was closed in the early 1900's due to adverse economic conditions and several silicosis fatalities among the workers (Vestal, *in* Spain et al., 1938). Figure 36 shows the main shaft of the mine. The main entrance has collapsed, and entry was achieved through a small opening afforded by an air vent into the main shaft area. A map of the mine (completed by S. C. Knox and M. K. Everett, 1985) is shown in Figure 37. The mineralogy and origin of samples collected from the mine during the present study are discussed in the Clay Section of this report. The pulverulent silica (tripoli) averages 18 feet in thickness, and grades upward and downward into hard, dense, very light-gray chert. Tuscaloosa gravels unconformably overlie Fort Payne chert intervals in this area.

Upper portions of the Fort Payne Formation occur at the surface of Tishomingo County as very light-gray, thinly bedded chert. Bedded chert intervals grade laterally into weathered intervals of fragmental chert, in a matrix of clay derived from weathering of the chert. Unaltered beds of dense chert are generally restricted to a particular horizon, and are frequently enclosed in a sequence of weathered fragmental clayey chert. Angular unaltered chert fragments range from silt size particles up to several inches in diameter, and are supported in a matrix of kaolinitic clay. Figure 38 illustrates the typical outcrop appearance of the Fort Payne Formation in Tishomingo County. The chert phase comprising the upper Fort Payne Formation is conformably overlain by bioclastic grainstones, mudstones, and crystalline limestones comprising the Tuscumbia Formation. Figure 44 describes the Fort Payne-Tuscumbia contact interval and the overlying Tuscumbia limestone sequence in measured section. The Fort Payne Formation is sparsely fossiliferous, containing occasional fragmental molds of crinoid stem fragments, brachiopods, and bryzoans. Morse (1930) reported the occurrence of the brachiopod *Orthotetes keokuk*, plus several genera of Bryzoa, Brachiopoda, Bivalvia, Crustacea and Blastoidea, from an exposure on Indian Creek, in the SW/4 of Sec. 17, T.2S., R.11E. Presently, floodwaters of Pickwick Lake cover all but the uppermost, highly weathered, clayey chert strata, and the lowermost fossiliferous intervals described in Morse (1930) are no longer exposed. A small exposure at the southern entrance to Fred Hollow, located in the NE/4, SW/4, SW/4, Sec. 15, T.2S., R.11E., reveals a local occurrence of nodular-bedded, sparingly fossiliferous chert (Figure 39), which is replaced to the south by weathered, thinly bedded, unfossiliferous chert. Nodular bedding is typical in exposures of the Fort Payne Formation in Alabama (Thomas, 1979), although the majority of exposures in Tishomingo County reveal horizontal and continuous thin chert beds, which are often gently to irregularly folded.

The maximum exposed thickness of the Fort Payne Formation occurs in the general vicinity of the confluence of Indian Creek and the Tennessee River, and northward along the western shore of the Tennessee River to the vicinity of Whetstone Branch (between NW/4, Sec. 8, T.2S., R.11E., and NE/4, Sec. 31, T.1S., R.11E.). This sequence of exposures reveals up to about 170 feet of thinly bedded limestones and cherts above the Chattanooga Formation and below the Tuscaloosa and Eutaw formations. The Fort Payne Formation also is well exposed on the east side of the Tennessee River, in Alabama, and in roadcuts of the north-south trending roadway on the eastern shore of the Bear Creek embayment of Pickwick Lake (W/2, Sec. 11, 14, 23, T.3S., R.15W.). The gradational contact of the Fort Payne Formation with the overlying Tuscumbia Formation is very well exposed in lowermost portions of the limestone quarry (Vulcan Materials Company) located in the NW/4 of Sec. 27 and the NE/4 of Sec. 28, T.4S., R.11E. Here limestones containing very dark gray to black chert beds are overlain by the thick limestone sequence comprising the Tuscumbia Formation. The distribution of this contact interval at the surface of Tishomingo County is shown on Plate 1 (sheet 2).

Tuscumbia Formation

The upper intervals of the stratigraphic sequence described as the Fort Payne Chert in Smith (1890), and named the St. Louis Limestone in Smith (1892), were subsequently named the Tuscumbia Limestone in Smith (1894) for exposures at the town of Tuscumbia, Alabama. Butts (1926) divided the Tuscumbia Limestone of Smith (1894) into the Warsaw and St. Louis limestone intervals in northern Alabama and southeastern Tennessee (see Figure 31). Smith (1894) restricted the Tuscumbia Limestone to include all strata above the Lauderdale Cherty Limestone and below the Oxmoor Sandstone and Shale or Bangor Limestone in Alabama. Lowe (1915) included all strata above the

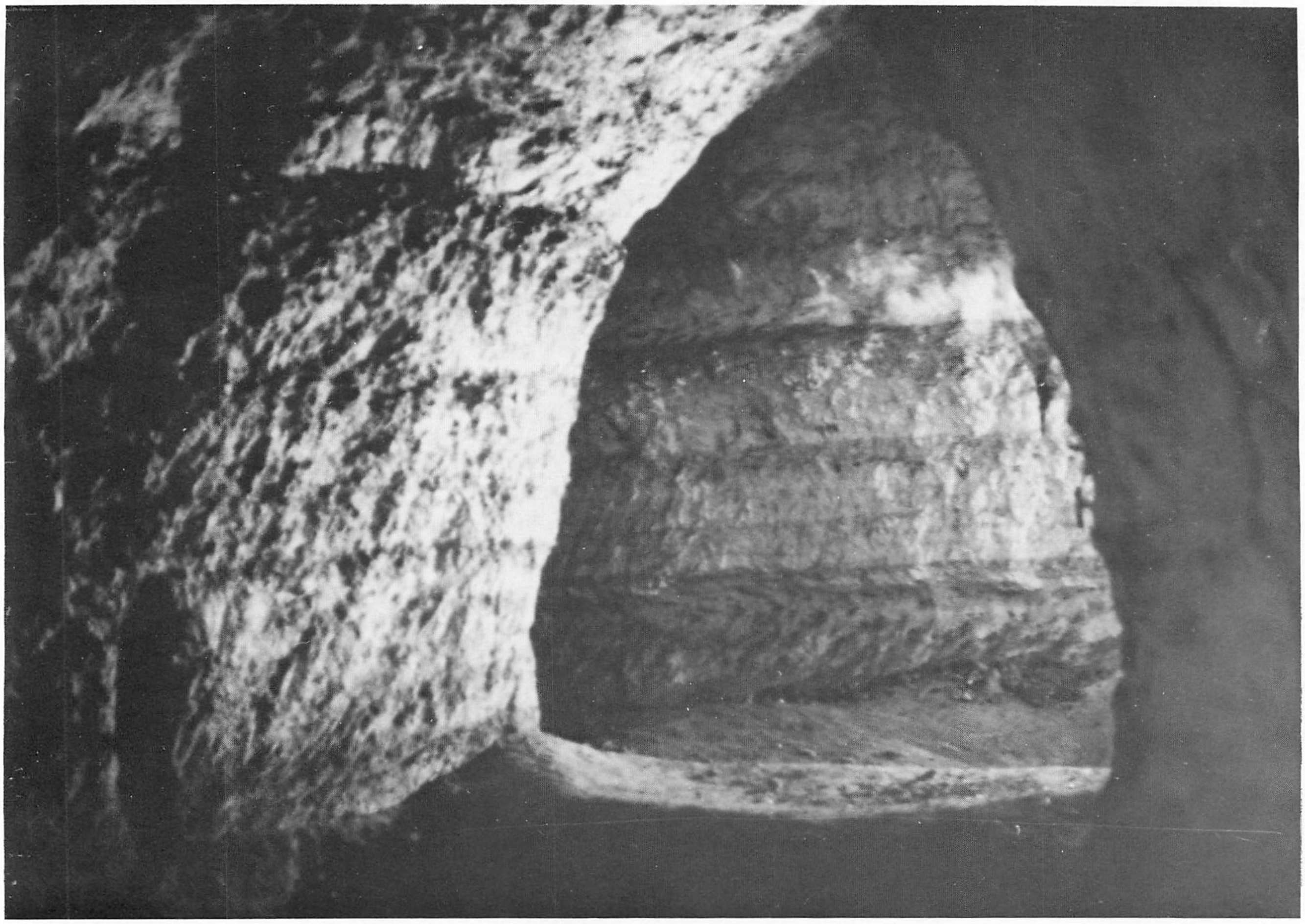


Figure 35 - Pulverulent siliceous phase of the Fort Payne Formation (often referred to as tripoli or silicastone) exposed in an abandoned tripoli mine. Iron staining produces dark brown bands in the otherwise brilliant white, chalky appearance. Location: NE/4, SW/4, SW/4, Sec. 26, T.2S., R.11E.

Lauderdale Limestone (Fort Payne Formation) and below the Hartselle Sandstone (Formation) in the Tuscumbia Limestone (Formation) in Mississippi. Butts (1926) restricted the Tuscumbia Limestone to stratigraphic intervals above the Fort Payne Chert and below the Floyd Shale, or Ste. Genevieve Limestone (lowermost Pride Mountain Formation of this report). The lower Tuscumbia (Warsaw Limestone) was described at the surface in east-neighboring Colbert County, Alabama, in Butts (1926). The St. Louis Limestone overlies the Warsaw Limestone to the northeast, in Morgan, Madison, and Jackson counties, Alabama, and to the north in exposures in Franklin and Grundy counties in south-central Tennessee (Butts, 1926).

The stratigraphic interval comprising upper portions of the Fort Payne Formation and the entire thickness of the Tuscumbia Formation described in earlier reports by Smith and Butts in Alabama was described in Mississippi as the Iuka Terrane (of formational rank) in Morse (1928 and 1930). Morse (1928) named the Iuka Terrane for the sequence of bedded chert exposed near the town of Iuka, Tishomingo County, Mississippi. Morse (1930, p. 129) described an exposure of the "old Tuscumbia Limestone" in the Cripple Deer Creek valley of eastern Tishomingo County as an isolated limestone interval of the Iuka Terrane, and as the only surficial occurrence of the unit in Mississippi.

After Lowe's (1915) recognition of the Tuscumbia in Tishomingo County, the name Tuscumbia was absent in the literature describing occurrences of that stratigraphic interval in Mississippi until Welch (1958 and 1959) described the Tuscumbia Limestone (of formational rank) at the surface and in the subsurface of northeastern Mississippi and northwestern Alabama. Bicker (1979) accepted the nomenclature of Morse (1930) regarding the Mississippian System in Tishomingo County, and described the Tuscumbia Limestone as being correlative with upper portions of the Iuka Formation (upper Fort Payne Formation of this report). In this report the local units named by Morse are dropped in favor of the more widely accepted nomenclature of Butts (1926), Welch (1958 and 1959), and Thomas (1972b and 1979) regarding the stratigraphic interval comprising the Osagean

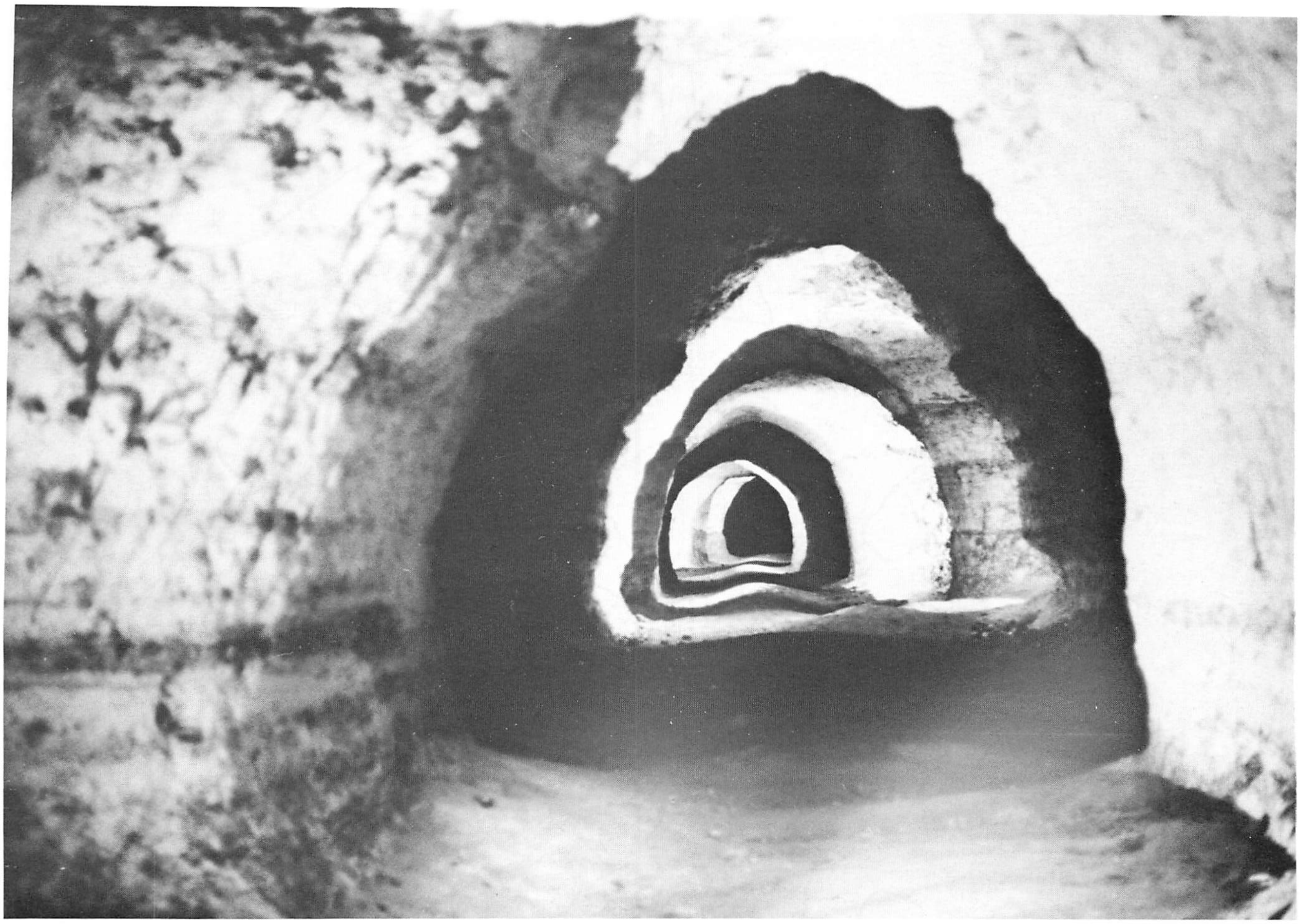


Figure 36 - Main shaft of abandoned tripoli mine illustrates the lateral continuity of the tripolitic phase of Fort Payne cherts. The shaft extends approximately 300 feet southward into the hillside, on the south side of Chalk Mine Hollow, and the deposit averages 18 feet in thickness. Location: NE/4, SW/4, SW/4, Sec. 26, T.2S., R.11E.

and Meramecian series (Fort Payne and Tuscumbia formations) exposed in Tishomingo County.

The Tuscumbia Formation occurs in Tishomingo County as a thick sequence of bioclastic (crinoidal), crystalline limestones, cherty limestones, and less frequent occurrences of chert. Colors vary from light- to dark-gray, depending on the degree of weathering in surface exposures. The Tuscumbia Formation is primarily composed of medium- to thick-bedded, medium-gray, bioclastic grainstone, wackestone, and mudstone, with occasional lenses and thin beds of fine- to coarse-crystalline limestone; and coarse-crystalline calcite-filled voids occur locally. Locally these limestones grade laterally into a cherty phase in the form of silicified grainstones and other phases of the parent limestone.

Harris, Moore, and West (1963) reported a maximum thickness of about 200 feet for the Tuscumbia Formation in Colbert County, Alabama. The Tuscumbia Formation is over 160 feet thick in north-central Alabama, thins to the southwest to less than 50 feet within the Black Warrior Basin, and pinches out along the Coosa Synclinorium and the Cahaba Syncline (Thomas, 1979). The Tuscumbia Formation is between 115 and 213 feet thick in northwestern Georgia (Thomas and Cramer, 1979). The Tuscumbia Formation of Alabama is correlative with the Warsaw, Salem, and St. Louis formations of the Upper Mississippi Valley, a sequence that in Illinois is represented by an approximately 1100 foot-thick sequence of gray to black limestones, cherts, and siltstones (Drahovzal, 1967). The Tuscumbia Formation of northern Alabama contains a Warsaw-Salem fauna and a St. Louis fauna (Drahovzal, 1967). The Tuscumbia was initially divided into a lower Warsaw and upper St. Louis limestone interval in northern Alabama and southeastern Tennessee by Butts (1926). The Warsaw and St. Louis limestone intervals were correlated through eastern Tennessee by Milici et al. (1979). In western Kentucky, the Warsaw, Salem, and St. Louis limestones represent the northward extension of Tuscumbia equivalent strata. This sequence comprises the lower portion of the Newman Limestone in southeastern Kentucky, which overlies the Fort Payne Formation (Rice et al., 1979). The Borden Formation comprises Fort Payne and Tuscumbia equivalent strata in northeastern and east-central Kentucky (Rice et al., 1979). Here the Bor-

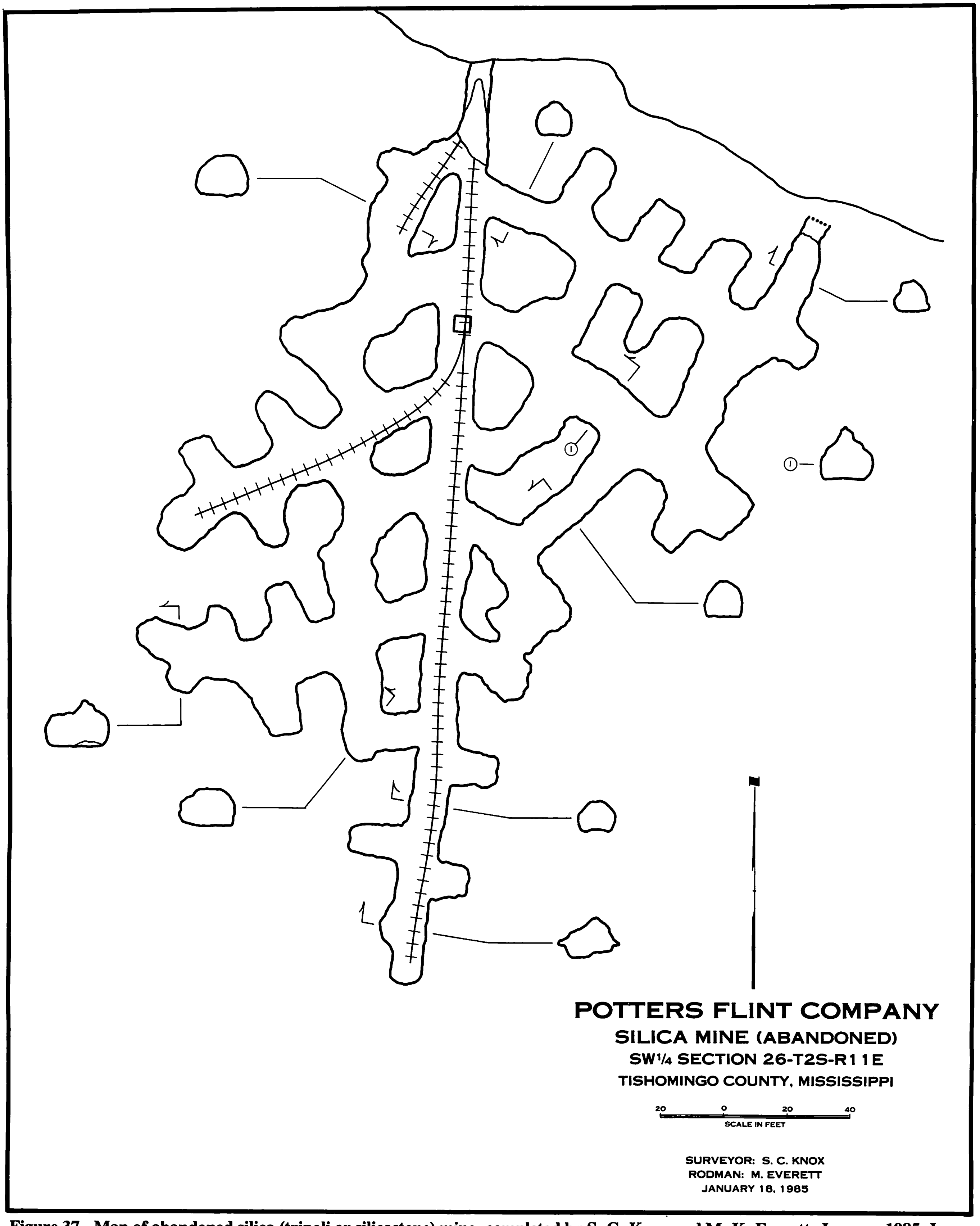


Figure 37 - Map of abandoned silica (tripoli or silicastone) mine, completed by S. C. Knox and M. K. Everett, January 1985. Location: NE/4, SW/4, SW/4, Sec. 26, T.2S., R.11E.

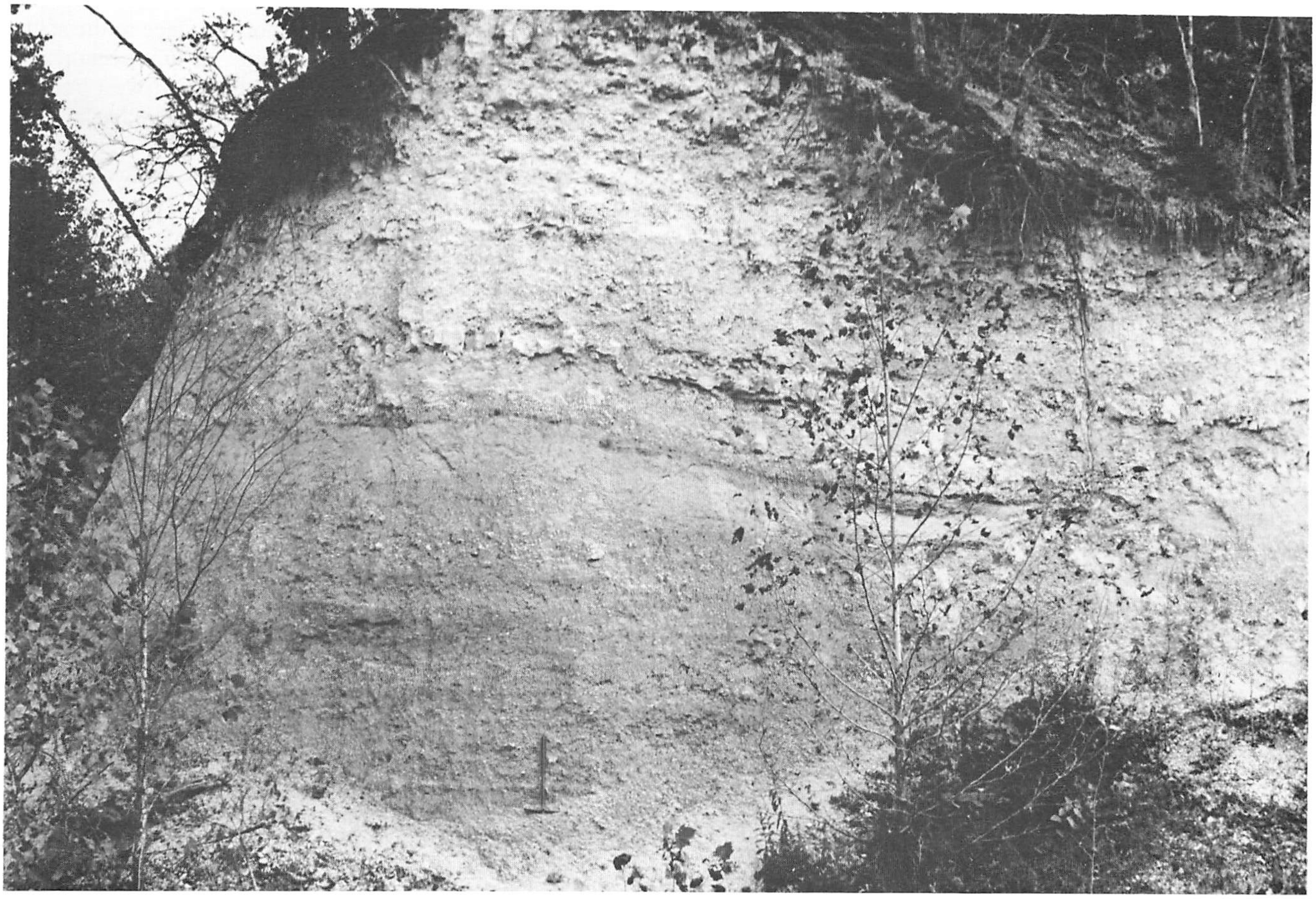


Figure 38 - Weathered, horizontally bedded chert comprising upper portions of the Fort Payne Formation. Clay content increases upward in the exposure; lower intervals contain large proportions of sand to cobble-size angular fragmental chert. Pickax is 26 inches in length. Location: SE/4, NE/4, SW/4, Sec. 10, T.2S., R.10E.

den Formation is overlain by the upper part of the Newman Limestone.

The Tuscumbia Formation conformably overlies the Fort Payne Formation in Alabama (Thomas, 1972b) and northeastern Mississippi (Welch, 1958). The contact of the Tuscumbia Formation with the overlying Monteagle Limestone (Formation) in northeastern Alabama is gradational (Thomas, 1972b). The Tuscumbia Formation is unconformably overlain by the Pride Mountain Formation in the Black Warrior Basin of northwestern Alabama and northeastern Mississippi (Welch, 1958). The unit thins westward from a maximum exposed thickness of 240 feet at Blount Springs, Blount County, Alabama, to the eventual truncation by the upper erosional surface in southwestern Itawamba County, Mississippi (Welch, 1959). The Tuscumbia Formation is continuous in the subsurface of Tishomingo County along the line of section shown on Plate 2, from the Itawamba County boundary to the northward truncation of the unit by the Upper Cretaceous erosional surface at the base of the Tuscaloosa Group (Plate 1, sheet 1). The maximum county-wide thickness of the limestone sequence comprising the Tuscumbia Formation occurs in the subsurface of east-central Tishomingo County, below the valleys of Providence Branch and Cripple Deer Creek. Subsurface samples from a petroleum test well drilled on the north valley wall of Cripple Deer Creek (Plates 3 and 4, well 19, MGS File Number 214.0-214.3, Mellen and Gear, number 1 E. K. Wood, located in the NW/4, SE/4, SE/4, Sec. 21, T.4S., R.11E.), reveal an approximately 240 foot-thick sequence consisting mainly of light- to medium-gray and brownish-gray, medium- to coarse-grained, bioclastic grainstones, mudstones fine- to medium crystalline limestones, cherty limestones, and light-gray chert. The conformable contact with the underlying Fort Payne Formation is located in the subsurface by the appearance of thin intervals of dark-gray chert, underlain by medium-gray cherty limestones and medium-gray limestones characteristic of the lower Fort Payne Formation. The Fort Payne Formation is about 170 feet thick in this well, and is underlain by a very thin (20 feet at most) interval of black, sandy shales of the Chattanooga Formation.

The limestone lithologies characteristic of the Tuscumbia Formation are gradually replaced to the west by finer textured, less fossiliferous chert sequences, characteristic of lithologies that comprise the upper Fort Payne Formation.

Figure 39 - Nodular bedded chert and residual clays characterize Fort Payne strata exposed at the southern entrance to Fred Hollow. This exposure contains occasional poorly preserved fragmental molds of brachiopods and bryzoans and faint burrows. Pickax is 26 inches in length. Location: NE/4, SW/4, SW/4, Sec. 15, T.2S., R.11E.

The approximate westerly limit of occurrence of the Tuscumbia Formation in the subsurface of Tishomingo County is shown on Plate 3 (well 8, U.S. Army C.O.E. Hydrologic Site 32). The Tuscumbia occurs as thin intervals of bioclastic limestone within a light- to medium-gray sequence of chert in the westernmost limits of occurrence (the vicinity of well 8 on Plate 3). The gradation of the Tuscumbia limestone sequence into the Fort Payne chert sequence is a gradual westerly change, into increasingly thick sequences of light- to medium-gray chert. This thick chert sequence is classified as the Iuka Terrane (Formation) of Morse (1928) and Iuka Formation of Bicker (1979). Petroleum geologists usually group subsurface occurrences of the Fort Payne and Tuscumbia formations into the Iowa Series (Welch, 1959). Plates 2, 3, and 4 illustrate the general subsurface distribution of the Tuscumbia Formation in Tishomingo County.

Plate 1 illustrates the distribution of the Tuscumbia Formation at the surface of east-central Tishomingo County. The northernmost exposures of the Tuscumbia Formation in Tishomingo County occur near the Mississippi-Alabama state line, in cuts of the Illinois Central Railroad along Clear Creek valley located in the NE/4, Sec. 35, T.3S., R.11E. The outcrop belt of the Tuscumbia continues eastward into Colbert County, Alabama, along the shoreline of the Bear Creek embayment of Pickwick Lake. The outcrop distribution of the Tuscumbia Formation is affected by the gentle folding of Paleozoic rocks into a series of very shallow anticlines and synclines, with axes trending east-northeast to west-southwest. The upper Tuscumbia surface dips southward from the northernmost county-wide exposures in Clear Creek, and dips below Pennywinkle Creek valley. The Tuscumbia Formation is exposed a short distance to the south, in Cripple Deer Creek valley, where the unit occupies the south limb of a shallow anticline with an east-west trending axis, located between the valleys of Pennywinkle and Cripple Deer creeks. The Tuscumbia dips southward below the surface of Tishomingo County beyond the south wall of Cripple Deer Creek valley (Plate 1, sheet 2). The entire thickness of the Tuscumbia Formation is preserved below a thin interval of the Pride Mountain Formation exposed near the mouth of Cripple Deer Creek in Colbert County, Alabama, and westward as far as the W/2 of Secs. 22 and 27, T.4S., R.11E., in easternmost Tishomingo County (Plate 1, sheet 2). West of that area, all of the Pride Mountain Formation and upper portions of the underlying Tuscumbia Formation are truncated by the Tuscaloosa fluvial sequence, which thickens to the west at the expense of the underlying Paleozoic strata (Plate 3). Increasingly thick intervals of the Pride Mountain overlie the Tuscumbia Formation to the east, in western Colbert County, Alabama. Exposures of the Tuscumbia Formation in Tishomingo County indicate a general trend from thin- to medium, horizontal-bedding in lower micritic intervals, to medium and thick bedded, coarser grained and frequently cross-bedded intervals of packstones and grainstones in upper portions. Thin, laterally discontinuous intervals of nodular chert occur in uppermost intervals of the Tuscumbia limestone sequence.

The Tuscumbia Formation is well exposed in the Vulcan Materials Company limestone quarry that occupies adjoining portions of Secs. 21, 22, 27 and 28, T.4S., R.11E., wherein the limestone is quarried for use as riprap, gravel, agricultural lime, and other uses. Limestone riprap from this quarry was utilized in the construction of the Tennessee-Tombigbee Waterway, and the riprap lines the shores of portions of the waterway that extend through Tishomingo County. Tuscumbia limestones are also mined from a rock quarry (Hoover Stone Products, Inc.) located near the Mississippi-Alabama state line in Colbert County, Alabama. The Hoover quarry occupies most of the SW/4 of Sec. 16, T.4S., R.15W. The overlying Pride Mountain Formation occurs in upper portions of the Hoover quarry as a thick sequence (over 60 feet thick) of olive-gray shale containing thin (less than 8 feet thick) intervals of limestone and sandstone. The Pride Mountain is truncated to the west by the basal Tuscaloosa erosional surface, and the Pride Mountain sequence exposed in upper portions of the Hoover quarry is represented at the Vulcan Materials Company quarry by a thin veneer of fragmental shales, sandstones, limestones and cherts, which have been re-worked into basal portions of the Tuscaloosa Formation.

Lower portions of the Tuscumbia Formation are exposed on the southwest wall of the Vulcan Materials Company quarry (Figure 40) as a sequence of thin- to medium-bedded mudstones, cherty limestones, and thin chert beds. Thin, very dense, dark-gray to black chert beds, which occur in the lowermost portions of the quarry, indicate the beginning of the downward transition into the conformably underlying

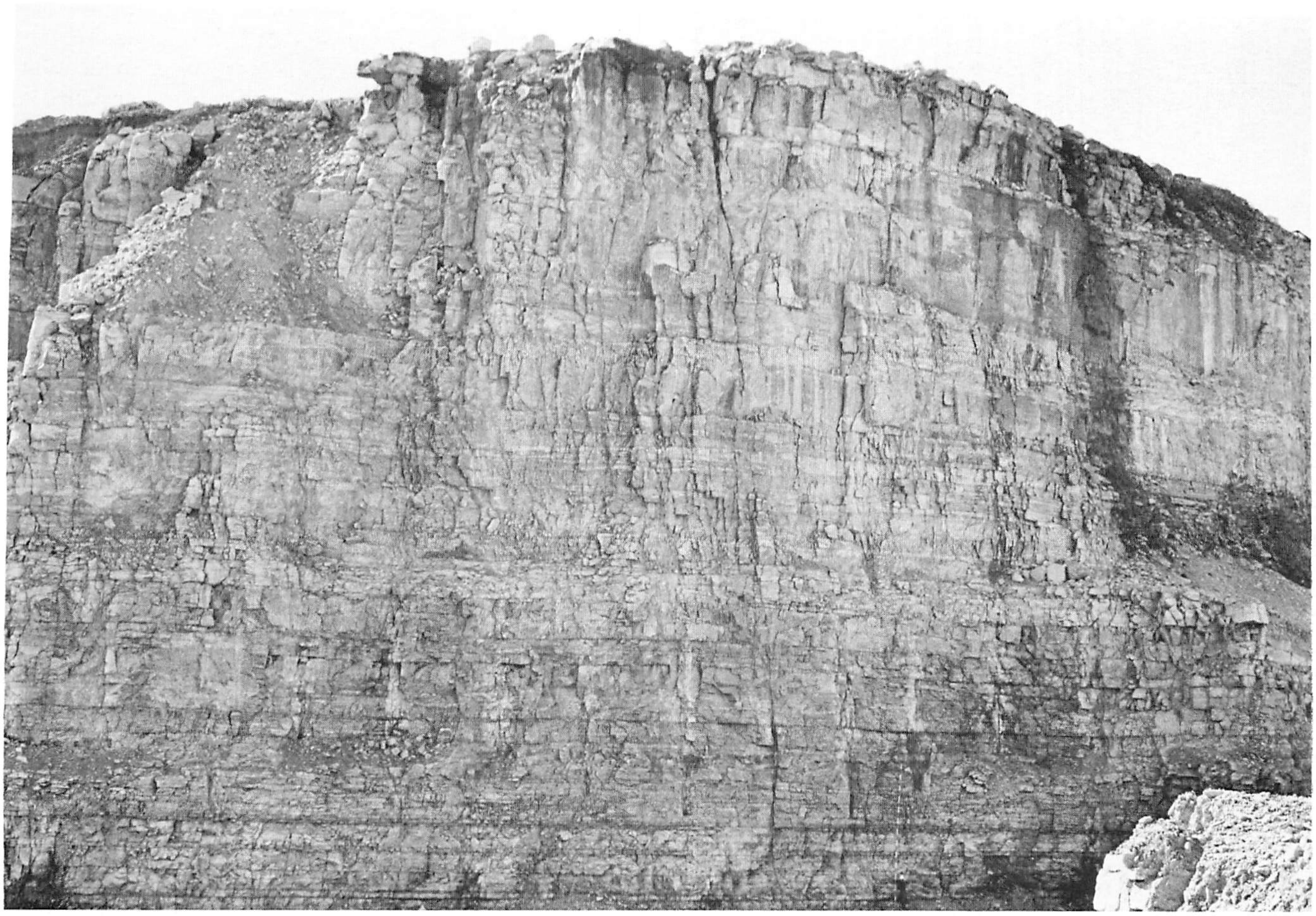


Figure 40 - Lower portion of the Tuscumbia Formation exposed on the southwest wall of the limestone quarry (Vulcan Materials Company) located in eastern Tishomingo County. Pole is 25 feet in length. Location: SW/4, NE/4, NE/4, Sec. 28, T.4S., R.11E.

Fort Payne Formation. The uppermost continuous black chert bed appears at the base of the vertical pole scale shown in Figure 41. Thicknesses of these dark-colored chert beds increase downward, and a 1.3 foot-thick black chert bed, exposed 2.5 feet above the base of the northeast wall, is the thickest of the dark-colored (dark-gray to black) chert beds in the quarry. The top of the Fort Payne Formation is defined in Alabama by Thomas (1972b) as the "top of the stratigraphically highest, dark-colored, fine-grained limestone, highest abundant dark-colored chert, and/or highest bedded chert." The uppermost continuous, thin bed of black chert, which occurs 10.4 feet above the lowermost quarry floor, is arbitrarily defined in the present report as the top of the Fort Payne Formation (Figure 42).

The Tuscumbia Formation is 201 feet thick in exposure at the Vulcan Materials Company quarry. A 10.4 foot-thick interval of the conformably underlying Fort Payne Formation is exposed in lowermost portions of the quarry. The Tuscumbia Formation grades upward, through a sequence of medium-gray mudstone, cherty limestone, and occasional lenses and thin beds of cherty limestone (Figures 40 and 41), into very light- to light-gray, coarse-grained, cross-bedded, bioclastic packstones and grainstones (Figures 43 and 45). A measured section of the limestone quarry of Vulcan MaterialsCompany, completed on 12 February, 1987, by D. T. Dockery and the author, is shown in Figure 44.

Vertical fracturing extends through the entire thickness of the Tuscumbia Formation. A prominent vertical fracture is shown near the center of Figure 41. Water-worn surfaces, produced by the flow of water through fractures in the limestones, characterize uppermost exposed intervals of the Tuscumbia limestone sequence (Figure 45). Isolated pockets of grayish-green to grayish olive-green clay and thinly interbedded glauconitic sand, occasionally interspersed with chert gravel, occupy some of the crevices in uppermost intervals of the quarry exposure. These isolated occurrences probably represent a marine facies of the Tuscaloosa Group, preserved in depressions or crevices in uppermost intervals of the Tuscumbia limestone sequence. Occurrences of small caverns are preserved as small, circular openings in the quarry highwall.

The contact between the Tuscumbia Formation and the overlying Pride Mountain Formation is unconformable in the Black Warrior Basin of northwestern Alabama and northeastern Mississippi (Welch, 1958 and 1959). Exposures of

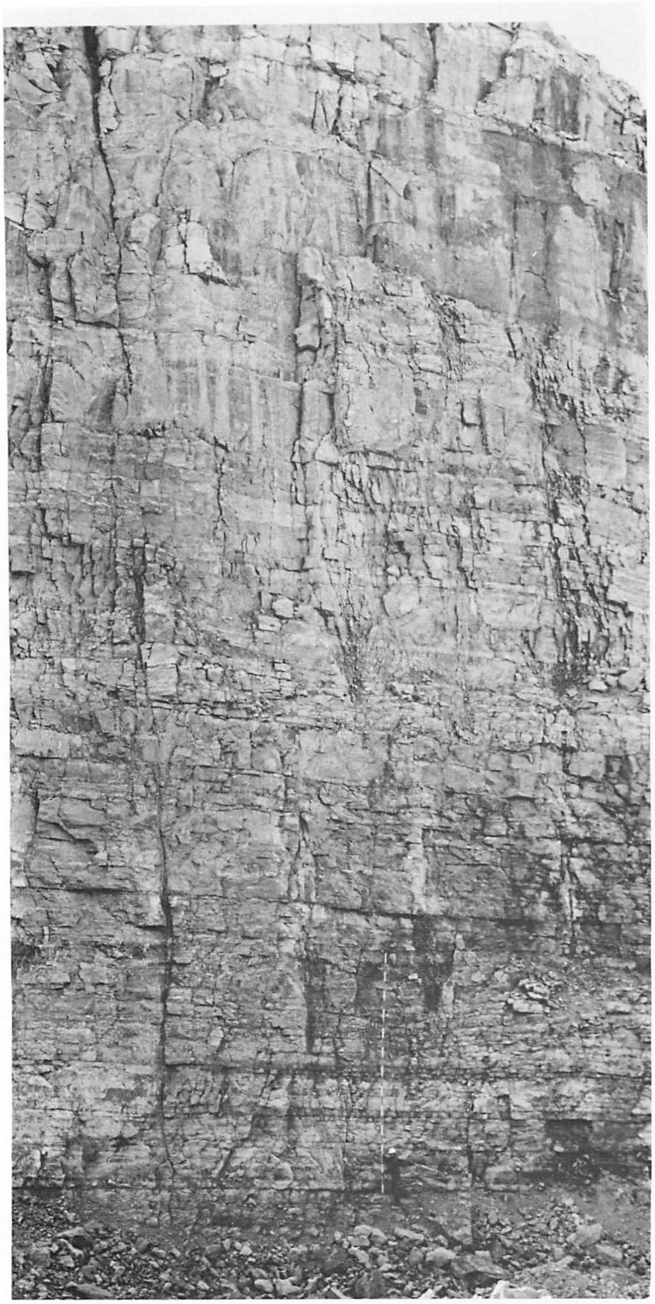


Figure 41 - Closer view of the Tuscumbia limestone sequence shown in Figure 40. A very thin (4 inches thick) laterally continuous bed of black chert at the base of the pole indicates the beginning of the downward transition into the conformably underlying Fort Payne Formation. Pole is 25 feet in length, scaled in 1 foot increments. Location: SW/4, NE/4, NE/4, Sec. 28, T.4S., R.11E.

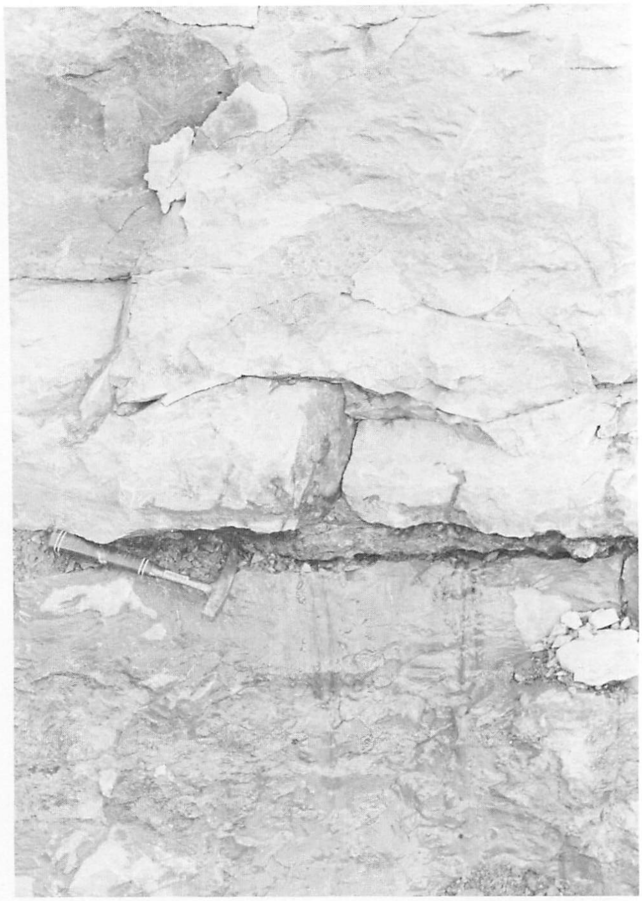


Figure 42 - Uppermost thin (3 to 4 inches thick) black chert bed at the base of the Tuscumbia Formation indicates the beginning of the downward transition into dark-colored cherts and finely textured limestones comprising the conformably underlying Fort Payne Formation. Location: Northeast wall of the limestone quarry owned by Vulcan Materials Company in SE/4, NE/4, NE/4, Sec. 28, T.4S., R.11E.

this contact in Tishomingo County are small and weathered, and the disconformity is obscure in outcrop. A thick, relatively unweathered sequence wherein the contact between the Tuscumbia and Pride Mountain formations can be accurately located occurs in the large quarry (Hoover Stone Products) located near the Alabama-Mississippi state line, in Colbert County, Alabama, SW/4, Sec. 16, T.4S., R.15W. Plate 1 illustrates the distribution of the Tuscumbia Formation and the unconformably overlying Pride Mountain Formation at the surface of Tishomingo County.

CHESTERIAN SERIES

The term Chester was initially utilized in the literature as a group designation and applied to type lithologies exposed at Chester, Randolf County, Illinois, by Worthen (1860). This sequence was described as the Chester Series in Illinois and divided, in ascending order, into the Lower Chester, Middle Chester, and Upper Chester groups in Weller (1920). This stratigraphic sequence was defined as the Chesterian Series and divided, in ascending order, into the New Design, Hamberg, and Elvira groups, in reference to exposures in the Mississippian type area in Iowa and Illinois, by Weller et al. (1948). Only the New Design and Hamberg groups of the standard section are correlated with the Chesterian stratigraphic sequence exposed in Tishomin-

Figure 43 - Upper portions of the Tuscumbia Formation exposed on the northeast wall of the limestone quarry (Vulcan Materials Company) are composed of horizontal and cross-bedded, bioclastic lime-packstone, grainstone, and thin interbeds of mudstone. Underlying, finer textured intervals are shown in Figures 40 and 41. Location: NE/4, NE/4, NE/4, Sec. 28, T.4S., R.11E.

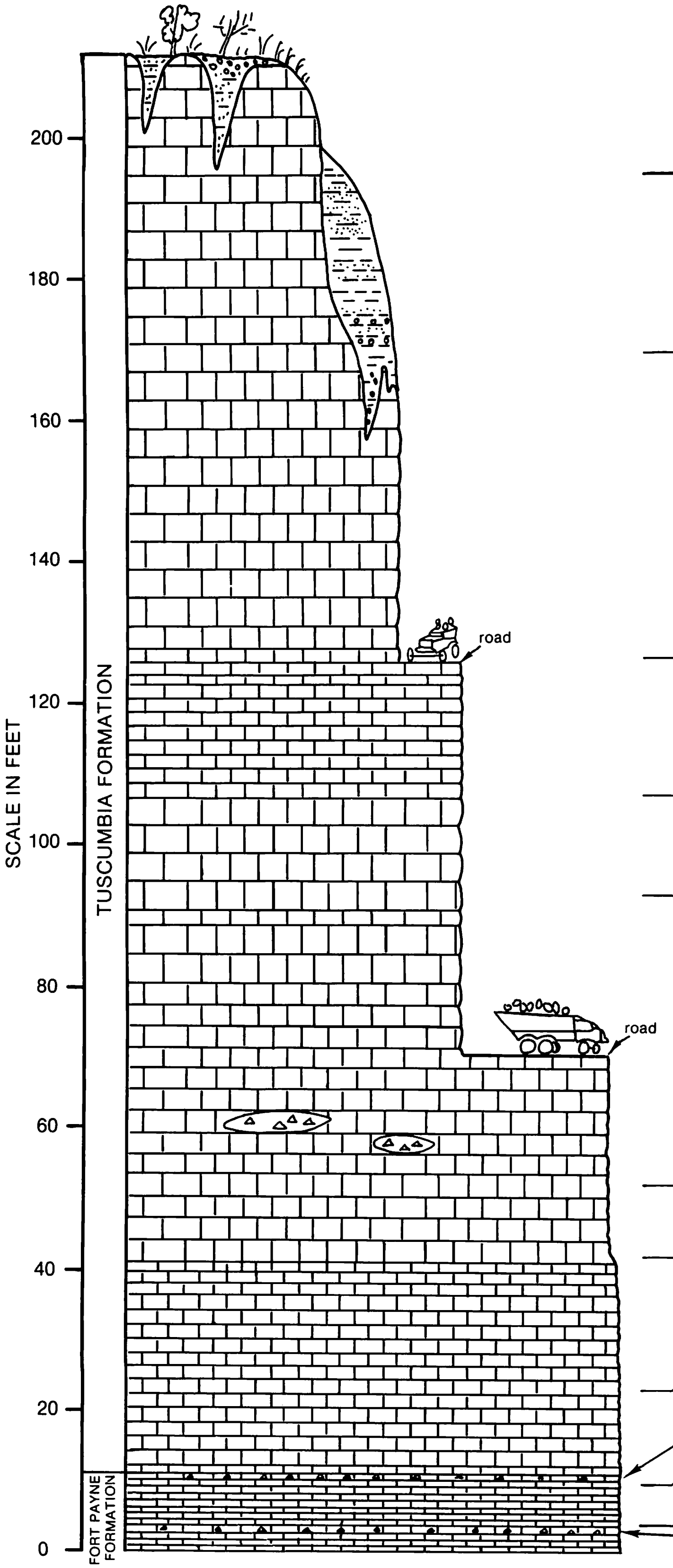
go County. Weller et al. (1948) correlated strata equivalent to the Alsobrook, Allsboro and Southward Pond formations of Morse (1928) with the New Design Group and strata equivalent to the Southward Spring, Southward Bridge, and Forest Grove formations of Morse (1928) with the Hamberg Group of the Mississippian System type area in Iowa and Illinois. The formations comprising the Chesterian Series described in Morse (1928) were grouped into the Pride Mountain Formation by Welch (1959), who retained many of Morse's formations as members of the Pride Mountain Formation (Figure 31). The base of the Southward Spring Sandstone of Morse (1928) (central portions of the Gasper Formation described in Alabama by Butts, 1926) was correlated as the boundary between the New Design and Hamberg groups of the Mississippian type area in Weller et al. (1948). The present report includes in the Chesterian Series all strata of Mississippian age within Tishomingo County which occur above the Tuscumbia Formation.

The Chesterian Series includes, in ascending order, the Pride Mountain and Hartselle formations of the present report. Overlying intervals of the Chesterian Series reported from northern Alabama in Butts (1926) are absent from Tishomingo County, except for possible thin, discontinuous occurrences of the Bangor Limestone in southernmost Tishomingo County. The Bangor Limestone overlies the Hartselle Formation in the subsurface of south-neighboring Itawamba County, and at the surface of east-neighboring Colbert County, Alabama (Welch, 1959). The Bangor Limestone does not occur in Welch's (1958) cross section through eastern Tishomingo County and Colbert County, Alabama. The Bangor Limestone does not occur in subsurface well samples or in surface exposures observed during the present study, although this does not preclude the possibility of occurrences of the unit in the deep subsurface of southernmost Tishomingo County. Available subsurface data indicate that the stratigraphic intervals that occur above (and are younger than) uppermost Hartselle beds are truncated by the erosional surface at the base of the Tuscaloosa Group (Plates 2 and 4). Plate 3 illustrates the westward truncation of older beds along a line of section parallel to the axis of a westward opening paleochannel.

Pride Mountain Formation

The Pride Mountain Formation was named by Welch (1958) for exposures on the northeastern slope of Pride Mountain, located about 2 miles east of Pride, Colbert County, Alabama. The unit occurs at the surface of Tishomingo County and Colbert County, Alabama, as a sequence of shale and siltstone, containing thin intervals of sandstone and limestone. The alternating lithologies were classified into thin units of formational rank in northern Alabama by Butts (1926). Morse (1928) described the Pride Mountain sequence from exposures in Tishomingo County, Mississippi, and Colbert County, Alabama, and divided the sequence into several thin formations and members. Figure 31 illustrates the stratigraphic relationships of the units and nomenclature utilized in the Butts (1926) and Morse (1928) classifications. Welch (1958) retained many of the formational names utilized in Butts (1926) and Morse (1928) as members of the Pride Mountain Formation (Figure 31).

The present report utilizes the classification of Welch (1958 and 1959) for the formations comprising the Chesterian Series in northwestern Alabama and northeastern Mississippi. The Pride Mountain Formation is the lowermost unit of the Chesterian Series, and includes all strata above the Tuscumbia Formation and below the Hartselle Formation. The Pride Mountain Formation and its members were correlated in northeastern Mississippi and northern Alabama in Welch (1958). The Pride Mountain Formation is comprised, in ascending order, of the Alsobrook, Tanyard Branch, Wagnon, Southward Spring Sandstone, Sandfall, Mynot Sandstone, and Green Hill members (Welch, 1958). The relatively thick intervals of shale and thin intervals of limestone, sandstone, and siltstone comprising the Pride Mountain Formation in Tishomingo County and Colbert County, Alabama, described in Welch (1958) grade eastward into the Monteagle Limestone in northeastern Alabama (Thomas, 1979), and



Limestone, light-gray, bioclastic grainstone and packstone, coarse-grained, cross-bedded with occasional thick, massive interbeds, 18 feet. Frequent water-worn solution fissures locally filled with grayish green clay, sand, and occasional gravel and fragments of chert.

Limestone, light-gray, bioclastic grainstone and packstone, coarse- to very coarse-grained, medium-bedded, with frequent, thin interbeds of chert, light- to medium-gray, 25 feet. Isolated pockets of clay, grayish- to grayish olive-green, sandy, with occasional gravel and fragments of chert, are preserved locally in fissures and small paleochannels.

Limestone, light- to medium-gray, bioclastic packstone and grainstone, medium- to very coarse-grained, cross-bedded, thickly bedded, prominent parting 25 feet above base, 43 feet. Isolated pockets of clay; grayish-green, sandy, with occasional small pebbles and fragments of chert, are preserved locally in fissures and small paleochannels.

Limestone, medium-gray, mudstone, thin- to medium-bedded, frequently cherty, 19.5 feet.

Limestone, medium-gray, bioclastic grainstone and packstone, medium- to coarse-grained, medium- to thick-bedded, 17 feet.

Limestone, medium-gray, bioclastic packstone and grainstone, fine- to coarse-grained, medium- to thick-bedded, lower half of interval contains frequent lenticular beds of chert, light- to medium-gray, sparite-filled voids up to 4 inches in diameter, and very small pockets of tar in voids and fractures in the limestones, 38 feet.

Limestone, medium bluish-gray, bioclastic packstone and grainstone, fine- to medium-grained, medium-bedded, 10 feet.

Limestone, medium-gray, mudstone, medium-bedded, contains sparite-filled voids up to 4 inches in diameter; uppermost 9 feet contain frequent beds of carbonate siltstone, very fine-grained, bioclastic packstone and grainstone, 19 feet.

Limestone, medium-gray, mudstone, thin- to medium-bedded, prominent partings 7 feet above base and at top, 11.5 feet.

Chert, black, dense, 0.3 feet.

Limestone, medium dark-gray, mudstone thinly bedded, cherty, contains sparite-filled voids up to 3 inches in diameter in upper 3 feet, 6.3 feet.

Chert, black, dense, 1.3 feet.

Limestone, medium dark- to dark-gray, mudstone, very thin- to thin-bedded, cherty, calcareous shale partings at base, 2.5 feet.

Figure 44 - Measured section describing the Tuscumbia Formation exposed in the limestone quarry of Vulcan Materials Company. A 201-foot-thick sequence of coarsening upward bioclastic limestones of the Tuscumbia Formation grade downward into an interval containing thin, dark gray to black chert beds of the uppermostFort Payne Formation. Section by R. K. Merrill and D. T. Dockery, 12 February 1987. Location: SW/4, NE/4, NE/4, to NE/4, NE/4, NE/4, Sec. 28, T.4S., R.11E.

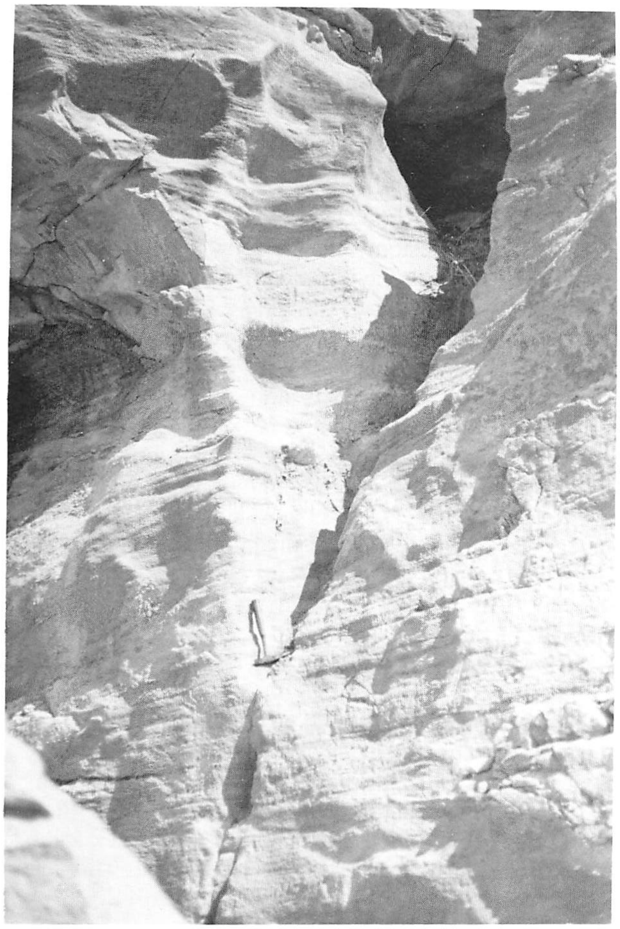


Figure 45 - Water-worn surfaces characterize uppermost intervals of the cross-bedded bioclastic grainstones in the upper Tuscumbia limestone interval. Smooth erosional surfaces were produced along crevice walls as a result of the flow of water through fissures and small caverns in the upper limestones of the Tuscumbia Formation. Rock hammer is 12 inches in length. Location: NE/4, NE/4, NE/4, Sec. 28, T.4S., R.11E.

northward into the Monteagle and Ste. Genevieve limestones described in Tennessee by Milici et al. (1979).

The Pride Mountain Formation is truncated by the erosional surface at the base of the Tuscaloosa Group in west-neighboring Prentiss County (Mankin et al., 1986). Thick sequences of Tuscaloosa fluvial sediments fill deep paleochannnels in the subsurface of west-central Tishomingo County, wherein variable thicknesses of Paleozoic strata have been removed by erosional forces of Tuscaloosa fluvial systems; the stratigraphic intervals present in the subsurface vary locally. Plate 5 illustrates the distribution of the erosional Paleozoic surface in Tishomingo County and the westward-opening paleovalley system that continues into the subsurface of Prentiss County. Plate 3 illustrates the westward truncation of the Pride Mountain Formation by the erosional surface at the base of the Tuscaloosa Group, along a line of section that parallels the axis of the westward-opening paleovalley system.

The Pride Mountain Formation grades westward into an undifferentiated shale sequence in the subsurface of northeastern Mississippi. This sequence, called the Floyd Shale in Mankin et al. (1986), is present in the subsurface of Itawamba, Lee, Monroe, Chickasaw, and Calhoun counties (Welch, 1959), and is 220 to 255 feet thick in the subsurface of east-central Mississippi (Oktibbeha County). The Floyd Shale was described by Hayes (1891) for exposures east of White Oak Mountain and Taylor Ridge in Floyd County, Georgia.

The thin members of the Pride Mountain Formation are not laterally continuous units (Welch, 1958) and are not differentiated in the present report. All strata above the Tuscumbia Formation and below the Hartselle Formation are included as the Pride Mountain Formation on the geologic map (Plate 1) and cross sections (Plates 2, 3, and 4) of this report.

The northernmost occurrences of the Pride Mountain Formation in the subsurface of Tishomingo County are shown on Plate 2 (sheet 1). Pride Mountain strata are truncated by the erosional surface at the base of the Tuscaloosa Group in northern Tishomingo County. The very gently folded Paleozoic beds dip southward with a regional dip of less than 1° (Plates 2, 3, and 4). Strike trends approximately N. 70° W. Lower intervals of the Pride Mountain Formation are preserved in shallow synclinal basins, and upper Pride Mountain intervals are truncated by Tuscaloosa fluvial deposits in the subsurface of central Tishomingo County, along the line of cross section shown on Plate 2. The entire thickness of the Pride Mountain Formation is preserved below the Hartselle Formation in the subsurface of southern Tishomingo County, where the unit attains a maximum observed thickness of about 350 feet (Plate 4). The Pride Mountain Formation is 345 feet thick in well 11 (Johnson and Daniel No. 1 Allen) and 349 feet thick in well number 22 (M.G.S. Stratigraphic Test, 382-1) of Plate 4. Correlations of subsurface occurrences with surface exposures of the Pride Mountain Formation are shown along the lines of cross section on Plates 3 and 4. The unit does not occur at the surface in the cross section illustrated on Plate 2.

The Pride Mountain Formation thins eastward from Tishomingo County and Colbert County, Alabama, and is only about 150 feet thick in eastern Lawrence County, Alabama (Welch, 1958). It is 125 feet thick to the south, where exposed at Blount Springs, Blount County, Alabama (Welch, 1958, 1959). Sandstone intervals do not occur in the Pride Mountain Formation northeast of Lawrence and Cullman counties, Alabama, and the sequence consists entirely of shale, calcareous shale, and limestone, which grades northeastward in Alabama and northward in Tennessee into the Monteagle Limestone. Lower portions of the 250 foot thick limestone sequence comprising the Monteagle Limestone in eastern portions of the Highland Rim Physiographic Section are correlative with the Ste. Genevieve Limestone of the western Highland Rim in Tennessee (Milici et al., 1979). The Ste. Genevieve Limestone is about 200 feet thick in northwestern portions of the Highland Rim, and is lithologically similar to the Monteagle Limestone (Milici et al., 1979). The Monteagle Limestone of Tennessee consists primarily of bioclastic, oolitic limestone and micrite, with occasional localized interbeds of dolomite, shale, and chert (Milici et al., 1979). The 200 foot-thick sequence of bioclastic limestones, micrites, and occasional dolomite and dolomitic limestones comprising the Monteagle Limestone in northeastern Alabama grades southwestward into the predominantly shale sequence comprising the Pride Mountain Formation in the subsurface of Cullman, Blount, and St. Clair counties, Alabama (Thomas, 1972b). Figure 7 shows the location of counties in Mississippi, Alabama, and Tennessee.

The Pride Mountain Formation occurs at the surface of eastern Tishomingo County in a narrow belt of exposures along the valley walls of Clear, Pennywinkle, Bear, and Cedar creeks. The northernmost Pride Mountain exposures within Tishomingo County occur in Clear Creek valley, near the eastern county boundary in the W/2, Sec. 35, T.3S., R.11E. Thin intervals of the Pride Mountain Formation occupy valley walls in the lower reaches of Pennywinkle Creek in easternmost Tishomingo County. Plate 1 illustrates the areal distribution of the Pride Mountain Formation at the surface of Tishomingo County. The main outcrop belt occupies valley walls and stream beds along portions of Bear and Cedar creeks. A thin, lowermost interval of the Pride Mountain Formation overlies the Tuscumbia Formation in the valley of Cripple Deer Creek near the eastern county boundary as far west as the W/2 of Sec. 22 and 27, T.4S., R.11E.

The Pride Mountain Formation is overlain by the Hartselle Formation, or by the Tuscaloosa Group in areas where the Hartselle is absent, depending on the degree of erosion and truncation by Tuscaloosa fluvial processes. The Hartselle Formation is a ridge-forming sandstone; it forms a resistant caprock below which uppermost portions of the Pride Mountain Formation are preserved throughout the main outcrop belt along Bear and Cedar creek valleys. The Pride Mountain and Hartselle formations occupy uppermost portions of a southwest plunging Paleozoic ridge that occurs in the subsurface and at the surface of southern Tishomingo County (Plate 5).

Welch (1958) included the formations and members defined in earlier classifications (Butts, 1926, and Morse, 1928) in the Pride Mountain Formation, and redefined the thin and laterally discontinuous stratigraphic units described as formations in earlier reports as members of the Pride Mountain Formation. Several formation names of Morse were retained as member designations in the classification given in Welch (1958 and 1959). Figure 31 shows the various classifications utilized in literature describing the Pride Mountain interval in northeastern Mississippi and northwestern Alabama. Morse (1928) named the Alsobrook Formation for the lowermost Pride Mountain intervals, exposed at Alsobrook Bridge and homestead, located about 3 miles north of Allsboro, in the SW/4, NE/4, NE/4, Sec. 10, T.4S., R.15W., Colbert County, Alabama. A fossiliferous limestone interval, characterized by frequent occurrences of *Productus inflatus* (McChesney), occupies the lowermost 1 to 10 feet of the Alsobrook Formation of Morse (1928). Welch (1958) retained this basal limestone, and the overlying 70 to 80 foot-thick sequence of marine shale, in the Alsobrook Member of the Pride Mountain Formation in eastern Tishomingo County, Mississippi, and Colbert County, Alabama. The overyling interval of sandstone (Cripple Deer Sandstone Member of Morse, 1928) was named as a lower interval in the Tanyard Branch Member in Welch (1958) (Figure 31).

The basal limestone interval in the Alsobrook Member, and the contact with the underlying Tuscumbia Formation, are not well exposed in Tishomingo County, although the contact can be traced into easternmost Tishomingo County by occurrences of displaced blocks of Alsobrook limestone weathering from valley walls along lower reaches of Clear and Cripple Deer creek valleys (Figure 46). Exposures are small and obstructed by slumping of overlying chert gravels of the Tuscaloosa Group, although the contact is preserved in the shallow subsurface between stream valleys. Exposed thicknesses of basal Pride Mountain intervals preserved below the erosional base of the Tuscaloosa Group increase to the east. The contact between the Tuscumbia and Pride Mountain formations is best exposed in the limestone quarry (Hoover Stone Products) located on the north side of Cripple Deer Creek valley, in SW/4, Sec. 16, T.4S., R.15W., Colbert County, Alabama. Exposures of the interval that includes upper Tuscumbia and lower Pride Mountain strata are preserved below Tuscaloosa gravels to the north along the western shores of the Bear Creek embayment of Pickwick Lake, between the mouth of Cripple Deer Creek and Clear Creek in western Colbert County, Alabama. This interval

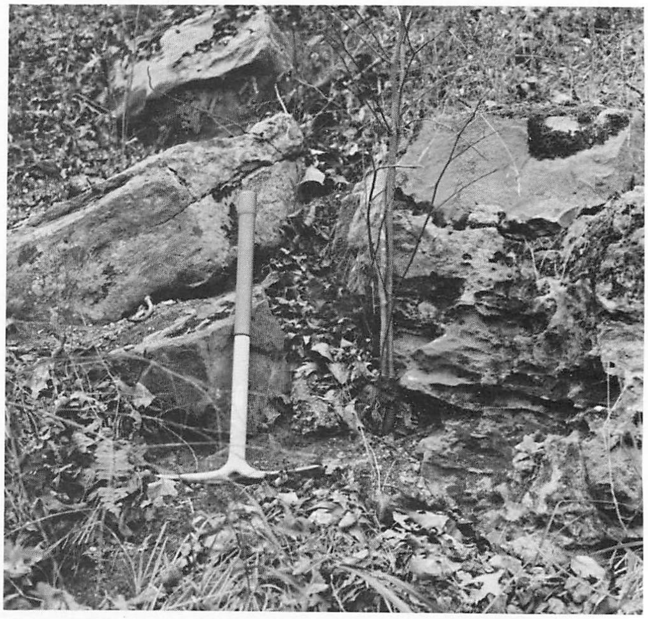


Figure 46 - Loose blocks of basal fossiliferous limestone intervals in the Pride Mountain Formation (Alsobrook Member) weather from the valley walls of lower reaches of Clear Creek valley in eastern-most Tishomingo County. Pickax handle is 26 inches in length. Location: cut of southern railway in NE/4, SE/4, NE/4, Sec. 35, T.3S., R.11E.

continues westward in exposures near the mouth of Cripple Deer Creek valley, until the lowermost Pride Mountain strata are truncated by Tuscaloosa gravels west of well 19 (Plate 3). Fragments of Pride Mountain lithologies (sandstones, shales, and fossiliferous, cherty limestone) occur in basal Tuscaloosa beds in and a short distance west of the limestone quarry (Vulcan Materials Company) located on the north side of Cripple Deer Creek valley, about 1 mile west of the state line.

The shales and limestones of basal Pride Mountain strata (Alsobrook Member) are overlain by a sequence of sandstones, interbedded with thin (less than 20 feet thick) shale units. Lower portions of the sandstone sequence consist of a thinly bedded, sparingly petroliferous sandstone of variable thicknesses (about 40 feet average thickness). This interval is the Cripple Deer Sandstone Member of the Alsobrook Formation, named for exposures along the north side of Cripple Deer Creek valley, and in exposures along the north-south trending roadway between Malone and Allsboro, in the S/2, Sec. 16, T.4S., R.15W., Colbert County, Alabama, by Morse (1928). This sandstone interval is separated from an overlying sandstone interval by a very thin interval of shale. The overlying sandstone was named the Allsboro Sandstone (of formational rank) for exposures in the vicinity of the town of Allsboro, Colbert County, Alabama, in Morse (1928). The sandstone intervals comprising the Cripple Deer Sandstone Member and the Allsboro Sandstone (Formation) of Morse (1928 and 1930), and the thin (less than 20 feet thick) interval of shale separating them, were included in the Tanyard Branch Member of the Pride Mountain Formation of Welch (1958 and 1959) (Figure 31). This interval comprises the Bethel Sandstone as described in northern Alabama by Butts (1926). The sandstone interval comprising the Tanyard Branch Member (Bethel Sandstone of Butts, 1926) is described in the petroleum industry as the Lewis Sand (Welch, 1959). The Tanyard Branch Member has a maximum thickness of about 35 feet in western Colbert and eastern Tishomingo counties, and averages about 20 feet in thickness in Colbert County (Welch, 1958). The unit grades eastward across northern Alabama into a sequence of shale and limestone (Welch, 1958). The Tanyard Branch Member locally contains small amounts of interstitial petroleum residue. Morse (1928) described occurrences of sparingly petroliferous and fossiliferous sandstones (Allsboro Sandstone and Cripple Deer Sandstone of that report) exposed near the mouth of Cripple Deer Creek and to the south near the town of Allsboro and the old Bishop Bridge on Bear Creek, in western Colbert County, Alabama. The old Bishop Bridge is still intact, but is no longer used. Figure 47 illustrates the outcrop appearance of the thinly bedded (horizontal and cross-bedded) sandstones of the Tanyard Branch Member (Lewis Sand equivalent; Allsboro Sandstone of Morse, 1928) exposed along the banks of Bear Creek at and in the vicinity of the abandoned Bishop Bridge, in the SW/4, Sec. 4, T.5S., R.15W., Colbert County, Alabama.

Morse (1928) named several additional units in the vicinity of the Southward homestead, located on the north side of Bear Creek valley in eastern Tishomingo County. These units include, in ascending order, the Southward Pond, Southward Spring, and Southward Bridge formations (Figure 31). Southward Pond of Morse (1928) is a cutoff meander loop of Bear Creek, the present name of which is Cypress Pond Ditch, whose tributaries have laid bare the fossiliferous, argillaceous, thinly bedded limestones and shales of the Southward Pond Formation of Morse (1928). This interval was defined as the Wagnon Member of the Pride Mountain Formation by Welch (1958) for exposures on Wagnon Mountain, Colbert County, Alabama. The Wagnon Member is not recognized east of Colbert County, Alabama (Welch, 1958). It is composed primarily of three thin intervals (less than 20 feet thick) of fossiliferous limestones, which are separated by varying thicknesses (15 to 25 feet) of shale. The lower limestone (Pond Limestone A of Morse, 1928) is very fossiliferous, oolitic, and locally asphaltic. This asphaltic limestone has been quarried for road material in Colbert County, Alabama (Welch, 1958).

Morse (1930) gave detailed and well illustrated descriptions of the fossils that occur in Pride Mountain strata ex-

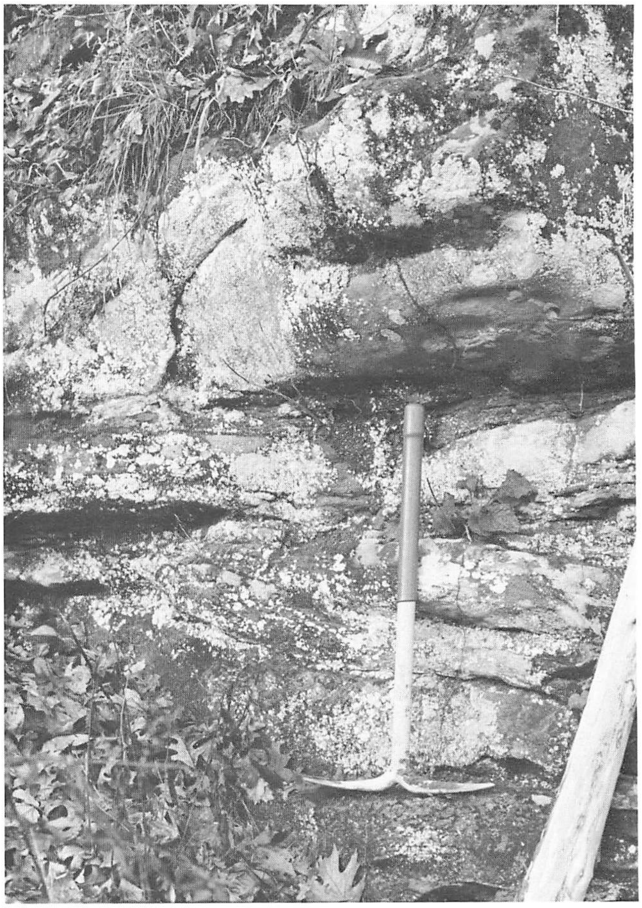


Figure 47 - The Tanyard Branch Member of the Pride Mountain Formation (Allsboro Sandstone of Morse, 1928 and 1930). This sandstone unit is characterized by local occurrences of small amounts of petroleum residue. Pickax is 26 inches in length. Location: north side of Bishop Bridge (abandoned), NW/4, SW/4, SW/4, Sec. 4, T.5S., R.15W.

posed in Tishomingo County and western Colbert County, Alabama. A few of the most common fossil occurrences are included in the present report, although the reader is referred to Morse (1930) for detailed descriptions of faunal assemblages present in the Paleozoic strata of Tishomingo County. Figures 48 and 49 illustrate the general appearance of thinly bedded, fossiliferous limestones that occur in lower intervals of the Wagnon Member. The limestones are thinly interbedded and interlaminated with calcareous shale, producing a flaggy or shaly bedding appearance upon weathering. Limestone intervals in upper portions of the Wagnon Member are not continuous in outcrop and, when present, rarely exceed 1 foot in thickness. The lower limestone is the most recognizable limestone interval in the Wagnon Member (Figures 48 and 49). The unit is very fossiliferous, and limestone lithologies consist primarily of medium- to coarse-crystalline, fossiliferous limestone in lower intervals, to micritic, thinly bedded mudstones and wackestones containing varying amounts of argillaceous limestone and calcareous shale in the upper intervals. These thin limestone intervals are separated by thin intervals of shale and calcareous shale that are locally fossiliferous. The Wagnon Member attains a maximum exposed thickness of about 70 feet in Tishomingo County. Fossils in the lower limestone interval are very well preserved in exposure on the north side of Pennywinkle Creek valley near the confluence with Bear Creek, in the NW/4, SW/4, SE/4, Sec. 34, T.3S., R.15W., Colbert County, Alabama (Locality 81 of Morse, 1930). Figures 50 and 51 illustrate well preserved specimens of *Pentremites* collected from that locality during the present study.

The Wagnon Member is overlain by the Southward Spring Sandstone Member of the Pride Mountain Formation. Morse (1928) named the Southward Spring Sandstone (of formational rank) for exposures near the Southward Spring located south of Cypress Pond in the NW/4, NE/4, SE/4, Sec. 16, T.5S., R.11E. This spring is designated as Cave Spring on topographic maps, and is a rest area on the north side of the Natchez Trace Parkway. Welch (1958) retained the name Southward Spring Sandstone and placed the unit as a member of the Pride Mountain Formation (Figure 31). Figure 52 illustrates the outcrop appearance of the Southward Spring Sandstone Member in outcrop, at the type locality. The unit consists of dark yellowish-brown, thin- to medium-bedded, fine- to medium-grained, well cemented,

Figure 48 - Fossiliferous limestone characteristic of the Wagnon Member of the Pride Mountain Formation (Southward Pond Formation of Morse, 1928) in exposures in eastern Tishomingo County and western Colbert County, Alabama. Quarter for scale. Location: NW/4, SW/4, SE/4, Sec. 34, T.3S., R.15W., western Colbert County, Alabama.

Figure 49 - Well preserved cryptostome fenestrate bryozoans and brachiopods in the thinly bedded limestones comprising basal portions in the Wagnon Member of the Pride Mountain Formation. Quarter for scale. Location: NW/4, SW/4, SE/4, Sec. 34, T.3S., R.15W., western Colbert County, Alabama.

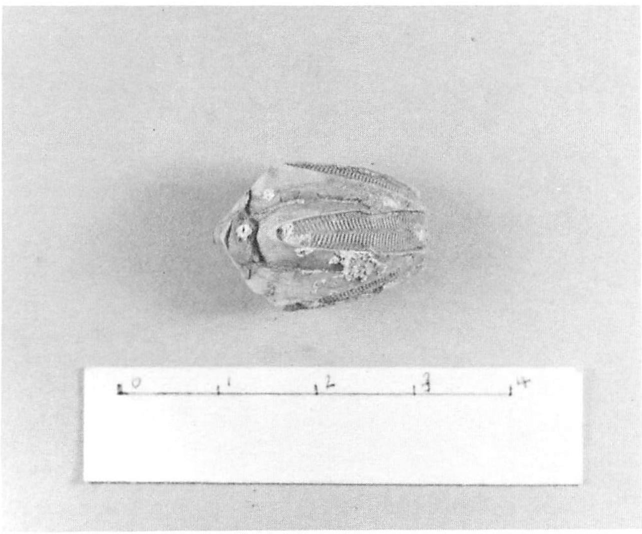


Figure 50 - Specimen of *Pentremites* sp., cf. *P. pulchellus* (described in Morse, 1930) collected from the thinly bedded, fossiliferous limestones comprising the basal portion of the Wagnon Member of the Pride Mountain Formation (Locality 81 of Morse, 1930). Scale in centimeters. Location: NW/4, SW/4, SE/4, Sec. 34, T.3S., R.15W., Colbert County, Alabama.

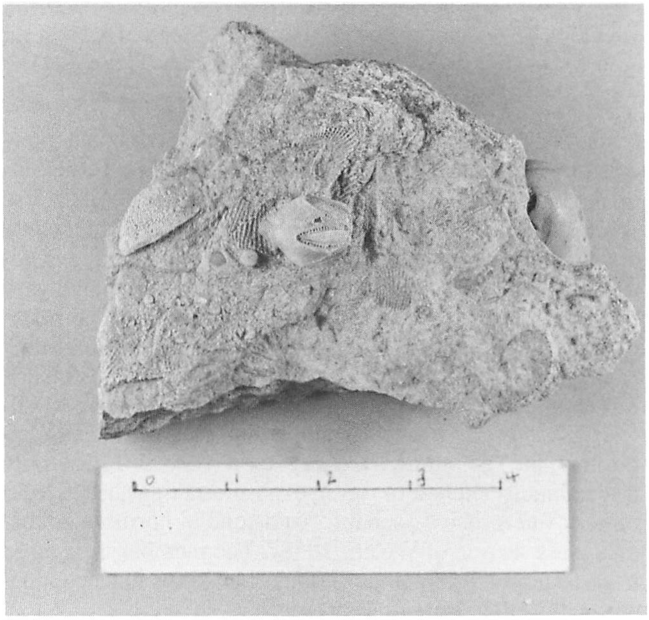


Figure 51 - Specimen of *Pentremites godoni* (described in Morse, 1930) collected from lower limestone intervals in the Wagnon Member of the Pride Mountain Formation. Scale in centimeters. Location: NW/4, SW/4, SE/4, Sec. 34, T.3S., R.15W., Colbert County, Alabama.

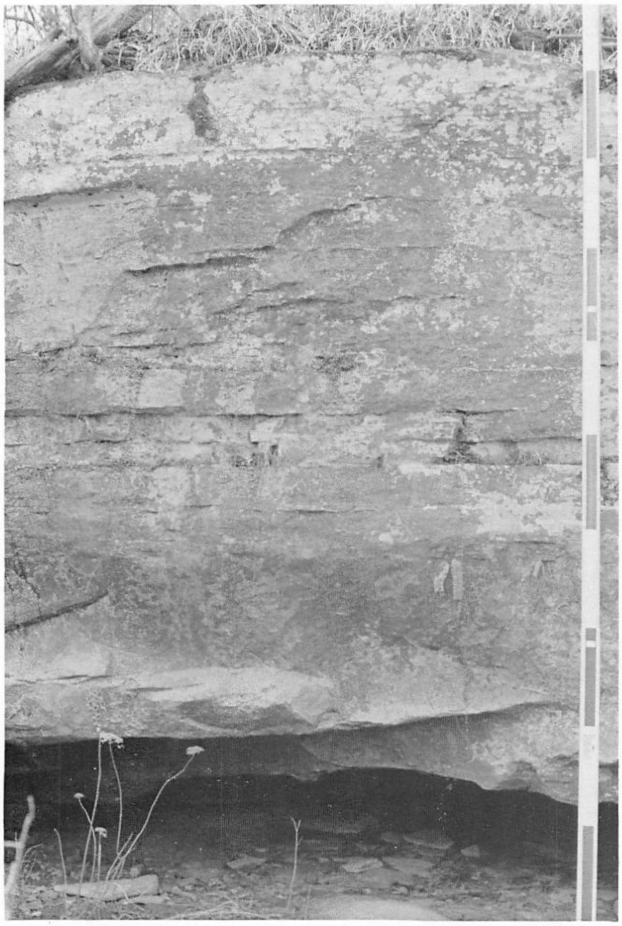


Figure 52 - Southward Spring Sandstone Member of the Pride Mountain Formation at the type locality of Morse (1928). Scale in feet. Location: NW/4, NE/4, SE/4, Sec. 16, T.5S., R.11E.

partially calcareous, quartz sandstone with occasional intervals of sandy shale. Indistinct fossil casts are preserved locally along bedding planes, as preservation is poor. Morse (1930) described occurrences of crinoid stem fragments, brachiopods, and bivalves from the Southward Spring Sandstone stratigraphic interval at the north end of Southward (Cypress) Pond (his collecting locality no. 48). The maximum exposed thickness of the Southward Spring Sandstone is about 15 feet at the type locality. A maximum estimated thickness of 30 feet is reported in Morse (1930). The Southward Spring Sandstone Member thins eastward from exposures in Tishomingo County to a very thin, laterally discontinuous interval (4 feet in exposures along Cane Creek) of very fine-grained asphaltic sandstone in northern Alabama (cross section of Welch, 1958). The member is exposed in easternmost Tishomingo County, but seems to be continuous within the small area of outcrop.

The Southward Spring Sandstone is overlain by an interval of olive-gray shale that grades upward through a sequence of calcareous, fossiliferous shales into fossiliferous, oolitic limestones and interbedded calcareous shales. Welch (1958) named this interval the Sandfall Member for exposures on Sandfall Mountain, SE/4, SE/4, Sec. 15, T.4S., R.12W., Colbert County, Alabama. The Sandfall interval occupies lowermost portions of the sequence named the Southward Bridge Formation by Morse (1928). Morse's Southward Bridge Formation also included the overlying Mynot Sandstone Member and the lowermost limestone and shale intervals in the Green Hill Member of Welch (1958). Morse (1928) divided the Southward Bridge Formation into, in ascending order, a shale, lower limestone, shale and sandstone, and an upper limestone division. The lower shale and limestone intervals of Morse (1928) are correlative with the Sandfall Member of Welch (1958). The shale and sandstone interval of Morse is correlative with the Mynot Sandstone Member of Welch (1958), and the upper limestone interval is correlative with the thin limestone beds at the base of the Green Hill Member of Welch (1958) (Figure 31). Figure 53 illustrates the outcrop appearance of a thin interval of fossiliferous, oolitic limestone (lower limestone division of Morse, 1930) of the Sandfall Member exposed along valley walls and in the creek bed of Mingo Branch. This limestone bed is about 4 feet thick, and is underlain by about 30 feet of dark-gray carbonaceous shale. It is overlain by calcareous shales with thin interbeds of fossiliferous, oolitic limestone in the uppermost intervals. Morse (1930) described specimens of bryzoans, brachiopods, bivalves, gastropods, and cephalopods from the Sandfall interval in exposures located in eastern Tishomingo County. The Sandfall Member is about 70 feet thick in eastern Tishomingo County, although the entire thickness of the member is not exposed at any single locality. Limestone and shale lithologies of the Sandfall Member are continuous in Colbert County, Alabama, where the thickness of the member varies between a maximum of

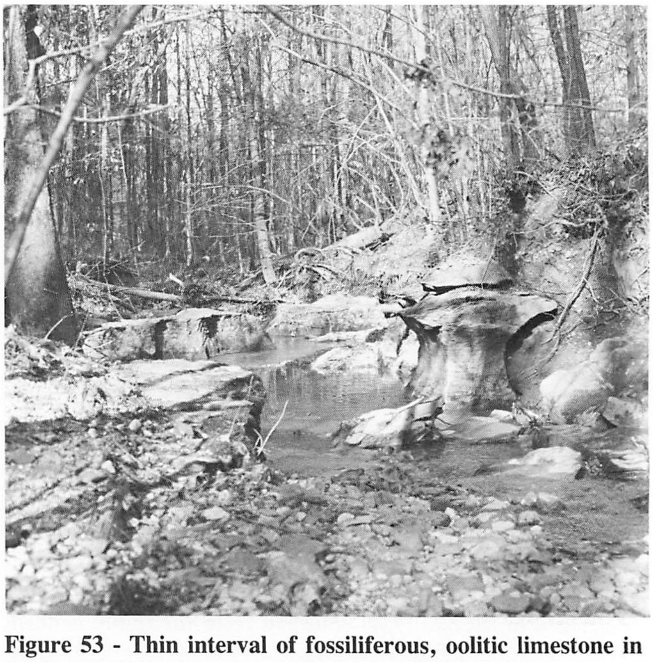


Figure 53 - Thin interval of fossiliferous, oolitic limestone in the Sandfall Member of the Pride Mountain Formation, exposed along the banks and in the bed of Mingo Branch. Location: NE/4, SW/4, SE/4, Sec. 20, T.5S., R.11E.

86 feet at the type locality on Sandfall Mountain and 65 feet in exposures along Cane Creek (Welch, 1958). Shale lithologies in the Sandfall Member grade eastward through northern Alabama into a limestone sequence (Welch, 1958) described in the Monteagle Limestone of northeastern Alabama in Thomas (1972b and 1979).

The shale and limestone lithologies of the Sandfall Member are overlain by thin- to medium-bedded sandstones, siltstones, and shales of the Mynot Sandstone Member of the Pride Mountain Formation. This member was named by Welch (1958) for exposures near the town of Mynot, SW/4, NW/4, Sec. 7, T.5S., R.14W., in southwestern Colbert County, Alabama. This interval was included in the Southward Bridge Formation of Morse (1930), and is equivalent to the Cypress Sandstone (of formational rank) described in northern Alabama in Butts (1926) (Figure 31). The Mynot Sandstone Member is exposed in Cedar Creek and Bear Creek valleys of eastern Tishomingo County, in Secs. 20, 21, 28, and 29, T.5S., R.11E. Figure 54 illustrates the outcrop appearance of the member exposed in the bed of the small stream east of Forest Grove Church, in the SW/4, SE/4, NE/4, Sec. 29, T.5S., R.11E. The Mynot Sandstone Member consists primarily of thinly bedded sandstone that is locally calcareous and sparingly fossiliferous. The member contains medium-bedded sandstone in lowermost intervals, and thin-bedded sandstone, shales, and siltstones occupy upper intervals. The Mynot Sandstone Member is about 30 feet thick in eastern Tishomingo County, although the entire thickness of the member is not exposed at any given locality. The member thins eastward from a maximum thickness of about 30 feet in western Colbert County, to a thin, discontinuous sandstone bed in eastern Colbert County, Alabama (Welch, 1958). The Mynot Sandstone is not known to extend east of Colbert County (Welch, 1958).

Figure 54 - Thinly interbedded sandstone and shale lithologies characteristic of the Mynot Sandstone Member of the Pride Mountain Formation. Location: SW/4, SE/4, NE/4, Sec. 29, T.5S., R.11E.

The Mynot Sandstone Member is overlain by the Green Hill Member of the Pride Mountain Formation. The Green Hill Member was named by Welch (1959) for exposures in Green Hill Branch, located about 3 miles south of the town of Barton, in the SW/4, NW/4, Sec. 22, T.4S., R.13W., Colbert County, Alabama. The member consists primarily of thinly bedded, bioclastic, fossiliferous, oolitic limestones and finely crystalline, fossiliferous limestones in lowermost portions, which grade upward into intervals of locally calcareous shale and siltstone. The lowermost crystalline, fossiliferous limestone interval of the Green Hill Member is equivalent to the upper limestone division of the Southward Bridge Formation of Morse (1928 and 1930). This results in the offset between the top of the Southward Bridge Formation of Morse (1928) and the base of the Green Hill Member described in Welch (1958) as shown on the correlation chart (Figure 31) of this report. Upper shaly intervals of the Green Hill Member are equivalent to lower portions of the Forest Grove Formation of Morse (1928). The Green Hill Member is approximately 80 feet thick in eastern Tishomingo County, and thins eastward to a thickness of 30 feet or less in eastern Colbert County, Alabama (Welch, 1958). The member is not recognized east of Lawrence County, Alabama (Welch, 1958).

The Green Hill Member is the uppermost interval of the Pride Mountain Formation. The fossiliferous limestones and shales in lower portions of the Green Hill Member are well exposed behind the dam of a pond that occupies the confluence of Rock Quarry Branch and Maudlin Branch in Tishomingo State Park, in the NE/4, SE/4, NE/4, Sec. 25, T.5S., R.10E. The lower limestone interval contains numerous crinoid fragments, productids, and bryozoans, and the shales contain trace fossils. Figure 55 illustrates the close-up appearance of the lower limestone interval. The limestone appears massive in relatively unweathered exposure, but upon weathering attains a brown color and a laminated appearance. The basal limestone is up to 5 feet thick, and is overlain by a sequence of calcareous shale, siltstone, and very thin intervals of thinly bedded sandstone. Fracture patterns are enhanced by stream erosion in the exposure behind the dam of the small pond in Tishomingo State Park (Figure 56). Overlying shales and siltstones in the Green Hill Member are locally calcareous and fossiliferous. Morse (1930) reported specimens of bryzoans, brachiopods, bivalves, and gastropods from thinly bedded sandstones, siltstones, and shales comprising upper portions of the Green Hill interval.

Hartselle Formation

Smith (1894) named the Hartselle Sandstone for exposures at the town of Hartselle, Morgan County, Alabama. This persistent sandstone interval was initially named the Legrange Sandstone by Smith (1879). Butts (1910) placed this interval as the Hartselle Sandstone Member of the Bangor Limestone. Later Butts (1926) placed the Hartselle Sand-

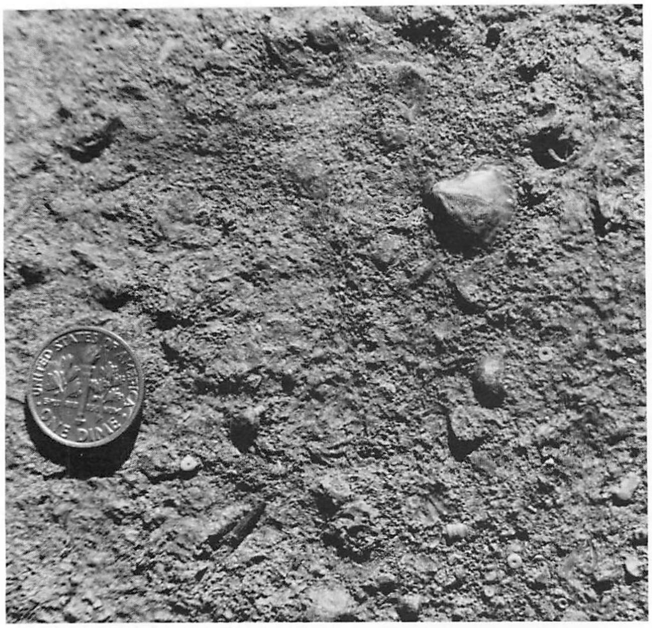


Figure 55 - Fossiliferous limestone interval that occupies lowermost portions of the Green Hill Member of the Pride Mountain Formation. This interval is 5.5 feet thick at this locality, and is continuous locally in outcrop. Dime for scale. Location: NE/4, SE/4, NE/4, Sec. 25, T.5S., R.10E.

stone as a formation separating the underlying Golconda Formation and the overlying Bangor Limestone. Morse (1928 and 1930) named the Hartselle sandstone interval the Highland Church Sandstone Member of the Forest Grove Formation for exposures near the church located in the NE/4, SE/4, NE/4, Sec. 26, T.5S., R.10E., Tishomingo County, Mississippi. Shaly intervals in the Forest Grove Formation of Morse (1928) that underlie the Hartselle interval were subsequently named the Green Hill Member of the Pride Mountain Formation. The name Hartselle rather than Highland Church is used in this report as it is more widely recognized (Welch, 1958; Thomas, 1972b). However, Morse's terms including Highland Church were used in a recent report by Bicker (1979). The Bangor Limestone and uppermost portions of the Hartselle Formation are truncated by the erosional surface at the base of the Cretaceous Coastal Plain onlap in Tishomingo County, and the Hartselle is the youngest Paleozoic formation that occurs in the subsurface or at the surface of Tishomingo County.

The contact between the Pride Mountain Formation and the overlying Hartselle Formation is locally erosional and slightly undulating in outcrop, but appears to be gradational in samples from core holes that penetrate this interval in southwestern Tishomingo County. The Hartselle Formation is overlain by fluvial sediments of the Tuscaloosa Group, or gravels and marine sands of the Eutaw Group where the Tuscaloosa is absent. The Hartselle Formation is locally overlain by Quaternary terrace deposits where exposed at the surface of Tishomingo County. The upper surface of the Hartselle Formation is erosional, and originally deposited

Figure 56 - Fractures in basal limestone interval in the Green Hill Member of the Pride Mountain Formation. The fractures generally trend N. 48° E. and N. 60° W., with local variations of ± 5° in the immediate area. Rock hammer is 12 inches in length, and the handle points northward. Location: NE/4, SE/4, NE/4, Sec. 25, T.5S., R.10E.

thicknesses of the sandstone interval are not preserved at the surface of Tishomingo County.

The Hartselle Formation consists primarily of a thin- to thick-bedded, well-cemented, sparingly fossiliferous, quartz sandstone sequence that contains occasional thin intervals of sandy shale, and isolated intervals and zones of calcareous sandstone and shale. Thick-bedded sandstone intervals have a homogeneous or massively bedded appearance in outcrop, and form small cliffs and overhangs as less resistant shales in the underlying Pride Mountain Formation weather from beneath the sandstone ledges. The Hartselle Formation locally contains zones of thin-bedded and ripple-bedded sandstones and thin intervals of sandy shale. The cliff-forming sandstones comprising the Hartselle Formation stand out in relief along the valley walls of Bear Creek in Tishomingo State Park, and form interesting features such as the well known rock climbing locality described as Jeans Overhang in McCafferty (1987) (Figure 57). The maximum exposed thickness of the Hartselle Formation at any given locality is about 30 feet, although the base of the formation is fre-

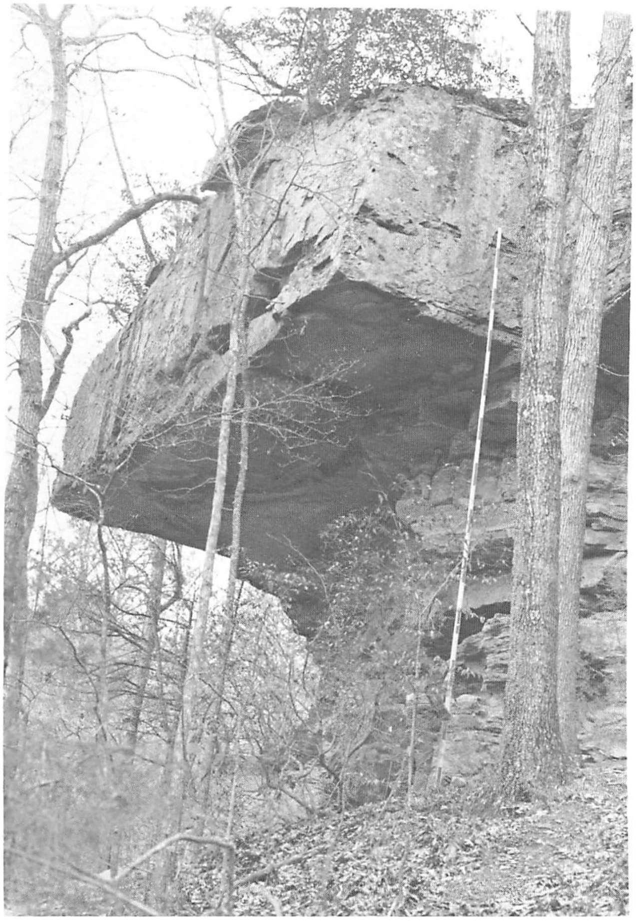


Figure 57 - Small cliffs and overhangs form in thick, massive sandstone beds of the Hartselle Formation exposed along Bear Creek valley in the vicinity of Tishomingo State Park. Scale in feet. Location: NE/4, NE/4, NE/4, Sec. 31, T.5S., R.11E.

quently covered by colluvial talus generated by downslope movement of large, displaced blocks of sandstone. The maximum observed thicknesses of the Hartselle Formation within Tishomingo County occur in continuous core samples from test wells drilled by the U. S. Army Corps of Engineers during geologic foundation studies regarding Bay Springs Dam. The maximum thickness observed in these well samples is 64 feet in core hole BS-DC-204, located in the SE/4, SE/4, SW/4, Sec. 26, T.6S., R.9E. The Hartselle Formation occurs in Alabama as a linear, northwest to southeast trending body of sandstone that attains a state-wide maximum thickness of more than 150 feet (Thomas, 1972b). The Hartselle Formation thins eastward across northern Alabama, from a thickness of 140 feet in Colbert County, to 10 feet in Madison County, Alabama (cross section of Welch, 1958). The isolith maxima of the Hartselle Formation extend from central Colbert County southeastward through Franklin, Walker, and St. Clair counties in Alabama (Thomas, 1972b). The Hartselle Formation pinches out northeastward in Alabama into the carbonate lithologies of the Monteagle Limestone (Thomas, 1979). The Hartselle Formation occurs to the north in Tennessee as a 90 foot thick (maximum) sequence of shale, sandy limestone, and calcareous sandstone (Milici et al., 1979). The Hartselle continues northward into south-central Kentucky, and is replaced eastward in Kentucky by the Newman Limestone; it is correlative with the Hardinsburg Sandstone of west-central and western Kentucky (Rice et al., 1979).

The Hartselle Formation continues southwestward from areas of outcrop in eastern Tishomingo County (Plate 1, sheet 2) and attains a maximum known county-wide thickness of 64 feet in the shallow subsurface of southwestern Tishomingo County (Plate 4). The Hartselle Formation grades westward into the Floyd Shale in eastern portions of Itawamba County, Mississippi, and thickens eastward to a maximum of 175 feet in the subsurface of Franklin County, Alabama (Welch, 1959). The westernmost limit of occurrences of the Hartselle Formation in the subsurface of northeastern Mississippi can thus be estimated to extend westward in the subsurface of northeastern Itawamba, southwestern Tishomingo, and eastern Prentiss counties.

The essentially flat-lying sandstone beds comprising the Hartselle Formation are gently folded locally, and the strike and dip vary accordingly. Regional strike of the Hartselle Formation is about N. 70° W., and dip is to the southwest at less than 1/2°, rarely exceeding 50 feet per mile in Tishomingo County.

The Hartselle Formation occurs at the surface of southeastern Tishomingo County in a narrow belt of exposures along Bear Creek and Cedar Creek valleys. Isolated occurrences of the Hartselle Formation occupy stream beds and lowermost valley walls of the upper reaches of McDougal Branch and Perry Branch, and intermittent exposures occur along the stream beds and valley walls of Jourdan Creek, Berry Branch, and Rock Creek in southwestern Tishomingo County. The Hartselle Formation is exposed on the south side of Bay Springs Dam, but floodwaters of Pickwick Lake cover exposures reported in Morse (1930), which are located north of the present dam site in Mackeys Creek valley.

Blocks of sandstone that occur in the uppermost reaches of Mingo Branch (NE/4, SE/4, NW/4, Sec. 29, T.5S., R.11E.) and in the stream bed of Rock Creek (NE/4, SW/4, SW/4, Sec. 11, T.7S., R.9E) represent the northeastern and southwestern limits (respectively) of occurrences of the Hartselle Formation at the surface of Tishomingo County. These exposures are too small in areal extent to appear on the surface map. The most spectacular exposures of the cliff-forming Hartselle sandstones occupy steep valley walls along portions of Bear Creek and Cedar Creek and their tributaries.

The Hartselle Formation occupies uppermost portions of a southwest trending Paleozoic ridge preserved at the surface and in the shallow sub-surface of southern Tishomingo County (Plate 5). To the northwest and southeast of this ridge the Hartselle is truncated by the Tuscaloosa Group. Where the Tuscaloosa is absent over the ridge in the vicinity of Horseshoe Bend on Bear Creek the Hartselle is overlain by the McShan Formation. The southwest extension of this Mississippian ridge across southern Tishomingo County is manifested at the surface by the presence of Hartselle sandstones in the stream valleys of Perry Branch, Jourdan Creek, Rock Creek, and Mackeys Creek (Plate 1, sheet 2). The sharp bends in the course of Bear Creek are the result of initial downcutting of the stream along planes of weakness afforded by the joint system developed in the Hartselle sandstones, and the subsequent deep incisement of Bear Creek within steep rock valley walls in areas where the stream course intersects the sedimentary rocks comprising uppermost portions of the Paleozoic ridge. Main fractures in the joint system trend N. 50° W. and N. 45° E., with local variations of up to ± 10°. Structural control of the course of Bear Creek by the joint system present in the sedimentary rocks of the Hartselle and Pride Mountain formations is most apparent along portions of Bear Creek located between the NE/4 of Sec. 25, T.5S., R.10E., and the NE/4, Sec. 13, T.6S., R.10E. (Plate 1, sheet 2). The main legs of each bend of Bear Creek along this portion of its course are parallel to a direction of fracture in the Hartselle Formation.

The contact of the Hartselle Formation with the underlying Pride Mountain Formation occurs as a very sharp lithologic boundary between upper Pride Mountain shales and lowermost sandstone beds in the Hartselle Formation (Figure 58). The contact is slightly undulatory locally, and appears to be erosional in surface exposures (Figure 59), although the lithologic boundary between the units is greatly enhanced by weathering in outcrop. No basal conglomeratic zones were observed during the course of fieldwork concerning the present study. Although the lithologic boundary between the Hartselle and Pride Mountain formations is very abrupt and often undulatory in outcrop, the contact probably does not span large intervals of time. The abrupt lithologic boundary is probably the result of brief periods of erosion or nondeposition (hiatus) between changing depositional environments in this region. The contact is unconformable locally, in western portions of east-neighboring Colbert County, but is generally considered to be conformable elsewhere in northwestern Alabama (Welch, 1959). Continuous core samples collected from test wells drilled in southwestern Tishomingo County during foundation studies regarding Bay Springs Dam show the contact of the Hartselle Formation and underlying shales in the upper Pride Mountain Formation as gradational through a thin interval of interlaminated sandstone, siltstone, and shale, similar in appearance and lithologies to the contact interval shown in Figure 58. Other exposures in eastern portions of the county show the contact to be erosional (Figure 59).

The Hartselle Formation is asphaltic along portions of the outcrop belt located between Hartselle and Littleville, Colbert County, Alabama (Welch, 1958) and in the subsurface of adjacent areas in northern Alabama (Beavers and Boone, 1976). Hartselle outcrops observed in Tishomingo County during the present study consist primarily of very clean quartz arenites with few impurities; petroliferous residue is rarely preserved in exposures or subsurface samples observed during this study. Hartselle sandstones are highly leached where overlain by Tuscaloosa fluvial sediments in Tishomingo County. Petroliferous sandstones in the

Figure 58 - Abrupt lithologic boundary between sandy shales of the uppermost Pride Mountain Formation and lowermost Hartselle sandstone beds. Scale in feet. Location: NE/4, NE/4, NE/4, Sec. 31, T.5S., R.11E.

Hartselle Formation are generally restricted to areas of northwestern Alabama, where the Hartselle is preserved below the Bangor Limestone.

The Hartselle Formation is composed of fine- to medium-grained sandstone, with occasional intervals of coarse-grained sandstone, rare quartz granules, and small pebbles. The sandstones are generally very light-gray to white when fresh (such as in recent quarry excavations) and weather to various shades of gray and brown. Locally, the sandstones are green, pink, purple, or grayish orange in fresh exposures. Intervals of varicolored (light-gray, green, pink, etc.) sandstones excavated during construction of Bay Springs Lock and Dam are utilized as riprap at the dam site. Purple sandstones occur locally in the sandstone quarry located in SE/4, NW/4, NE/4, Sec. 7, T.6S., R.11E. The sandstones are primarily thin- to medium-bedded (3 inches to 2 feet thick), with frequent intervals of thick-bedded (3 to 5 feet thick) sandstones that stand out as ledges and small cliffs (Figure 60). Individual beds within the thick-bedded sandstone intervals often appear homogeneous or massive in outcrop. Weathering enhances the bedding characteristics (where bedding is present), and very thin cross-bedding, ripple bedding and laminations within the thick sandstone beds stand out in local relief. Figure 61 illustrates the outcrop appearance of a thick-bedded (up to 4 feet thick) sandstone interval, in which each bed contains an upward gradation from thinly cross-bedded to laminated and ripple laminated, fine-grained sandstones. The Hartselle Formation frequently contains intervals of very thinly interbedded and interlaminated sandstone, siltstone, and shale. A persistent, 8 to 10 foot-thick interval of interbedded and interlaminated sandstone, silt-

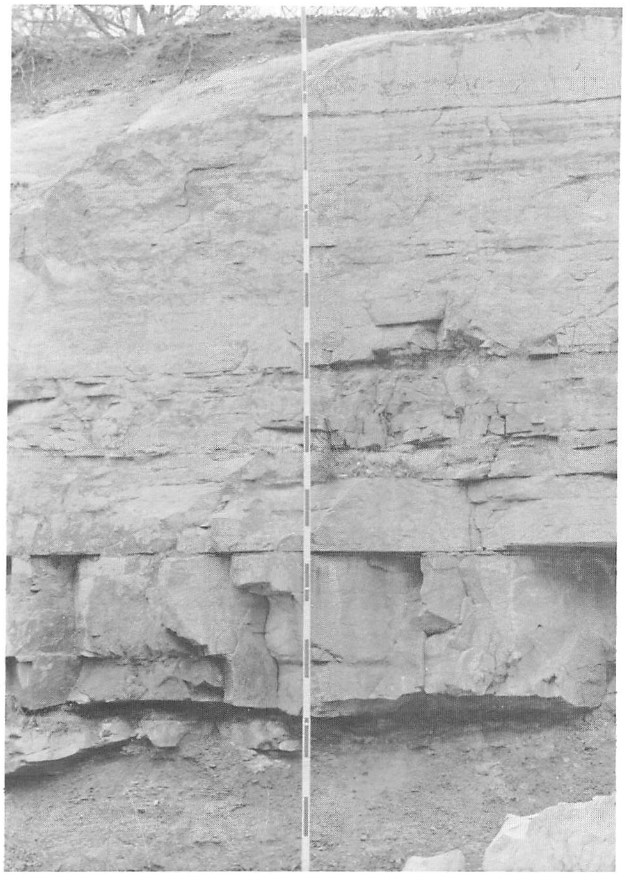


Figure 59 - Silica-cemented, fine- to medium-grained, horizontally bedded quartz sandstone (quartz arenite) of the Hartselle Formation in outcrop. The contact with the underlying Pride Mountain shales is abrupt, and slightly undulatory at this locality. Uppermost erosional surface of the Hartselle sandstone is overlain by quartzite-bearing, high elevation fluvial terrace gravels at this locality. Scale in feet. Location: NE/4, NE/4, SW/4, Sec. 30, T.5S., R.11E.

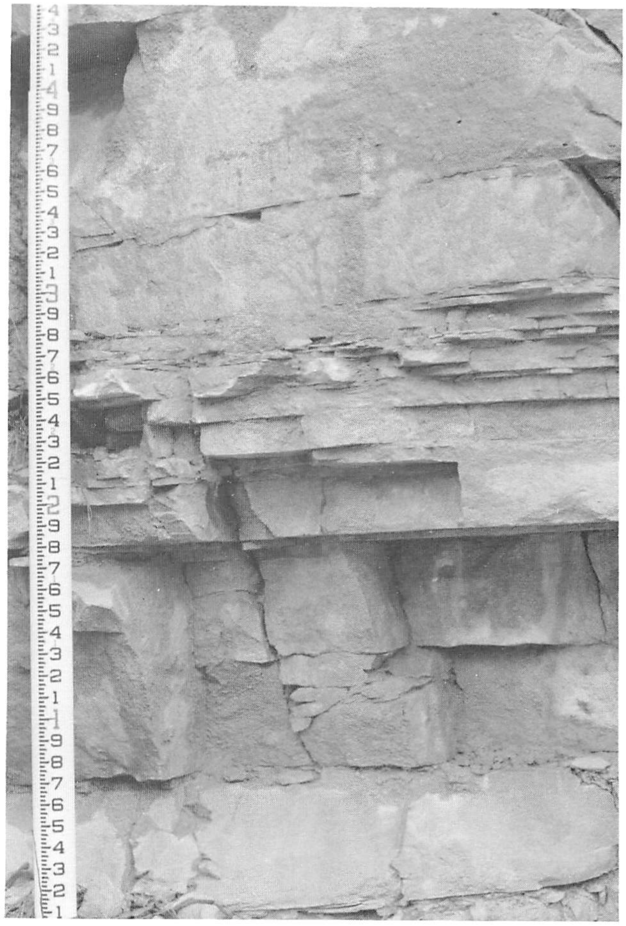


Figure 60 - Thin- to medium-bedded sandstone interval in lower portions of the Hartselle Formation. Scale in feet and 0.1 foot increments. Location: NE/4, NE/4, SW/4, Sec. 30, T.5S., R.11E.

stone, and shale occurs in central portions of the sequence of medium-bedded sandstones of the Hartselle Formation in southwestern Tishomingo County. This shaly interval occurs in exposures along the Tennessee-Tombigbee Waterway, immediately downstream from (south of) Bay Springs Dam (Figure 62).

The Hartselle Formation is fossiliferous locally. Morse (1930) reported local occurrences of crinoid stem fragments, bryozoans, brachiopods, bivalves, and gastropods, preserved as impressions in the sandstones. Fossil molds and casts in the sandstones are, in general, very faint and poorly preserved. Figure 63 illustrates a fossiliferous zone preserved in a lowermost interval of the Hartselle Formation, exposed on the north side of Bear Creek valley in Horseshoe Bend, NW/4, NE/4, NE/4, Sec. 31, T.5S., R.11E. Trace fossils, which probably represent burrowing activities of annelids, are frequently preserved along bedding planes as irregular, tubular trails (Figure 64). Plant remains, in the form of faint, indistinct leaf impressions and molds of tree trunks, are occasionally preserved in Hartselle sandstones. Figure 65 illustrates a well preserved log of the ancient scale tree *Lepidodendron* sp., exposed in the small sandstone quarry in the SE/4, NW/4, NE/4, Sec. 7, T.6S., R.11E.

Sandstone comprising the Hartselle Formation is an excellent building stone and is utilized extensively in the construction of buildings and houses (Figure 66). Several small sandstone quarries locally produce building stone in Tishomingo County. The sandstones are less weathered where protected by overlying Coastal Plain sediments, in areas adjacent to the main Hartselle outcrop belt. The potential resource of the Hartselle sandstone sequence of Tishomingo County as a building stone was initially reported in Logan (1911). Morse (1935) described various stone cutting and building techniques utilized in the construction of stone structures from sandstone locally quarried from the Hartselle Formation. Many houses in Tishomingo County are constructed of the very durable and beautiful sandstones locally excavated from small quarries in the Hartselle Formation located along Bear Creek valley.

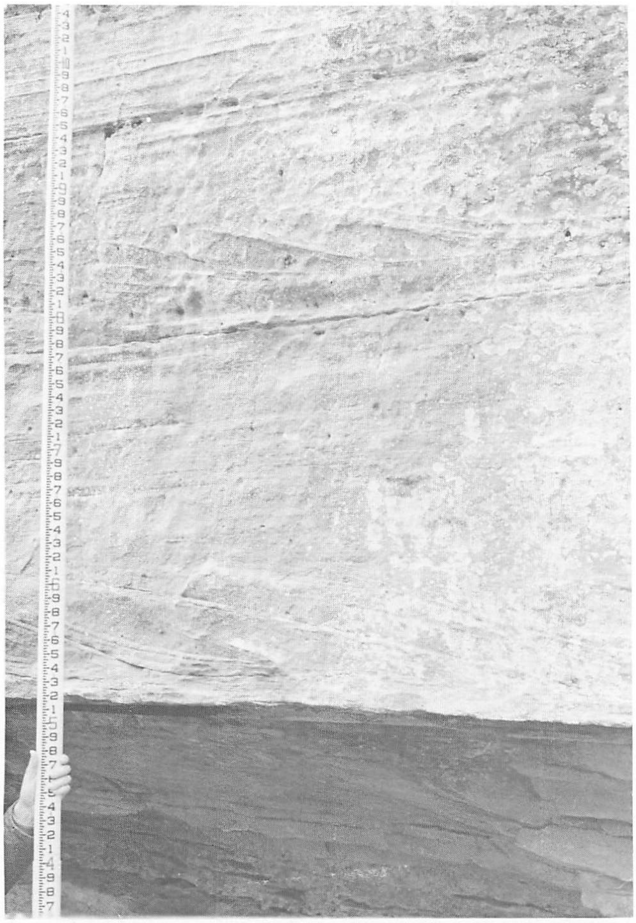


Figure 61 - Hartselle sandstone beds at this locality are 1 to 3 feet thick, and contain upward gradations from cross-bedded to laminated and ripple laminated sandstones. Scale in feet and 0.1 foot increments. Location: NW/4, NE/4, NE/4, Sec. 31, T.5S., R.11E.

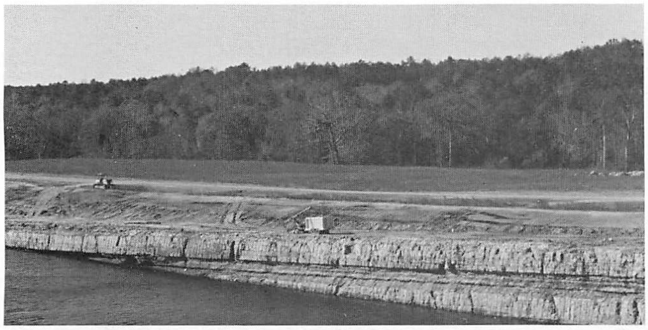


Figure 62 - Thinly interbedded and interlaminated sandstones, siltstones, and shales separate intervals of medium- to thick-bedded sandstones in the Hartselle Formation in southwestern-most Tishomingo County. Location: NE/4, NW/4, NW/4, Sec. 35, T.6S., R.9E.

Figure 63 - Fossil impressions of brachiopods, bivalves, and other forms preserved in a lowermost interval of the Hartselle Formation. Quarter for scale. Location: NW/4, NE/4, NE/4, Sec. 31, T.5S., R.11E.

Figure 64 - Trace fossils occur frequently along bedding planes in the Hartselle sandstones. This form probably represents the trail of an annelid. Quarter for scale. Location: small sandstone quarry in SE/4, NW/4, NE/4, Sec. 7, T.6S., R.11E.

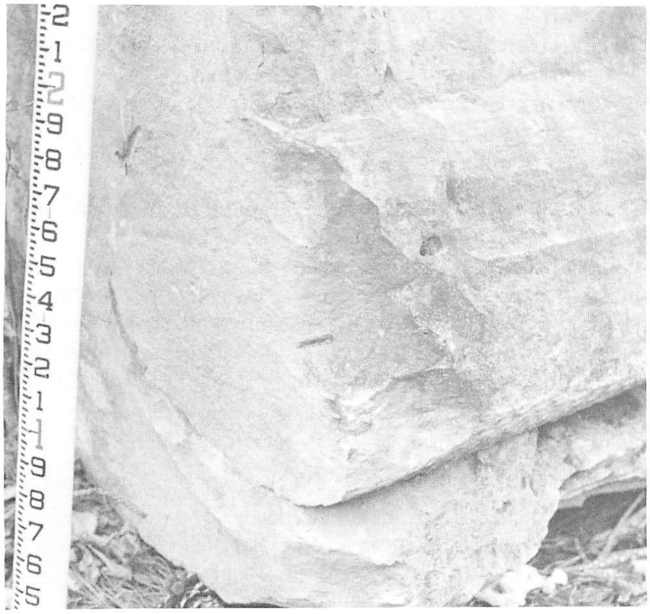


Figure 65 - Trunk of the ancient tree *Lepidodendron* sp. preserved in the Hartselle sandstone. Scale in feet and 0.1 foot increments. Location: SE/4, NW/4, NE/4, Sec. 7, T.6S., R.11E.

Figure 66 - Main office and museum at Tishomingo State Park constructed from the Hartselle sandstone. Location: NE/4, SW/4, NE/4, Sec. 31, T.5S., R.11E.

MESOZOIC ERATHEM

CRETACEOUS SYSTEM

UPPER CRETACEOUS

Tuscaloosa Group

The Tuscaloosa Group is the basal unit of the Coastal Plain sequence in Tishomingo County. The original reference to the Tuscaloosa (included in the Eutaw Group of Hilgard, 1860) assigned formational rank to pre-Eutaw, Upper Cretaceous strata exposed along the banks of the Black Warrior River near the town of Tuscaloosa, Alabama (Smith and Johnson, 1887). Stephenson (1914) correlated the Tuscaloosa in Mississippi and Alabama, and recognized the Tuscaloosa as a formation. McGlothlin (1944) recognized four distinct lithologic units, with the uppermost two units separated by a major unconformity. This classification defined the Tuscaloosa as consisting of a lower formation that is subdivided into three lithologies and an upper conglomeratic formation, although no formation names were proposed in that study.

The Tuscaloosa was assigned group rank and divided into the Cottondale, Eoline, Coker, and Gordo formations by Conant and Monroe (1945) and Monroe et al. (1946) (Figure 67). Unconformably overlying strata previously considered uppermost Tuscaloosa (Stephenson and Monroe, 1940) or lowermost Eutaw (McGlothlin, 1944) were included in the McShan Formation (Monroe et al., 1946). According to this classification, lower Tuscaloosa strata (the Cottondale and Eoline formations) are, at least in part, marine in origin and the overlying Coker and Gordo formations are considered to be of continental origin. The Gordo is the only formation in the Tuscaloosa Group to contain large thicknesses of gravel (Monroe et al., 1946).

Marcher and Stearns (1962) divided the Tuscaloosa lithologies into western and eastern facies, based on occurrences in Tennessee. The differing Tuscaloosa lithologies are a result of differing source areas and modes of transport. Prior to and during Tuscaloosa deposition, the Pascola Arch extended across areas presently occupied by the Mississippi Embayment (Stearns and Marcher, 1962). The sediments comprising the western Tuscaloosa lithofacies consist primarily of Devonian and Mississippian age cherts with occasional sandstone pebbles. These clastics were derived both locally (Fort Payne chert) and from bedrock comprising the Pascola Arch, which contributed Devonian age (Camden) chert and Cambrian or Ordovician age sandstones and frosted quartz. The poorly sorted chert gravels of the western facies grade eastward into, and interfinger with, the well-sorted chert and quartz-bearing (vein quartz and quartzite) gravels characteristic of the eastern Tuscaloosa facies in Tennessee (Marcher and Stearns, 1962). Possible sources of sediments comprising the eastern Tuscaloosa facies include Pennsylvanian bedrock in the Appalachian Plateau to the east, the southern Illinois Basin to the north, and the Black Warrior Basin to the southeast. The distribution and exotic lithologies of the eastern facies indicate that longshore currents may have transported and winnowed these sediments (Marcher and Stearns, 1962). Russell (1987) described two major late Cretaceous stream systems that transported Tuscaloosa gravels into northeastern Mississippi: a system of southeast flowing streams that contributed chert gravels and a southwest flowing system that contributed quartz sand and quartzite pebbles, in addition to chert.

Tuscaloosa exposures in Tishomingo County indicate that gravels that contain quartz sand and quartzite pebbles (eastern facies) occur at stratigraphically lower positions than quartz-free chert gravels characteristic of the western facies. The updip limit of gravels that contain a quartz sand matrix and rare quartzite pebbles occurs along a northeast-southwest line that passes north of Margerum, Alabama (Russell et al., 1983). These quartzite- and quartz-bearing gravels also occur west of Belmont in southern Tishomingo County, in the Rosebud and Rock Creek valleys.

All Cretaceous strata above the Paleozoic rocks and below the Eutaw Group are mapped and described in this report as the Tuscaloosa Group because strata previously included in the Gordo Formation as mapped in northeastern Mississippi, and adjacent areas in Alabama and Tennessee, are diachronous (Russell et al., 1983). Tuscaloosa gravels that underlie Tishomingo County are primarily composed of chert gravel, sand, and clay lithologies equivalent to the western lithofacies (Figure 68). An underlying sequence of quartz-bearing sands and gravels is exposed in southeastern portions of the county. Mineralogies of Tuscaloosa gravels in Tishomingo County indicate that the quartz (quartzite or vein quartz) bearing eastern lithofacies occupies lowermost portions of Tuscaloosa gravel sequences. The eastern lithofacies is generally less coarse than the larger chert pebbles and cobbles characteristic of the western lithofacies (Figure 69). Exposures of these Gordo equivalent gravels in Tishomingo County are limited to areas along the eastern county boundary south of U. S. Route 72, and areas occupied by Red Bud and Rock Creek valleys. The most instructive of exposures that reveal the boundary between the eastern and western Tuscaloosa facies occurs in a small gravel pit located in the Red Bud Creek valley in southernmost Tishomingo County (NE/4, NE/4, SW/4, Sec. 17, T.7S., R.10E.). Figure 69 shows the outcrop appearance of the facies boundary. Lenses and beds of quartz sand that occur below the interval shown in Figure 69 are also exposed one mile to the east of that locality (Figure 70).

The thickest of Tuscaloosa exposures in the Tishomingo County vicinity occurs in a gravel pit 1.5 miles east of the Mississippi-Alabama state line, about 0.2 mile south of U. S. Route 72 on the north side of Pennywinkle Creek valley in SE/4, Sec. 34, T.3S., R.15W. Pride Mountain shales in that vicinity are unconformably overlain by approximately 20 feet of quartz-bearing gravels in a quartz sand matrix, which are, in turn, overlain by approximately 185 feet of sand, clay, and chert gravel (western facies) lithologies characteristic of the majority of Tuscaloosa occurrences in Tishomingo County.

Tuscaloosa lithologies in east-central Tishomingo County include white to very light gray, silty, kaolinitic clay

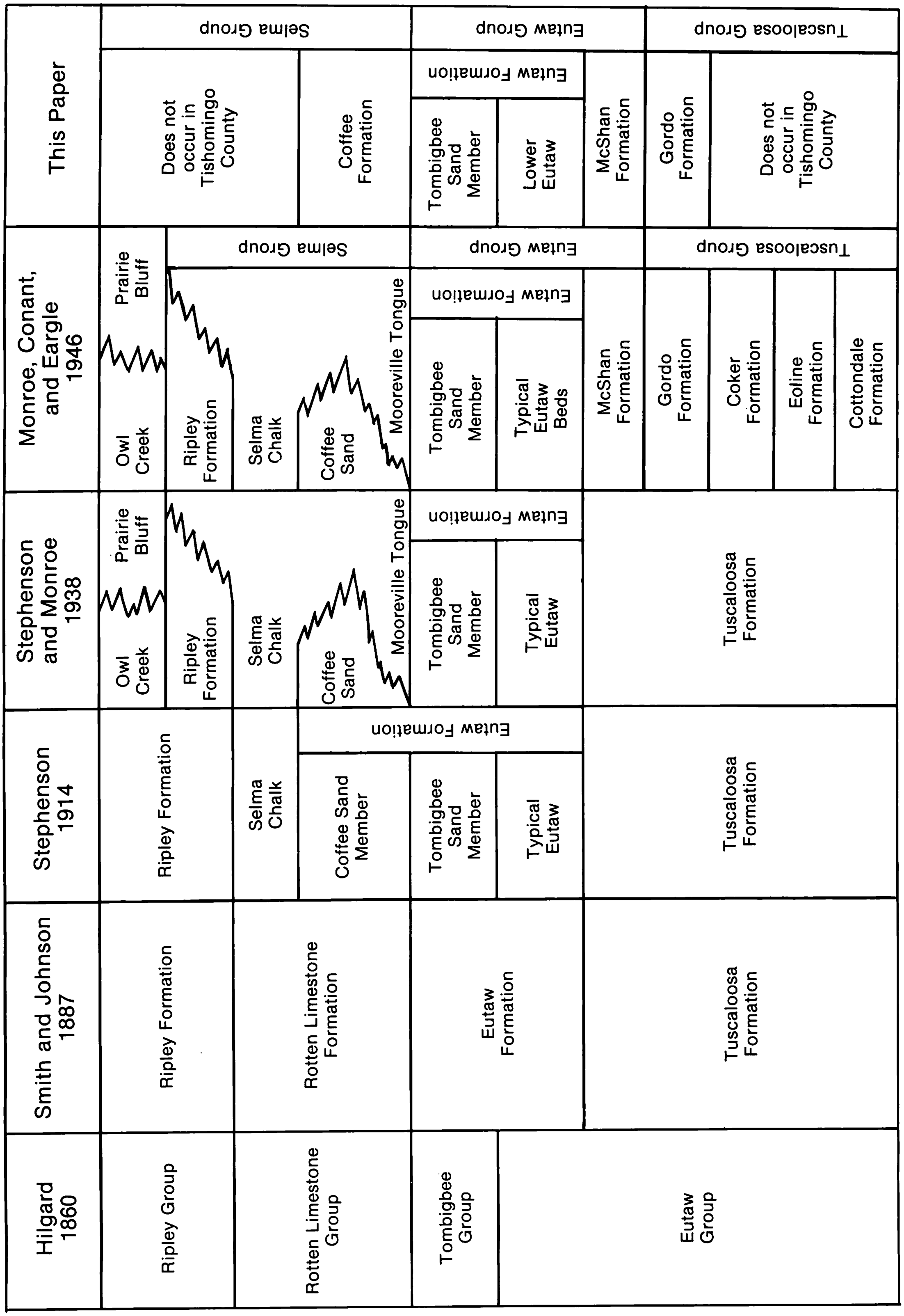


Figure 67 - Classifications utilized in earlier reports describing Upper Cretaceous strata in the Mississippi-Alabama region.

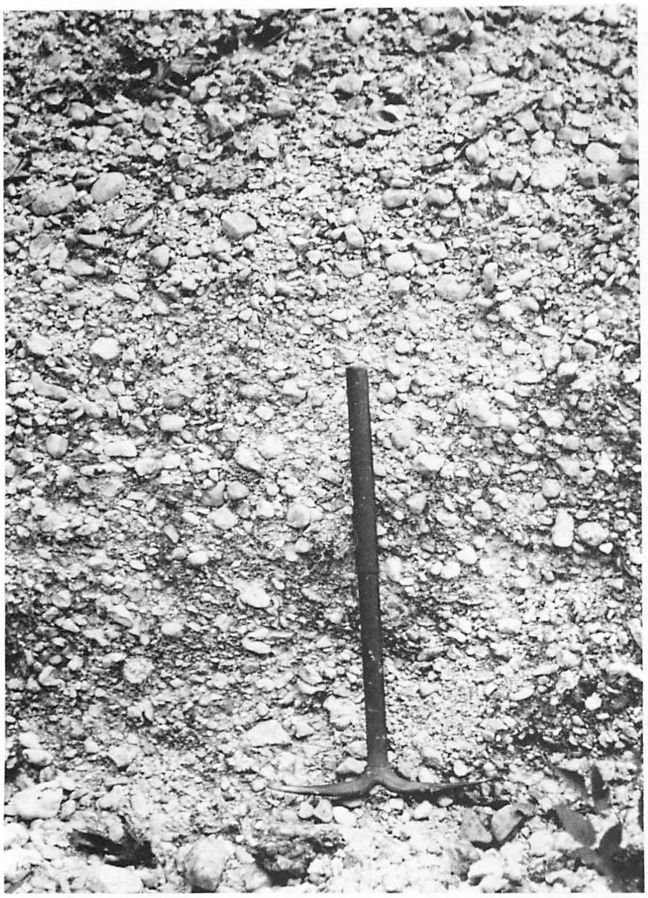


Figure 68 - General appearance of coarse Tuscaloosa chert gravel in outcrop. Larger chert cobbles in this area frequently exceed 5 inches in length. Pickax handle is 26 inches in length. Location: SW/4, SW/4, NW/4, Sec. 15, T.3S., R.11E.

lenses of variable thickness measuring less than 30 feet at any given exposure. Thinly interbedded and interlaminated marine sands and clays, typical of the McShan Formation, unconformably overlie upper Tuscaloosa clays in that area (Figure 71). The best exposures of this sequence begin on the north side of U. S. Route 72, 0.25 mile east of the Mississippi-Alabama state line in SE/4, SE/4, NW/4 of Sec. 33, T.3S., R.15W., Colbert County, and continue southward for 1.5 miles in Alabama, along the state line, along the secondary road across Pennywinkle Creek valley, where Tuscaloosa gravels unconformably overlie the Pride Mountain Formation. The north valley wall of Pennywinkle Creek, in NW/4, Sec. 4, T.4S., R.15W., Colbert County, marks the southern boundary of a Tuscaloosa fluvial channel that has cut down through and removed bedrock equivalent to the Pride Mountain strata presently preserved on the south valley wall of Pennywinkle Creek (SW/4, Sec. 4).

Occasional exposures of quartz-bearing (quartzite and vein quartz) Tuscaloosa gravels and sands are limited to southeastern and eastern portions of Tishomingo County. Exposed portions of the boundary between western and eastern Tuscaloosa lithofacies described by Russell et al. (1983) through southern Tishomingo County are exemplified by the exposure in the central portion of Section 17, T.7S., R.10E. (Figure 69). Here over 15 feet (basal portion not exposed) of horizontally bedded chert gravel in a predominantly medium-grained quartz sand matrix (eastern facies) are overlain by approximately 16 feet of irregularly bedded chert gravels in a predominantly silt and clay matrix, containing numerous thin, irregular, ferruginous cemented, chert pebble conglomeratic beds near the base (western facies). Tuscaloosa gravels at this locality (Figure 69) are unconformably overlain by 21 feet (exposed) of thinly interbedded sands and carbonaceous, silty clays characteristic of the McShan Formation in this area. Silt and clay lithologies similar to those that occur as lenses in uppermost Tuscaloosa exposures near Margerum, Alabama, occur here as matrix material in the uppermost chert gravels. Tuscaloosa clay lenses are limited in exposure primarily to easternmost Tishomingo County, and are replaced to the west by sands and gravels typical of the majority of the county-wide Tuscaloosa occurrences. A good example of these lithologic variations occurs in a gravel pit on the north side of Brown Creek valley (NE/4, Sec. 31, and NW/4, Sec. 32, T.2S., R.11E.), as white to very light gray, silty clay intervals are replaced laterally by sand and gravel lithologies (Figure 72) in which the silty kaolinitic clays that generally occur in lowermost and uppermost Tuscaloosa intervals occur as matrix material. These clays were derived from in situ clays developed on the underlying Paleozoic rocks. Mellen (1937) described the origin and distribution of these (Little Bear Residuum) clays. X-ray analyses of Tuscaloosa clays appear in the clay section of this report.

The Tuscaloosa Group unconformably overlies the Paleozoic sedimentary rocks (Figure 73). This highly irregular erosional surface is the boundary between the Highland Rim and East Gulf Coastal Plain Physiographic Sections, where exposed at the surface of Tishomingo County. Unusually large thicknesses of Tuscaloosa strata are preserved in paleovalleys, in which sequences of chert gravels interspersed with varying amounts of sand, silt, and clay exceed 300 feet (Figure 74). Isolated bodies of gravel, sand, and clay strata preserved in paleovalleys characterize the northern limit of Tuscaloosa occurrences in Tishomingo County.

The Geologic Map of Tishomingo County (Plate 1) illustrates the areal distribution of the Tuscaloosa Group where exposed at the surface in Tishomingo County, and Figure 74 is an isopach map giving thickness and updip limit of the Tuscaloosa Group in the subsurface. The Tuscaloosa Group is overlapped to the north by the Eutaw Group (Plate 1 and Figure 74). The Tuscaloosa Group is missing in areas of Tishomingo County where Paleozoic strata, occurring at relatively high elevations during deposition of Tuscaloosa sediments, are unconformably overlain by the Eutaw Group. These zones are shown by the areas of zero thickness illustrated in Figure 74. The Tuscaloosa often persists as only a few feet of chert gravel in a matrix of silt and clay in areas underlain by an elevated Paleozoic surface. An example of this can be seen in the uppermost reaches of McDougal Branch east of the town of Neil, where the roadcut in SE/4,

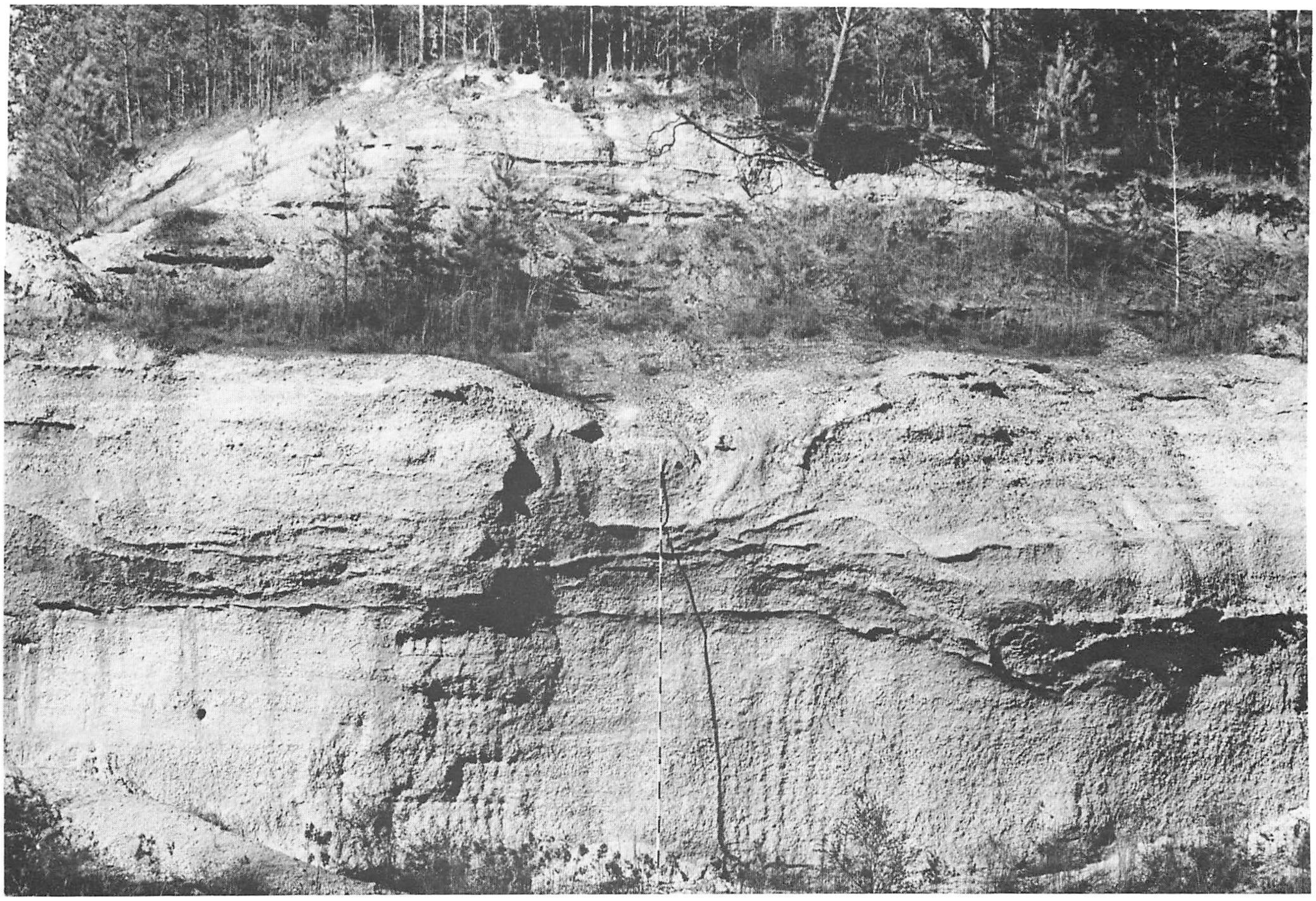


Figure 69 - The irregular boundary between the eastern (lower) and western facies of Tuscaloosa gravels. Thinly bedded marine sands and silty clays of the overlying McShan Formation occur above the terraced area 4 feet above the top of the pole. Pole is 25 feet high, scale in feet. Location: NE/4, NE/4, SW/4, Sec. 17, T.7S., R.10E.

Figure 70 - Eastern, quartz-bearing facies of the Tuscaloosa, exposed as massive quartz sand in lower portions, overlain by 3½ feet of small, well-rounded chert and flattened quartzite pebbles in a matrix of quartz sand. Scale in feet. Location: SE/4, SE/4, NW/4, Sec. 16, T.7S., R.10E.

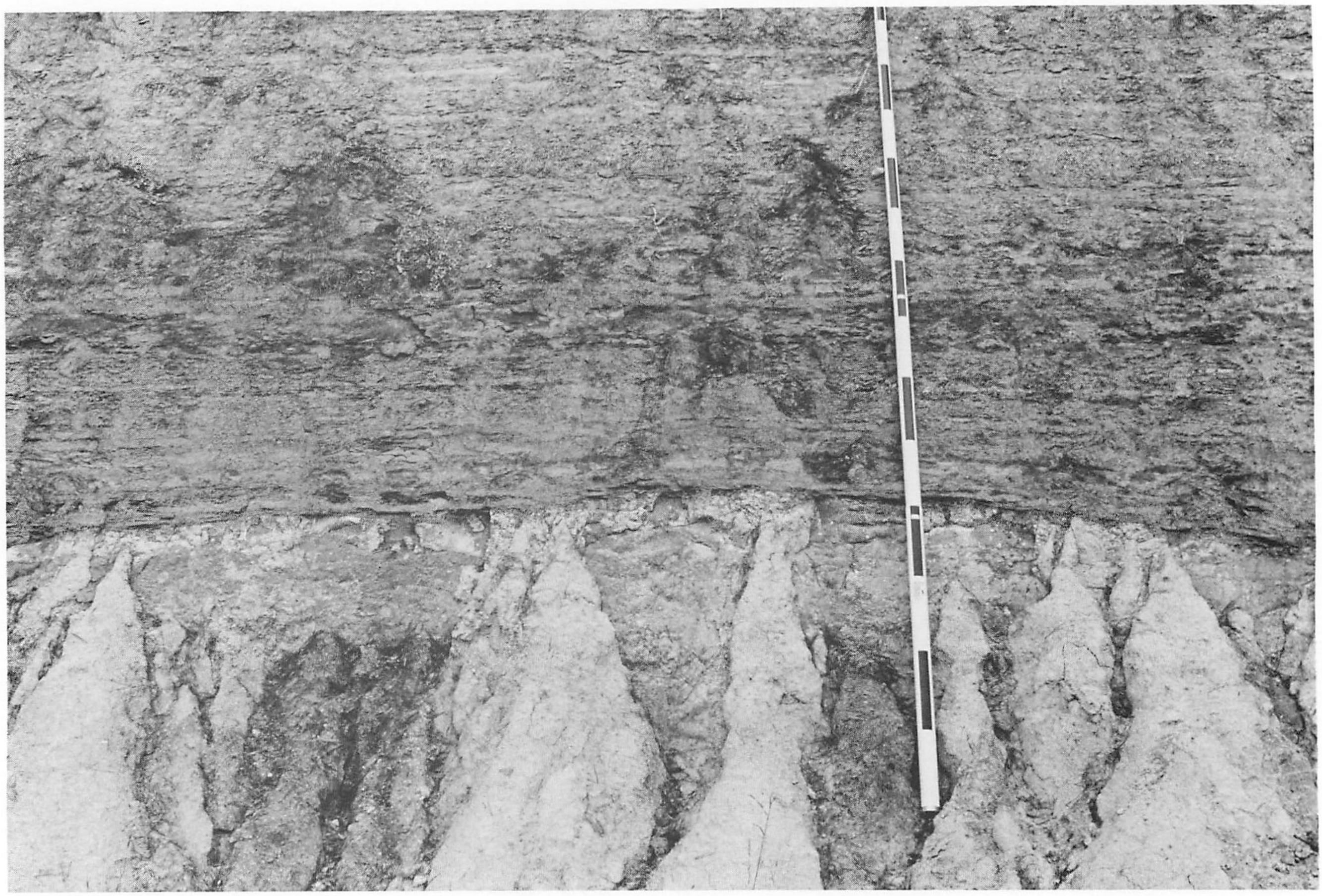


Figure 71 - Erosional contact between uppermost clays of the Tuscaloosa Group and the unconformably overlying horizontal and cross-bedded sands and silty clays of the McShan Formation. Scale in feet. Location: SE/4, SE/4, NW/4, Sec. 33, T.3S., R.15W.

SE/4, SE/4, Sec. 34, T.5S., R.10E., exposes 2 feet of chert gravel in a light-gray silt matrix separating the Hartselle sandstone from the McShan Formation. The Tuscaloosa is missing altogether in the vicinity of Highland Church, where a core hole drilled by the Bureau of Geology, file designation M.G.S.-1, located in the SE/4, NE/4, NE/4, Sec. 26, T.5S., R.10E., encountered 30 feet of McShan strata above the Hartselle Formation. The Tuscaloosa thickens to the north and south of areas underlain by this elevated Paleozoic surface as shown in Figure 74. Plate 5 illustrates the general distribution of ridges and depressions on the Paleozoic surface. Plates 2, 3, and 4 illustrate the subsurface relationship of Paleozoic strata with the overlying Tuscaloosa Group in cross section.

The Tuscaloosa Group attains a county-wide maximum thickness of 418 feet in the subsurface of west-central Tishomingo County, where the Paleozoic rock surface contains a large paleochannel system that opens to the west (Figure 74). Cross section A-A' (Plate 2) shows the subsurface stratigraphic profile across the deep fluvial valley. The east-west stratigraphic profile, which runs generally parallel to the axis of the depression or paleovalley floor, is illustrated on Plate 3. Test holes drilled by the U. S. Corps of Engineers in cooperation with the U. S. Geological Survey during ground-water investigations for the Tennessee-Tombigbee Waterway provide a great wealth of subsurface stratigraphic information about central Tishomingo County. The maximum county-wide Tuscaloosa thickness was encountered in Test Hole ME3-1, located in the NW/4, SE/4, NE/4, Sec. 13, T.4S., R.10E., where approximately 418 feet of chert gravel supported in the lower portions by a matrix composed predominantly of silt and clay overlie more than 60 feet of residual clays developed on Paleozoic strata. Clays of the lower interval gradually grade downward into unweathered limestones and cherts of the Tuscumbia Formation.

The boundary between Paleozoic bedrock and the overlying Tuscaloosa Group is generally masked in the subsurface in areas where residual clays are incorporated into lower Tuscaloosa beds. The outcrop pattern of the Little Bear Residuum (Mellen, 1937) follows that of the basal Tuscaloosa clay. This clay is exposed along the north side of Mill Creek valley and in roadcuts of the east-west trending road in the southernmost portions of Sections 9 and 10, T.3S., R.11E., where occasional lenses and thin, irregular chert gravel beds are supported in a clay matrix derived from the underlying

Figure 72 - Silty clays of the Tuscaloosa Group grade laterally into zones of chert gravel in which the silty clays are incorporated into the matrix. Pickax is 26 inches in length. Location: NW/4, NE/4, NE/4, Sec. 31, T.2S., R.11E.

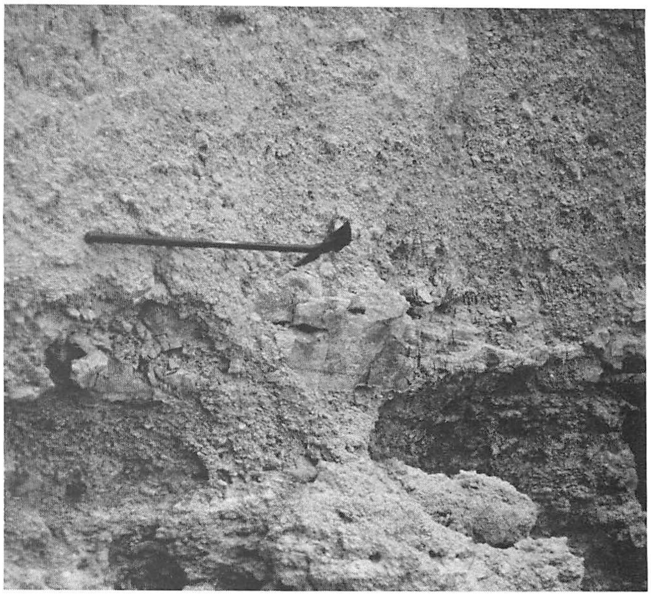


Figure 73 - Weathered chert in the Fort Payne Formation, unconformably over lain by slightly transported, subangular chert cobbles, intermixed with well-rounded chert pebbles, in a matrix of clay and sand. Angular chert and clay was derived locally, and reworked into fluvial gravels transported by Tuscaloosa fluvial systems. Pickax, 26 inches in length, is at the contact. Location: NE/4, SE/4, NE/4, Sec. 4, T.3S., R.15W.

Little Bear Residuum described in this area by Mellen (1937). More than 400 feet of leached bedrock, composed of varying percentages of clay, silt, and angular chert fragments, occur below a buried Tuscaloosa paleochannel in northern Tishomingo County. A core hole profile drilled during geologic investigations regarding the T.V.A. Yellow Creek Nuclear Power Plant located the channel, which is composed of approximately 140 feet of chert gravels, clays, and sands, in the vicinity of Goat Island Marina. The westward extension of this paleochannel was indicated by test hole data reported by Boswell and Wasson (1974), wherein an isolated gravel sequence occurred 130 feet lower than expected in Test Well 5. Figure 74 illustrates the configuration of this paleochannel as indicated by outcrop and subsurface data. The maximum depth and areal distribution of the paleochannel can only be generally determined with existing data. It is unlikely that the above mentioned test holes penetrated the absolute maximum thickness (axis) of the buried channel(s). These gravels, in addition to thin, isolated surface exposures to the east, generally constitute the northward limit of Tuscaloosa occurrences within Tishomingo County. The Tuscaloosa Group continues westward in the subsurface of Alcorn and Prentiss counties. Parks et al. (1960) reported a thickness of 87 feet of Tuscaloosa strata from the subsurface of Prentiss County. The Tuscaloosa Group is estimated to be about 200 feet thick to the south in adjacent Itawamba County (Vestal and Knollman, 1947). To the east in neighboring Alabama, the Tuscaloosa Group attains a maximum thickness of 170 feet in Lauderdale County (Harris, Peace, and Harris, 1963) and, to the south, 100+ feet in Colbert County (Harris, Moore, and West, 1963). The Tuscaloosa continues eastward across Alabama and into Georgia.

Much thicker occurrences of Tuscaloosa strata occur to the south in the subsurface of Mississippi and Alabama where the Cottondale, Eoline, and Coker formations, not divisible at the surface in Tishomingo County, occur below the Gordo Formation. Eargle (1946) described the Tuscaloosa Group in the subsurface of Neshoba, Kemper, and Lauderdale counties, Mississippi, northeastward to Tuscaloosa County, Alabama. The thickest Tuscaloosa sequence penetrated along this (Eargle, 1946) line of section occurs in the subsurface of Lauderdale County, where the Magnolia Petroleum Company-Culpepper Number 1 well penetrated a 1348-foot sequence of Tuscaloosa strata, comprising the Cottondale, Eoline, Coker, and Gordo formations. The Tuscaloosa Group is represented at the surface of Tishomingo County by strata that are lithologically (not necessarily time stratigraphically) equivalent to the Gordo Formation as described by Eargle (1946). Isolated pockets of olive-green clays, occasionally interlaminated with micaceous, glauconitic sands, occur in depressions in the uppermost Tuscumbia limestone beds exposed in the quarry in SE/4, Sec. 21, and SW/4, Sec.

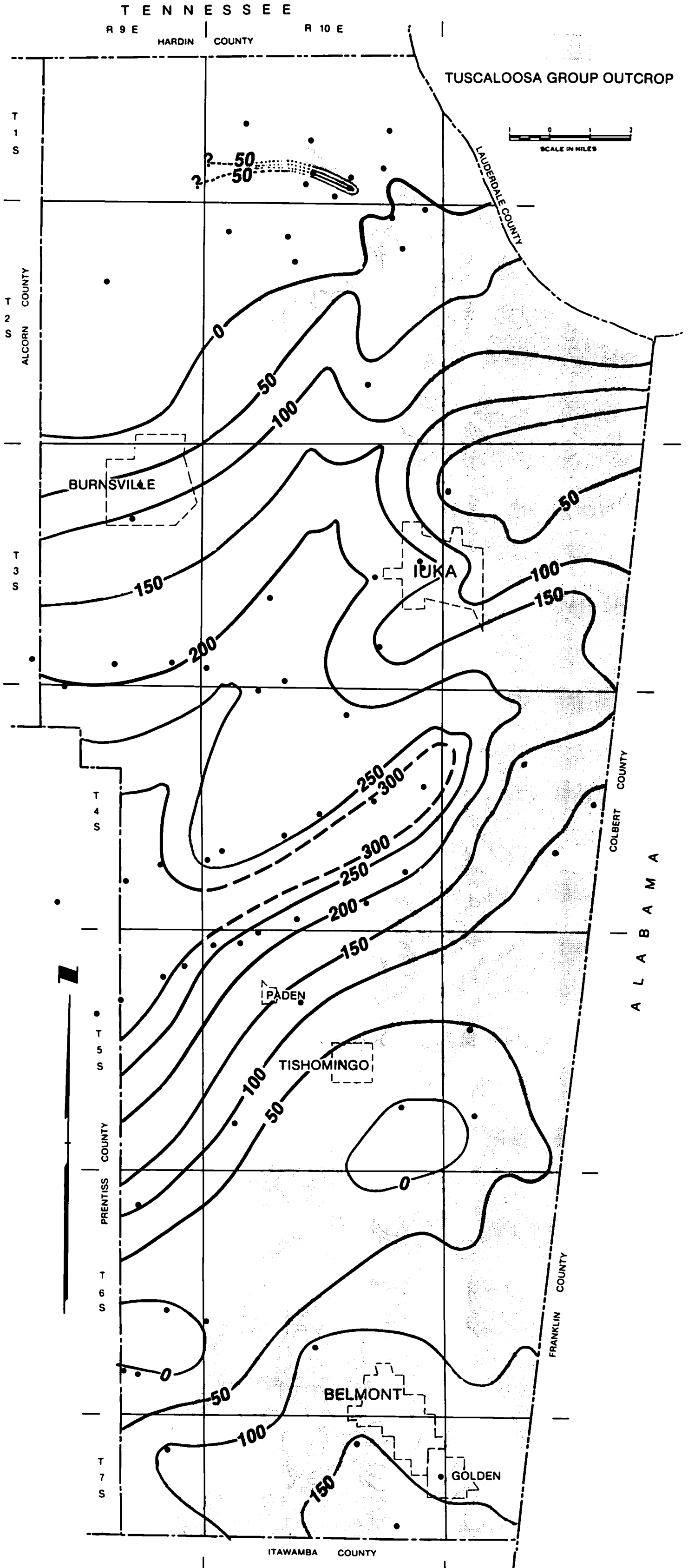


Figure 74 - Isopach map of the Tuscaloosa Group in Tishomingo County. Tuscaloosa outcrop is shown by the shaded area. Contour interval is 50 feet.

22, T.4S., R.11E., and probably represent a marine phase of the Tuscaloosa. Fluvial, nonmarine gravels, sands, and clays characterize the remainder of Tuscaloosa occurrences in Tishomingo County.

The Tuscaloosa is absent in test holes AP-1, 2, and 3, where Eutaw strata disconformably overlie Paleozoic rocks (Plate 1). Figure 75 illustrates the distribution of the Tuscaloosa Group at the surface and in the subsurface of Tishomingo County. Plate 1 illustrates the Tuscaloosa outcrop in detail. The strike of Tuscaloosa strata trends generally north-south with minor variations. Slight variations in strike occur in west-central Tishomingo County, where thick accumulations of Tuscaloosa gravels, sands, and clays fill a deep westward opening paleovalley or depression on the top of the Paleozoic rocks (Plate 5). The dip of Tuscaloosa strata is generally 28 to 30 feet per mile, although local variations in dip range from nearly horizontal to almost 40 feet per mile to the west. Cross section A-A' (Plate 2) illustrates the subsurface profile of the Tuscaloosa Group along strike. Cross section B-B' is generally parallel to dip (Plate 3). Cross section A'-B' crosses Tishomingo County at oblique angles with respect to strike and dip (Plate 4). These sections illustrate the highly variable structural characteristics, and the influence of the underlying Paleozoic surface upon the thickness of the Tuscaloosa sediments locally. Variations in strike determinations are probably partially due to local relief on the upper Tuscaloosa surface, upon which the McShan Formation rests unconformably (Figure 75).

Tuscaloosa surface exposure occurs as a belt, about 7 miles wide, and trending northeast-southwest (Plate 1). Surface exposures consist mainly of chert gravels in a silty, clayey sand matrix. Frequently, clays occurring in the matrix coat the gravels and impart a bleached appearance in outcrop (Figure 72). The only fossil occurrences (Berry, 1919, p. 14) reported from the Tuscaloosa are leaf impressions in lignitic and amber-bearing clays exposed in a cut of Southern Railway 1-5/8 miles southeast of Iuka. Stephenson and Monroe (1940, p. 43) determined that these beds comprise lowermost Eutaw strata. The McShan Formation was not recognized as a separate geologic unit prior to Conant and Monroe (1945).

Stephenson and Monroe (1940) reported discontinuous zones in the Tuscaloosa that contain thin intervals of carbonaceous clays in eastern Tishomingo County. These zones can be seen in exposures along the north side of Lee Highway, in NE/4, Sec. 2, T.4S., R.11E. Occurrences of silty clay, which are in general replaced laterally by gravels and sands, are more numerous in western Alabama than in eastern Tishomingo County. Figure 76 illustrates a local occurrence of silty clays separated from overlying, chert gravel conglomerate by a sharp, local, erosional contact, delineating the base of a Tuscaloosa fluvial channel. The sandy and silty clays in the lowermost portions of Figure 76 grade westward into sands and gravels. Figure 68 illustrates the general outcrop appearance of coarse lower Tuscaloosa gravel in Tishomingo County. An overall fining upward trend is indicated by the increasing frequency of occurrences of cross-bedded sands higher in the fluvial sequence (Figure 77). Uppermost Tuscaloosa intervals exposed in easternmost Tishomingo County consist of silty clays as shown in Figure 71. Tuscaloosa clays are replaced by sand and gravel lithologies in southwestern Tishomingo County (Figure 69). The various lithologies that occur in Tuscaloosa fluvial sequences are described in a composite section shown in Figure 78, which begins in westernmost Colbert County, Alabama, (location of Figure 71) in SE/4, SE/4, NW/4, Sec. 33, T.3S., R.15W., and terminates in easternmost Tishomingo County, SW/4, NW/4, SW/4, Sec. 35, T.3S., R.11E., in the Clear Creek flood plain. The Tuscaloosa Group is unconformably overlain by the McShan Formation, and the contact is described in Figures 78 and 79. Figure 79 describes the lithologies shown in Figure 69, in measured section.

Eutaw Group

The Eutaw Group was named after the town of Eutaw, Alabama, and defined to include all strata between the Paleozoic rocks and the Tombigbee Sand Group in Hilgard (1860). Smith and Johnson (1887) assigned lowermost gravels and sands of Hilgard's (1860) Eutaw Group to the Tuscaloosa Formation, and included strata comprising the Tombigbee Sand Group of Hilgard (1860) in the Eutaw Formation (Figure 67). Safford (1864) defined the Coffee sand in Tennessee as correlative with lower portions of the Eutaw in Mississippi. Stephenson (1914) defined the Coffee sand of Safford (1864) as the uppermost member of the Eutaw Formation, and defined the Tombigbee Sand Member to include all strata between the Coffee Sand Member and lower Eutaw. Stephenson and Monroe (1938) placed the Coffee sand at the base of the Selma Chalk, and retained the Tombigbee Sand Member as the uppermost unit of the Eutaw Formation. As the Eutaw passed from group to formational rank (Smith and Johnson, 1887), no new group name was proposed. Subsequent subdivision of the Eutaw Formation into members (Stephenson, 1914, and Stephenson and Monroe, 1938) assigned the name Typical Eutaw Beds to strata comprising lower portions of the Eutaw Formation below the Tombigbee Sand Member. The term Eutaw has been retained in the literature as a group, formation, and member designation. In the absence of new nomenclature concerning the Eutaw, the name is utilized in this report as defined in Stephenson and Monroe (1938 and 1940), as Eutaw Group, Formation, and Member designations.

Laminated sands and clays comprising the McShan Formation, included in the Tuscaloosa Formation of Stephenson and Monroe (1940) and in the Eutaw Formation of Smith and Johnson (1887), were described as a separate formation by Conant and Monroe (1945) to include strata above the Tuscaloosa and below the Eutaw Formation. The McShan Formation is the lowermost unit of the Eutaw Group, and is separated from the underlying Tuscaloosa Group by a major unconformity. The Eutaw Group extends to the base of the overlying Selma Group, represented in Tishomingo County by the Coffee Formation. Figure 67 illustrates the stratigraphic nomenclature and vertical distribution of units

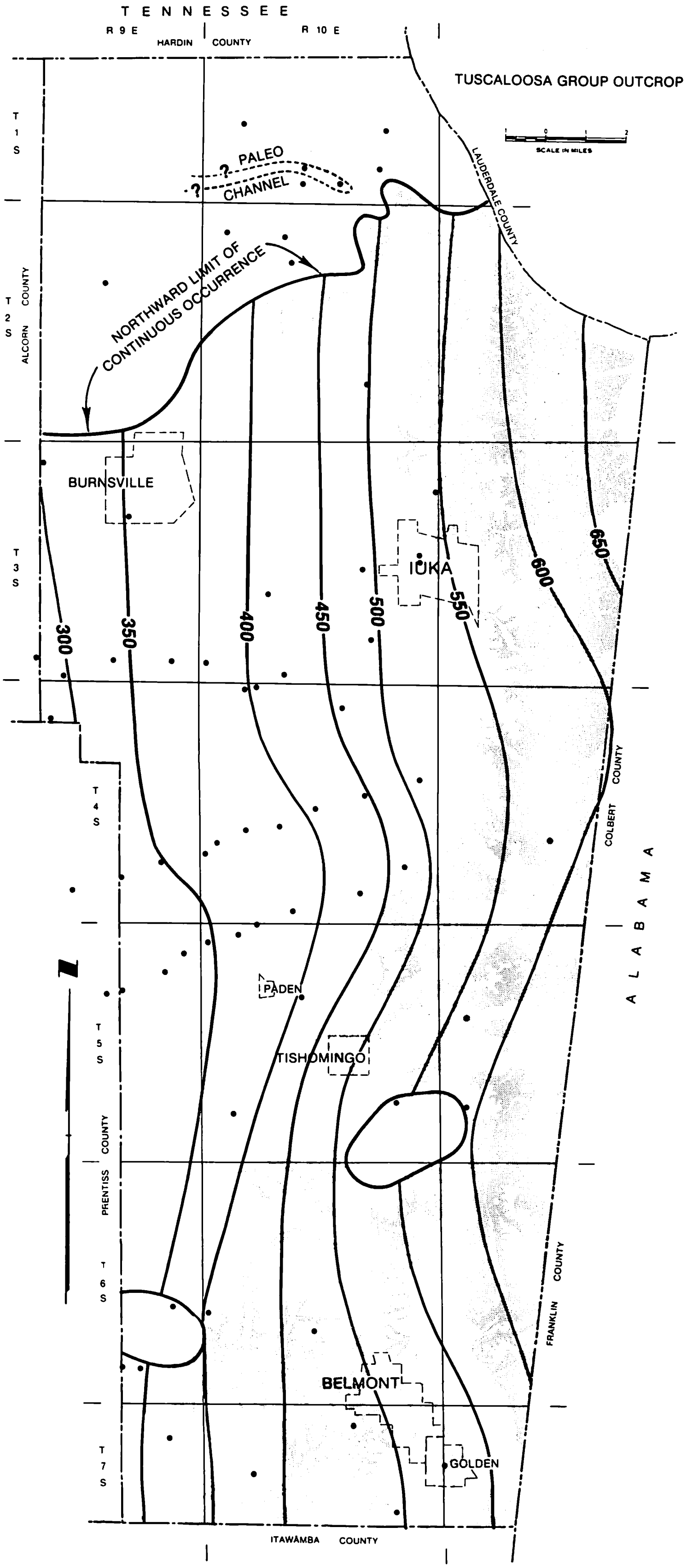


Figure 75 - Structure contours, datum top of Tuscaloosa Group, Tishomingo County. Contour interval is 50 feet.

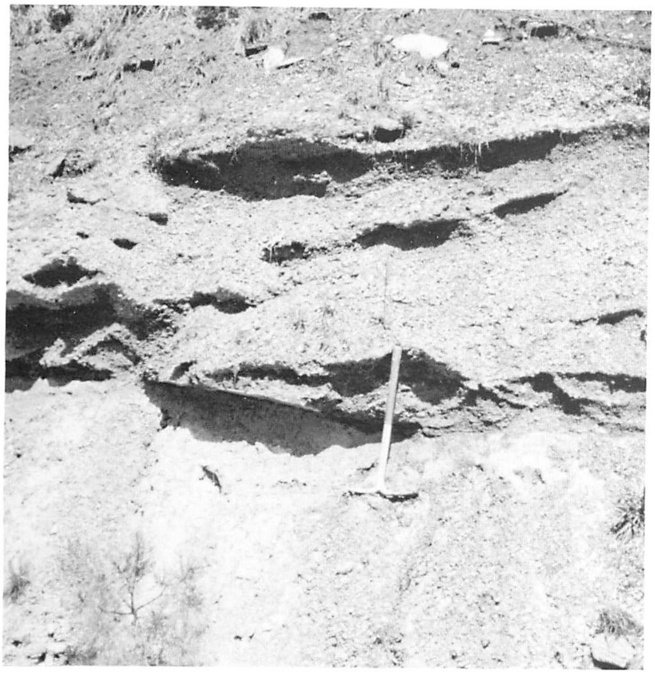


Figure 76 - Silty Tuscaloosa clays in erosional contact with fluvial Tuscaloosa channel lag gravels. Pickax handle is 26 inches in length. Location: SW/4, SW/4, SW/4, Sec. 33, T.4S., R.15W., 1/2 mile east of the Alabama state line.

mapped at the surface and in the subsurface of Tishomingo County. Plate 1 illustrates the county-wide distribution of the Eutaw Group. The Eutaw Group unconformably overlies the Paleozoic rocks where the Tuscaloosa is absent (Figure 75).

McShan Formation

The original reference to the McShan Formation as a separate geologic unit appeared in Conant and Monroe (1945). The McShan Formation is unconformably underlain by the Tuscaloosa Group and unconformably overlain by the Eutaw Formation. Previous investigations in Mississippi and Alabama included the strata comprising the McShan Formation in geologic units presently recognized as the Tuscaloosa Group or Eutaw Formation (Monroe et al., 1946) (Figure 67). The type locality of the McShan Formation is a series of roadcuts along U. S. Highway 82, 1.5 miles north of the village of McShan, Pickens County, Alabama, where approximately 200 feet of typical McShan lithologies occur in Sections 17 and 18, T.19S., R.15W. (Monroe et al., 1946). In Alabama, the McShan Formation is 240 feet thick in the Warrior River valley, 225 feet thick in Sipsey River valley, and 200 feet thick at the type locality (Monroe et al., 1946). The thickness of the McShan Formation decreases rapidly to the northwest, and is only 57 feet thick in roadcuts along U. S. Highway 78, 7 miles east of Fulton, Itawamba County, Mississippi (Monroe et al., 1946). Vestal and Knollman (1947, Figure 2) included McShan strata exposed east of Fulton in roadcuts of U. S. Highway 78 (NW. Cor. Sec. 6, T.10S.,

Figure 77 - Cross-bedded gravel and sand lithologies typical of the fining upward fluvial sequence represented in Tishomingo County. Size and abundance of the gravels increase downward, and silty clays comprise uppermost Tuscaloosa intervals exposed in easternmost Tishomingo County. Pickax is 26 inches in length. Location: NE/4, SE/4, NW/4, Sec. 5, T.6S., R.11E.

R.10E.) as an upper laminated and thinly bedded zone in uppermost Tuscaloosa beds. The McShan Formation is overlapped by the Eutaw Formation to the north in Tishomingo County. The McShan Formation is recognized and discussed as a separate lithology, ranging in known thickness from 25 to 57 feet thick at the surface of Prentiss County, although the McShan and Tuscaloosa lithologies are combined into one map unit for practical reasons in Parks et al. (1960).

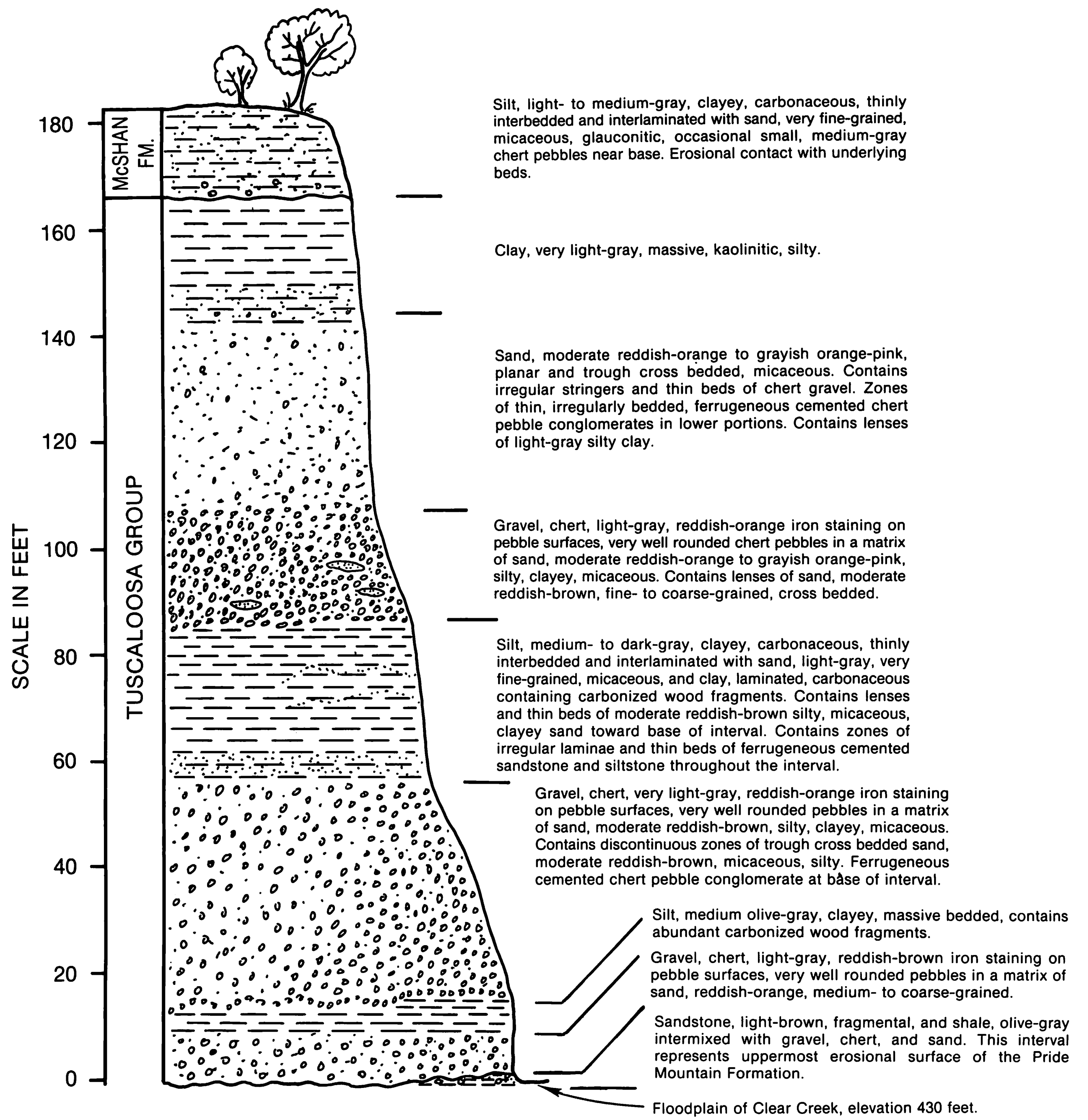


Figure 78 - Composite section of the Tuscaloosa Group at the Mississippi-Alabama state line, beginning in SE/4, SE/4, NW/4, Sec. 33, T.3S, R.15W., in Colbert County, Alabama, and terminating in SW/4, NW/4, SW/4, Sec. 35, T.3S., R.11E., in the Clear Creek flood plain, Tishomingo County, Mississippi.

The distribution of the McShan Formation at the surface of Tishomingo County is illustrated in Plate 1.

At the type locality the McShan Formation consists of about 200 feet of lenticular, intergradational beds composed of thin bedded to laminated, very fine- to medium-grained, glauconitic, micaceous sand that is thinly interbedded and interlaminated with carbonaceous clays, with zones of cross-bedded and ripple bedded, fine- to medium-grained, glauconitic, micaceous sand beds with clay partings. Detailed descriptions of the typical McShan lithologies contained in surface exposures of and near the type locality are given in Monroe et al. (1946). Lower portions of the McShan at the type locality contain varying amounts of cross-bedded sand and gravel, with a conglomeratic ironstone at the base. These basal gravels are not laterally continuous, and often lami-

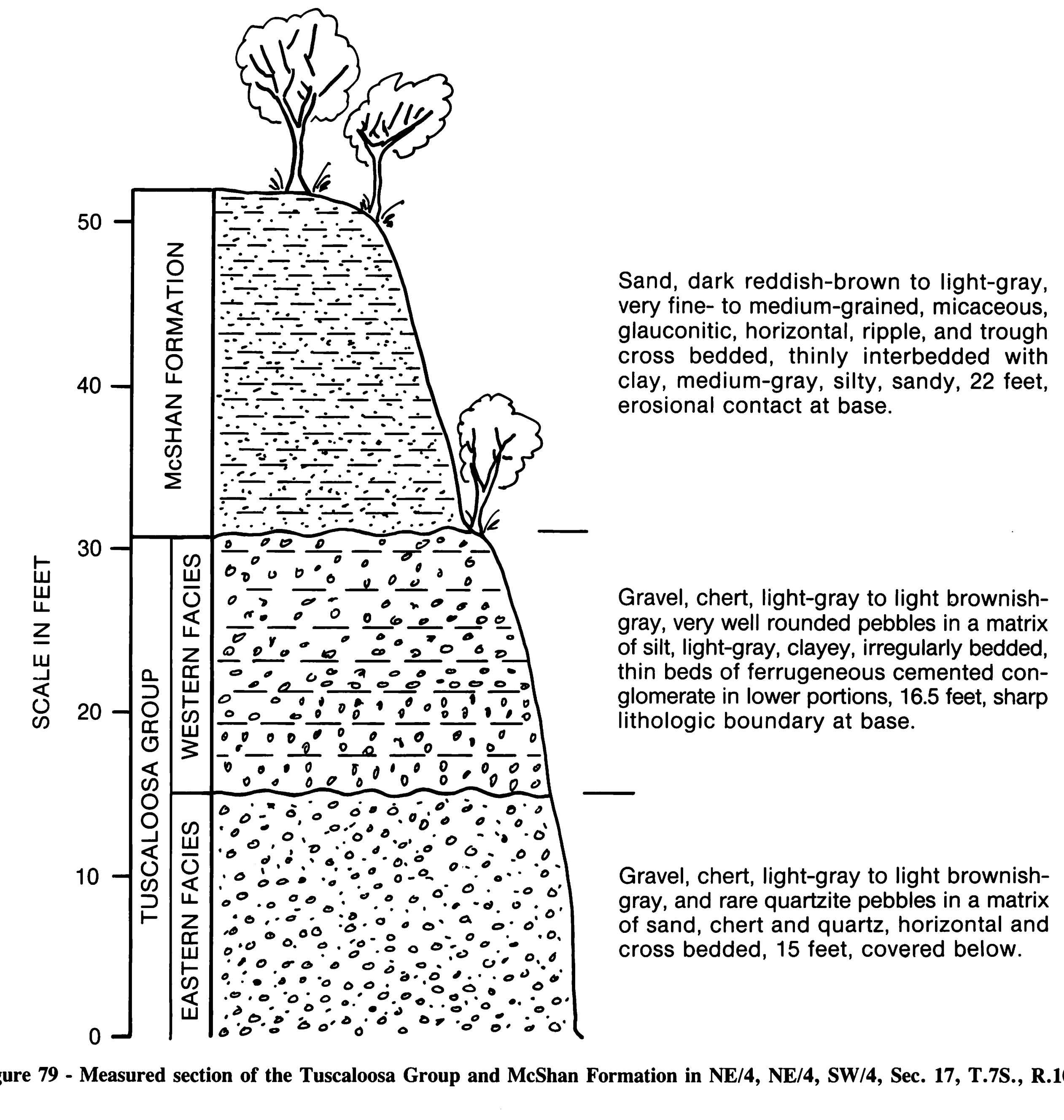


Figure 79 - Measured section of the Tuscaloosa Group and McShan Formation in NE/4, NE/4, SW/4, Sec. 17, T.7S., R.10E.

nated, very fine-grained, glauconitic sands occur at the base of the McShan Formation.

The McShan Formation thickens to over 200 feet downdip, in the subsurface of Neshoba and Kemper counties, Mississippi, and neighboring counties (Sumter, Greene, Pickens, and Tuscaloosa) in Alabama, with thickness variations of generally less than 50 feet in test wells located along the line of section described in Eargle (1946).

The maximum thickness of the McShan Formation observed during the present study occurs in Test Hole AP-7, wherein 70 feet of very fine-grained, glauconitic, micaceous sand and carbonaceous clays underlie basal Eutaw gravel and overlie Tuscaloosa gravels and clays (Plate 2, Hole Number 9). Similar thicknesses occur in surrounding wells. The McShan thins to the north and is overlapped by the Eutaw north of Township 4 South. The northernmost occurrences of typical lithologies comprising the McShan Formation at the surface are located in U. S. Route 72 roadcuts in SE/4, Sec. 34, T.3S., R.11E., and to the east of the Alabama state line. North of Clear Creek, the Eutaw Formation directly overlies Tuscaloosa lithologies (Plate 1). Plate 2 illustrates the northward thinning and eventual truncation of the McShan Formation in the subsurface. Cross section A'-B' (Plate 4) shows the southwest to northeast continuation of the McShan Formation in stream valley walls of Red Bud, Jourdan, McDougal, Bear, and Cripple Deer creeks. Surface exposures continue northeastward from Providence Branch valley and occupy hilltops at the Alabama state line. Plate 3 illustrates the westerly continuation of the McShan Formation in the subsurface (the northeast portion of Plate 4 is repeated on the eastern portion of Plate 3) of Prentiss County. Plate 2 illustrates the southward subsurface continuation of the McShan Formation, from Rock Creek valley into Itawamba County.

The distribution of the McShan Formation at the surface of Tishomingo County consists of a narrow, generally north-trending belt of exposures in central and southern portions of the county. Typical McShan lithologies can be traced into the subsurface as illustrated on Plates 2, 3, and 4. Strike varies locally due to the local relief on the upper surface imposed by variations in thickness, as well as the erosional contact with the overlying Eutaw Formation. The basal contact with the underlying Tuscaloosa Group is also erosional (Figure 82) and structural characteristics of underlying beds affect the thickness of the McShan locally. Figure 75 shows the local relief of the upper Tuscaloosa surface upon which the McShan rests unconformably. A slight depression on the upper Tuscaloosa surface reflects an underlying paleovalley that is filled with unusually thick sequences of Tuscaloosa fluvial deposits. This paleovalley corresponds to a trough on the erosional Paleozoic surface in west-central Tishomingo County as shown in Plate 5. Depressions on the Paleozoic surface are slightly reflected in overlying units as illustrated by the slight variation in strike at the Tuscaloosa-McShan contact (Figure 75) in this area. Cross section B-B' (Plate 3) shows the eastward increase in degree of dip of McShan strata and the structural relationship with the eastward rise of the Paleozoic floor. Cross section A-A' (Plate 2) transects the paleovalley in a north-south direction, crossing section B-B' at hole number 16, wherein the thickest occurrences of the McShan begin and continue southward in the shallow subsurface to the Itawamba County line. The southward rise of the Paleozoic floor (Plate 2) is reflected at the Tuscaloosa-McShan contact (Figure 75) by a slight change in strike, as well as corresponding southward thinning of Tuscaloosa gravels over buried Paleozoic ridges. Figure 74 illustrates county-wide Tuscaloosa thickness variations; areas enclosed by 0 thickness contour delineate areas where the McShan Formation directly overlies Paleozoic rocks, as the Tuscaloosa pinches out over Paleozoic ridges. A test hole drilled behind Highland Church (File number M.G.S. Stratigraphic Test 382-1) located in SE/4, NE/4, NE/4, Sec. 26, T.5S., R.10E., penetrated the Hartselle-McShan contact at a depth of 58 feet (elevation 562), overlain by 27 feet of McShan strata. During the present study, test hole AP-11, located on the hilltop across (to the east of) Bear Creek valley (SE/4, NE/4, NE/4, Sec. 26, T.5S., R.10E.) penetrated 34 feet of Tuscaloosa gravel below the McShan Formation. Tuscaloosa gravels increase in thickness to the north and south of the Paleozoic ridge penetrated in test hole AP-11. The southwest extension of the higher elevation occurrences of Paleozoic rocks (Paleozoic ridges) is shown on Plate 5. Areas of occurrence of the McShan-Paleozoic unconformity are northwest of Horseshoe Bend on Bear Creek, W/2, Sec. 30 and NW/4, Sec. 31, T.5S., R.11E.; S. 3/4, Sec. 25, Sec. 26, Sec. 35, and Sec. 36, T.5S., R.10E.; N/2, Sec. 2 and NW corner Sec. 1, T.6S., R.10E.; in the vicinity of Bay Springs Dam, W/2, Sec. 25, W/2, Sec. 24, Sec. 23, Sec. 26, and W/2, Sec. 35, T.6S., R.9E.; Sec. 1 and Sec. 2, T.7S., R.9E.; and areas to the north along Mackeys Creek that are now flooded by Bay Springs Lake. Plate 1 illustrates areas where the McShan Paleozoic contact occurs at the surface of Tishomingo County.

The McShan Formation was penetrated in several test holes drilled during the present study, and descriptions of the intervals penetrated appear in the Test Hole Records section of this report; see hole numbers AP-7, AP-8, AP-9, AP-10, AP-11, and AP-12. McShan lithologies vary in the subsurface as well as in surface exposure. Typical McShan lithologies are composed of very thinly interbedded and interlaminated, very fine-grained, glauconitic, micaceous sand, and clay laminae and very thin beds that are often varicolored with shades of red, purple, and very light gray, except where dark brownish gray shale intervals occur. Figure 80 illustrates the characteristic appearance of the McShan in outcrop. Bedding found in typical McShan lithologies is generally horizontal to various forms of ripple bedding and

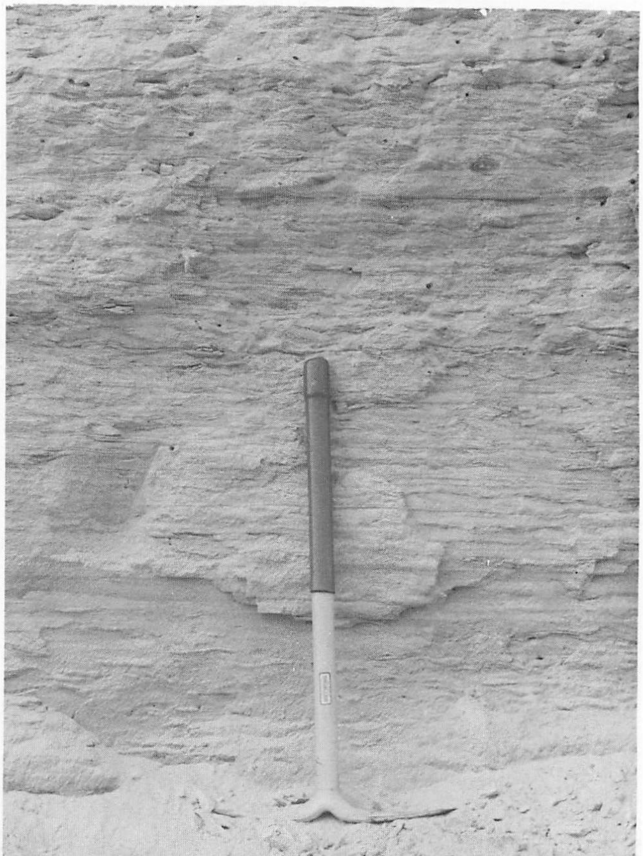


Figure 80 - Thinly interbedded and interlaminated, fine-grained, marine sands and silty clays impart a laminated appearance to McShan strata in outcrops. Pickax is 26 inches in length. Location: NE/4, NE/4, NE/4, Sec. 20, T.5S., R.10E.

ripple laminations (Figure 81). The thin beds and laminae of glauconitic sands are usually light gray in the subsurface and weather to various shades of red, although most commonly weathering imparts a dark reddish-brown color in outcrop. McShan clays are commonly very light gray, mottled with shades of pink and purple at the surface, and various shades of gray in the subsurface. Glauconite grains are frequently lighter in color and much smaller in size than those characteristic of the overlying Eutaw Formation. These characteristics are not the general rule in highly weathered exposures. The McShan is differentiated at the surface by its characteristic very thin, horizontally bedded and laminated appearance. Sediment particle size is generally much coarser in the sand fraction of the overlying Eutaw Formation, although laterally discontinuous zones of medium- to coarse-grained, massive- to cross-bedded, glauconitic sands, and occasional lenses and stringers of gravel occur in lowermost portions of the McShan.

The McShan Formation disconformably overlies the Tuscaloosa Group, except in areas where the Tuscaloosa is missing. Figure 82 shows the irregular nature of this contact where it occurs at the northwestern limit of the McShan outcrop in Colbert County, Alabama, as thinly interbedded, very fine-grained, glauconitic sands and silty clays are separated from underlying silty clays of the upper Tuscaloosa Group by an undulatory erosional boundary with apparent local relief. Exposures of this contact can be seen along U. S. Highway 72 roadcuts, 0.25 mile east of the Alabama state line, in SE/4, SE/4, NW/4, Sec. 33, T.3S., R.15W. In southwestern Tishomingo County, the McShan Formation disconformably overlies Tuscaloosa gravels (Figure 69). Exposures of this sequence can be seen in gravel pits on the north side of Red Bud Creek valley and in roadcuts of the east-west trending paved road passing through central portions of Sections 17 and 18, T.7S., R.10E., with the best exposure at this time being near the center of Section 17 on the north side of the road. Figure 79 illustrates this sequence in measured section. Figure 83 illustrates the abrupt nature of this contact exposed in SW/4, NE/4, SE/4, Sec. 12, T.5S., R.10E.

The McShan is unconformably overlain by the Eutaw Formation. Figure 84 illustrates the relatively unweathered appearance of this erosional contact in a small borrow pit located at NW/4, NE/4, NE/4, Sec. 20, T.5S., R.10E. This interval is also shown in Figures 85 and 86. Grain size and bedding in the McShan Formation are not uniform throughout Tishomingo County, and often horizontally bedded and laminated fine sands and clays grade laterally into massive-

Figure 81 - Ripple bedded, fine- to very fine-grained, silty marine sands in the McShan Formation contain thin clay laminae partings and finely cross-laminated silty sand within ripple bed sets. Quarter for scale. Location: NE/4, NE/4, NE/4, Sec. 20, T.5S., R.10E.

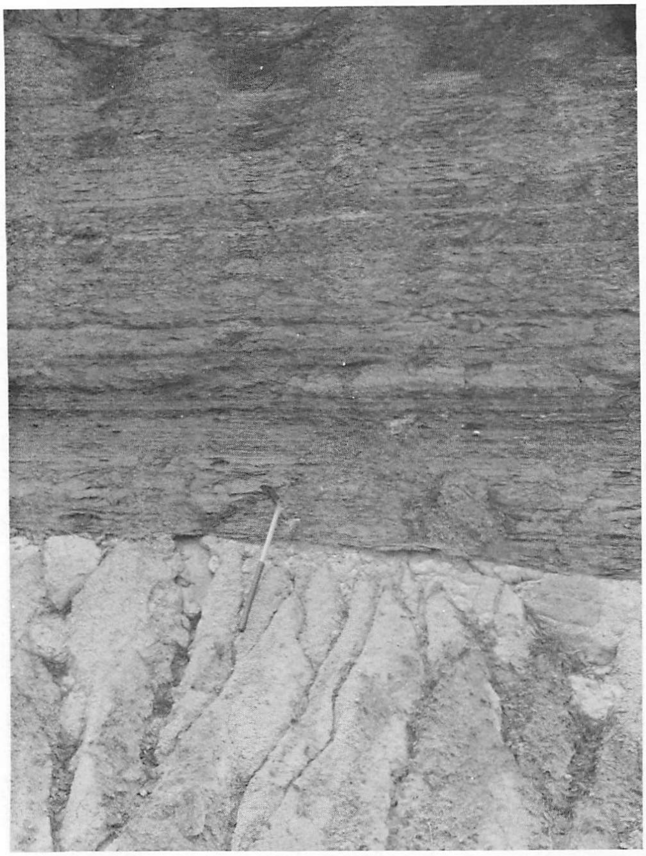


Figure 82 - Silty clays of the Tuscaloosa Group unconformably overlain by horizontally bedded and laminated carbonaceous clays and fine-grained marine sands of the McShan Formation. Pickax is 26 inches in length. Location: SE/4, SE/4, NW/4, Sec. 33, T.3S., R.15W.

and cross-bedded, medium- to coarse-grained, glauconitic sands. The best exposure of this higher energy facies of the McShan Formation can be seen in a gravel pit on the east side of State Highway 25 near the northern Tishomingo city limit in NE/4, SW/4, SE/4, Sec. 15, T.5S., R.10E., where the McShan disconformably overlies the Tuscaloosa Group. Surface occurrences of the McShan Formation a short distance east or southwest of this locality expose horizontally interbedded and interlaminated fine-grained sands and clays typical of the majority of McShan occurrences (Figures 80 and 81).

Petrified wood occurs frequently in the McShan Formation, and is most commonly found at or near the contact with the overlying Eutaw Formation. Figure 87 illustrates an occurrence of petrified wood fragments above the contact with the overlying Eutaw Formation, in NE/4, SE/4, SW/4, Sec. 15, T.5S., R.10E. Small fragments of petrified wood also are incorporated into the finely laminated McShan sands below the contact. Large petrified logs were encountered in McShan strata during excavation activities for the Tennessee-Tombigbee Waterway. The thick continual exposures of geologic strata along the waterway revealed fresh, unweathered McShan lithologies in which silicified logs and amber were observed (E. E. Russell and T. Haskins, personal communications). No fossil remains of marine invertebrates have been reported from the McShan Formation. Plant fossils were reported from the carbonaceous, laminated, amber-bearing clays exposed in a cut of Southern Railway 1-5/8 miles southeast of Iuka, in Berry (1919). Stephenson and Monroe (1940) identified the interval from which Berry (1919) collected to be located in the lowermost Eutaw Formation. This locality is located in a general way (as 1-5/8 miles southeast of Iuka) and exposures in that area are badly overgrown. The northwesternmost surface exposures of the McShan Formation occur in that area (SW/4, NW/4, NW/4, Sec. 33, T.3S., R.11E.). The McShan does not appear in the literature as a separate formation prior to Conant and Monroe (1945) and Monroe et al. (1946). The strata from which Berry (1919) reported fossil leaf impressions probably represent the northwest limit of the McShan Formation outcrop in Tishomingo County, as indicated by the presence of amber and carbonaceous, laminated clays, as well as the stratigraphic position of the sediments.

The McShan Formation is disconformably overlain by the Eutaw Formation (Figures 85 and 87). The contact is sharp and distinct in unweathered outcrop, as the thinly interbedded and interlaminated fine sands and silty clays of the McShan Formation are truncated at the top by trough cross-bedded, coarser sands of the Eutaw Formation (Figure 88). Thin, laterally discontinuous intervals of silty clays, sands, and thin lenses and stringers of small chert pebbles, and occasional petrified wood fragments occur in basal portions of the Eutaw Formation in areas where the McShan occurs (Figure 87). The Eutaw Formation is more conglomeratic in the lowermost portions where the McShan Formation is missing. Bioturbation can be seen locally above the McShan-Eutaw contact (Figures 86 and 88) in lowermost Eutaw beds. Fossils and evidence of bioturbation were not observed in the McShan Formation during the course of field work for the present report.

Eutaw Formation

The Eutaw Group of Hilgard (1860) originally included the lowermost Coastal Plain strata occurring below the Tombigbee Sand in Mississippi and was named for the town of Eutaw, Alabama. Smith and Johnson (1887) named and assigned formational rank to the Tuscaloosa interval, and retained the name Eutaw for the remainder of Upper Cretaceous beds below the Selma Chalk (Figure 67). Stephenson (1914) defined the Eutaw Formation as a sequence composed of three members: lowermost Typical Eutaw Beds, the Tombigbee Sand Member, and an uppermost Coffee Sand Member. Reclassification by Stephenson and Monroe (1938) assigned the Coffee Sand interval to the Selma Chalk and retained the typical and Tombigbee Sand Member designations as previously defined (Figure 67). Basal portions of the Eutaw Formation, as described by Smith and Johnson (1887), were excluded and defined as the McShan Formation in Conant and Monroe (1945). Eutaw Group, Forma-

Figure 83 - Laminated clay, silt, and very fine-grained marine sands of the McShan Formation unconformably overlie Tuscaloosa chert gravels in south-central Tishomingo County. Location: SW/4, NE/4, SE/4, Sec. 12, T.5S., T.10E.

tion, and Member designations have otherwise remained in the literature and, in the absence of reclassification of the strata at the original or any newly defined type locality, are retained in this report as well. The Eutaw Formation is recognized in the present study, in accordance with the classification of Stephenson and Monroe (1938 and 1940), as comprised of lower and upper members. The Lower Eutaw designation is utilized in the present study to include strata defined as typical beds in Stephenson and Monroe (1940). Russell (1965) proposed the name Counce for the lower, unnamed Eutaw member in Tennessee, but the term is not widely used (Russell, 1975). This lower member appears on the Tishomingo County Map and is discussed in the text as the Lower Eutaw Member.

The uppermost member, the Tombigbee Sand, conformably overlies the Lower Eutaw Member. The Tombigbee Sand member contains a diverse faunal assemblage, although *Callianassa* sp. burrows are common in each member. Stephenson (1914) described two major faunal assemblages in the Eastern Gulf Region, the *Exogyra ponderosa* zone, which begins at the base of the Tombigbee Sand Member and extends upward to include the lower half of the Selma Chalk, and the *Exogyra costata* zone, which includes all Cretaceous beds above the *Exogyra ponderosa* zone. The Coffee Sand was considered to be the uppermost member of the Eutaw Formation in that report, and reclassification by Stephenson and Monroe (1938) differentiated the Coffee Sand from the Eutaw Formation. Stephenson and Monroe (1940) correlated and described in detail the faunal assemblage in the Eutaw Formation in Mississippi. Fossil occurrences are also rare in the Lower Eutaw strata of Alabama. Stephenson (1914) reported fossiliferous zones in lowermost Eutaw strata in exposures along the Alabama River north of Montgomery, Alabama. Berry (1919) reported fossil plants, collected from the Tuscaloosa exposed in a cut of Southern Railway, 1-5/8 miles southeast of Iuka, Mississippi, tobecontained in lignitic, laminated, amber-bearing clay with leaf imprints. Subsequently, Stephenson and Monroe (1940) determined that these beds are in the lowermost Eutaw Formation. The plant species identified at that locality (Berry, 1919) include the forms *Andromeda wardinia, Androvettia carolinensis, Phyllites pistaeformis,* and (most abundant) *Sequoia reichenbachi.* This locality is only generally located in the Berry (1919) report, but the area 1-5/8 miles southeast of Iuka is mapped in the lowermost Eutaw Group, near and at the contact with the underlying Tuscaloosa Group. It is very likely that these laminated, carbonaceous, amber-bearing clays and sands represent the northwesternmost surface exposures of the McShan Formation, which occur in SW/4, NW/4, NW/4,

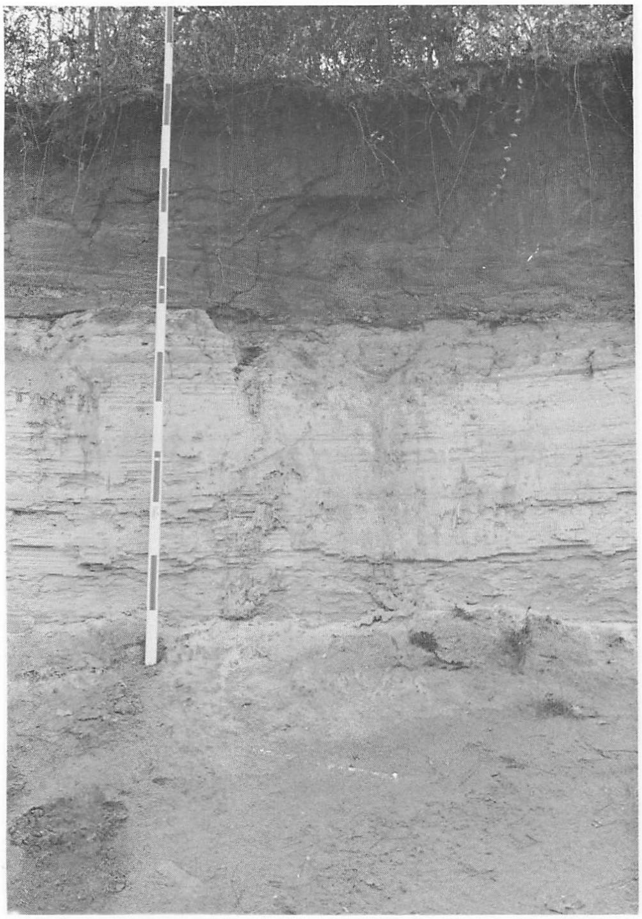


Figure 84 - Interlaminated and thinly interbedded, fine-grained, marine sands and clays of the McShan Formation, unconformably overlain by coarser trough cross-bedded marine sands of the Eutaw Formation. Scale in feet. Location: NW/4, NE/4, NE/4, Sec. 20, T.5S., R.10E.

Sec. 33, T.3S., R.11E. (Plate 1). The McShan Formation was not recognized as a separate geologic unit at that time.

Basic Eutaw lithologies that occur in Tishomingo County consist of a lower, horizontal- to cross-bedded, marine sand unit with frequent gravel beds and lenses near the base and frequent clay beds and laminae separating cross-bed sets, and an upper, massive-bedded, marine sand. The Lower Eutaw Member and the Tombigbee Sand Member are mapped separately, and their areal distribution at the surface of Tishomingo County is illustrated on Plate 1. Their distribution in the subsurface of Tishomingo County is illustrated on Plates 2, 3, and 4. The belt of Eutaw surface exposures extends across the entire length of Tishomingo County and northward into Hardin, Wayne, and Decatur counties in Tennessee. The Eutaw Formation outcrop belt for Mississippi in general is arcuate, trends in a generally north-south direction as far south as Lowndes County, then continues to the southeast and east across the entire state of Alabama and into Georgia. The strike of the Eutaw Formation in Tishomingo County trends north-northeast, with slight variations of an overall N. 0° to 10° E. county-wide trend. Dip is to the west at about 30 feet per mile overall, with local variations as shown on Plates 3 and 4. Cross section B-B' (Plate 3) is essentially parallel to the dip of the Eutaw Formation. Cross section A-A' is essentially parallel to strike, and illustrates the various units that disconformably underlie the Eutaw Formation as a result of its northbound overlap of McShan and Tuscaloosa strata. The Eutaw Formation disconformably overlies the McShan Formation in southern and east-central Tishomingo County (Plate 1). To the north, the Eutaw Formation overlies the Tuscaloosa Group, and eventually the Paleozoic rocks in northernmost Tishomingo County (Plate 2). The Eutaw Formation is disconformably overlain by the Coffee Formation.

The Eutaw Formation is generally 200 feet thick in areas of exposure in central and southern Tishomingo County, and thins northward to a minimum of about 130 feet. The minimum subsurface thickness of the entire Eutaw Formation in Tishomingo County is described from test hole AP-2, wherein 135 feet of Eutaw sands disconformably overlie the Fort Payne Formation. The maximum thickness of the Eutaw Formation occurs where an unusually thick lower Eutaw interval (125 ft. thick in hole 16 of Plate 3) was penetrated in the shallow subsurface. The Tombigbee Member is truncated at the surface in that area, so the entire thickness of the Eutaw Formation was not encountered along the line of section shown on Plate 3 (hole numbers 8, 15, and 16). Unusual thicknesses of Eutaw, McShan, and Tuscaloosa strata accumulated in this area above a buried depression on the upper surfaces of Paleozoic strata (Plate 5). This area is traversed by cross section A-A', hole numbers 7, 8, and 9 (Plate 2). All units above the Tuscaloosa Group were included as regolith in Colbert County (Harris, Moore, and West, 1963), Lauderdale County (Harris, Peace, and Harris, 1963), and Franklin County (Peace, 1963) in northwestern Alabama, so specific thicknesses of Eutaw strata are uncertain in those areas. Strata comprising the Eutaw Group were noted to occur in western portions of those counties during the course of the present study. The Eutaw Formation is 300 to 350 feet thick to the south in Itawamba County (Vestal and Knollman, 1947), and 185 to 255 feet thick in Prentiss County (Parks et al., 1960). The Eutaw Formation thins northward through Tishomingo County as it overlaps the Tuscaloosa pinch-out shown in Figure 74, and is absent north of Hardin County, Tennessee. The Geologic Map of Alabama illustrates the eastward continuance of the Eutaw Formation across the entire state and shows the Eutaw to overlap the Tuscaloosa Group near the Alabama River. The Counce and Pickwick quadrangles in Tennessee adjoin the Doskie and Yellow Creek quadrangles (respectively) of Mississippi along the Tennessee-Mississippi state line. These reports allow correlations of geologic units across the state line. The maximum thickness of the Eutaw Formation reported from the Counce Quadrangle, Tennessee, is 180 feet (Russell, 1968) and 140 feet in the Pickwick Quadrangle, Tennessee (Russell et al., 1972).

The Eutaw Formation continues downdip in the subsurface of Mississippi, except where it is truncated on the Sharkey Platform and the Jackson Dome, and attains a thickness

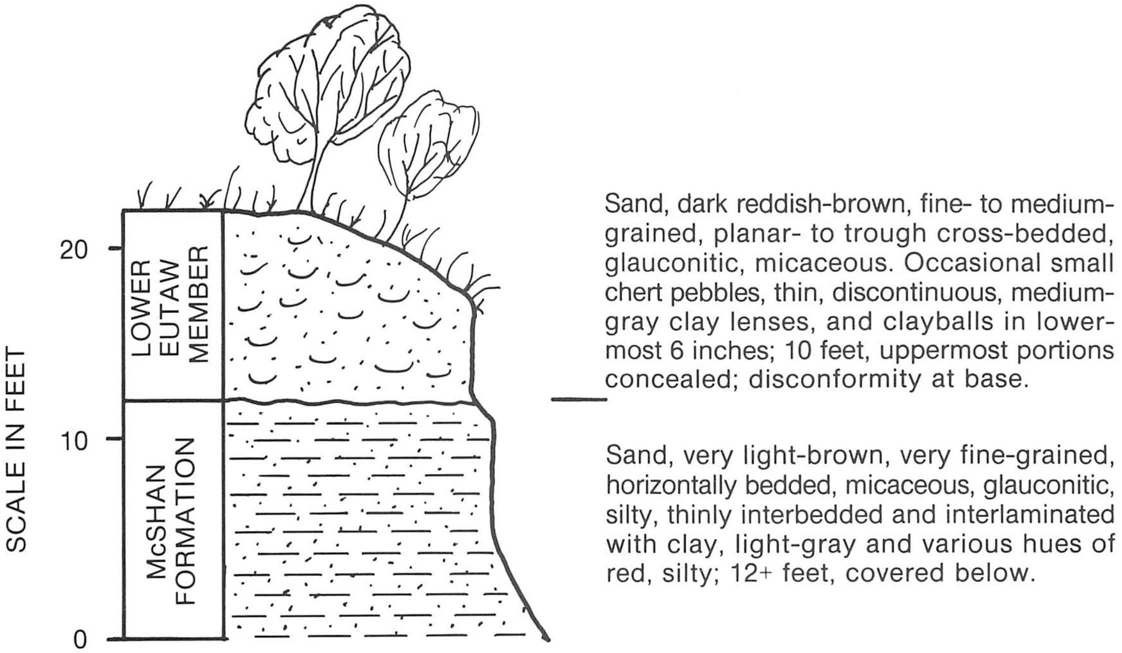


Figure 85 - Measured section describing the erosional contact between the McShan and Eutaw formations. Location: SW/4, NE/4, NE/4, Sec. 20, T.5S., R.10E.

Figure 86 - Laminated silty clays and very fine-grained marine sands of the McShan Formation, unconformably overlain by coarser, bioturbated marine sands of the Eutaw Formation. The pickax located at the contact is 26 inches in length. Location: NW/4, SW/4, NE/4, Sec. 34, T.5S., R.10E.

Figure 87 - Chert pebbles and fragments of petrified wood in lowermost portions of the Eutaw Formation mark the erosional McShan-Eutaw contact. Pickax is 26 inches in length. Location: NE/4, SE/4, SW/4, Sec. 15, T.5S., R.10E.

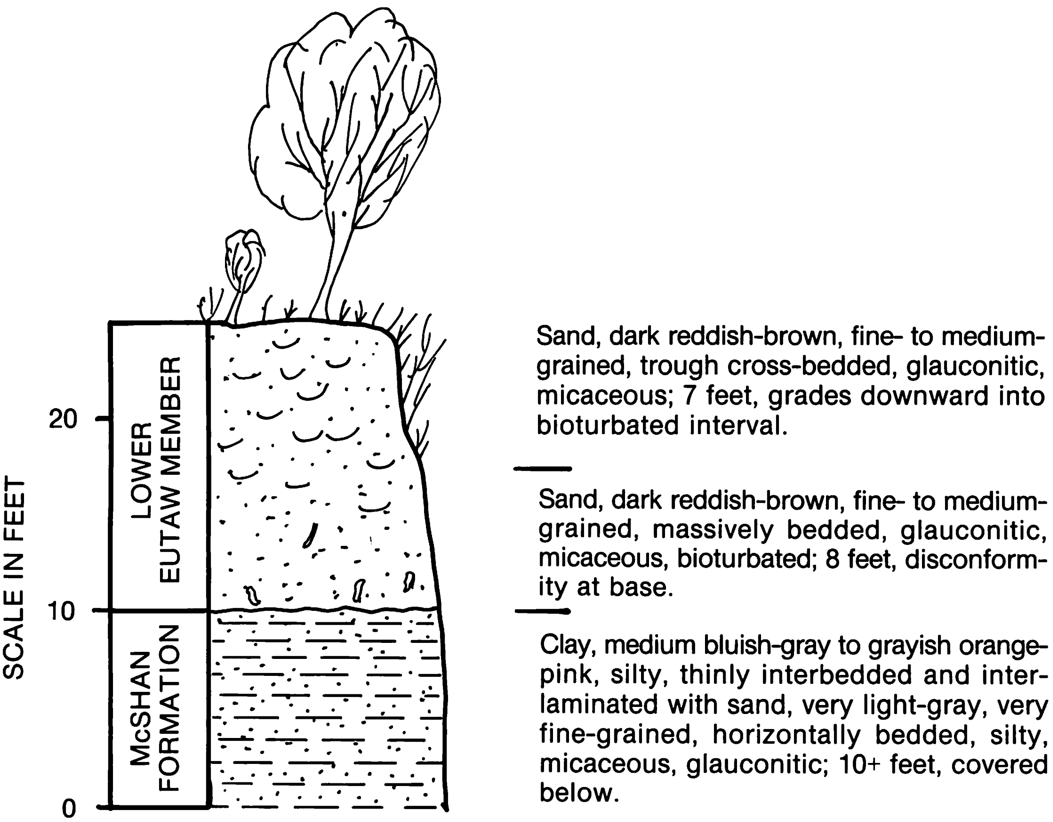


Figure 88 - Measured section describing typical McShan lithologies, unconformably overlain by an unusual, bioturbated interval in the lowermost Eutaw Formation in a cut of the Illinois Central Railroad. Location: NW/4, SW/4, NE/4, Sec. 34, T.5S., R.10E.

of 900 feet in the subsurface of Sunflower County (McGlothlin, 1944); lowermost portions of this sequence probably include McShan equivalent strata. Eargle (1946) recognized the McShan and Eutaw as separate formations in the subsurface of Neshoba and Kemper counties, Mississippi, and eastward to the surface near Tuscaloosa, Alabama. This is a provisional separation in the subsurface, as Eutaw and McShan lithologies are often similar in well cutting samples. Electrical log characteristics are also similar when a sandy facies of the McShan underlies cross-bedded Eutaw sands, although typical McShan laminated, fine sand and clay lithologies are easily separated at the surface and on subsurface electrical logs. The Eutaw Formation is 180 feet thick in the subsurface of Neshoba County, Mississippi, and continues eastward with similar thicknesses in the subsurface of Kemper County, Mississippi, and adjoining counties in western Alabama, along the line of section described in Eargle (1946).

Increasing percentages of water-laid volcanic materials occur in Eutaw strata penetrated by test wells in the vicinity of the Sharkey Platform (McGlothlin, 1944). Upper Cretaceous buried volcanic vents supplied undersaturated volcanic ash materials from which the bentonite deposits contained in Eutaw strata of northeastern Mississippi were derived. The Midnight Volcano and other volcanic structures associated with the Sharkey Platform, and possibly the Jackson Dome to the southeast, are primary sources for windblown ash (Merrill, 1983). Economic bentonite deposits such as those that occur in Monroe County (Grim, 1928) diminish northward, away from the volcanic source, where significant accumulations of volcanic ash in a marine environment conducive to the formation of bentonite deposits are absent from the Eutaw Formation. Significant accumulations of wind-transported volcanic ash from the Sharkey Platform and other Campanian age volcanic events probably did not occur as far northeastward as Tishomingo County, as no bentonite deposits are recorded in this or other reports from Tishomingo County. The Eutaw Formation is bounded above and below by major disconformities. Horizontal- to cross-bedded, marine, lower Eutaw sands, clays, and gravels grade upward into the massive marine sands comprising the Tombigbee Sand Member. The Eutaw Formation is unconformably overlain by the Coffee Formation of the Selma Group.

Lower Eutaw Member

The Lower Eutaw Member remained unnamed during the transition from the usage of the term Eutaw as a group designation to usage as a formation designation. The term Counce Member was proposed for exposures of the sequence near Counce, Tennessee (Russell, 1965), but has not been utilized in subsequent literature. In the absence of widely accepted nomenclature concerning lower portions of the Eutaw Formation, the name Eutaw is retained in the present study for the sake of convention.

The Lower Eutaw Member includes all strata between the unconformity at the base of the Eutaw Formation and the conformably overlying, massively-bedded, marine sands comprising the Tombigbee Sand Member. The Lower Eutaw Member is exposed at the surface of Tishomingo County (Plate 1) as a belt up to twelve miles wide, trending generally north in strike, with local variations between N. 5° W. and N. 10° E. The dip is westward at about 30 feet per mile. The lower Eutaw interval is generally 90 to 100 feet thick in southern and central Tishomingo County, and locally thinner in northern portions of the county where the lower Eutaw directly overlies the Paleozoic rocks. For example, test hole AP-1, located in SW/4, NW/4, NW/4, Sec. 4, T.3S., R.9E., penetrated 99 feet of lower Eutaw strata, and test hole AP-2, located in northernmost Tishomingo County (SE/4, SE/4, SE/4, Sec. 19, T.1S., R.10E.) penetrated only 78 feet of lower Eutaw strata unconformably underlain by Fort Payne chert. The lower Eutaw is between 90 and 100 feet thick in test holes drilled in central and southern Tishomingo County. Descriptions of subsurface lithologies of the lower Eutaw are contained in the Test Hole Records Section of this report. The maximum thicknesses of the Lower Eutaw Member were encountered in test holes located in west-central Tishomingo County that were drilled during groundwater studies concerning the Tennessee-Tombigbee Waterway (Simmons, 1985) in a cooperative drilling program implemented by the U.S. Army Corps of Engineers and the U.S. Geological Survey. In tracing the McShan-Lower Eutaw contact in the subsurface, only those test wells were used that had the most complete data, including samples, electrical logs, drillers logs, and on-site sample descriptions of test hole cuttings.

Cross section A-A' shows subsurface and surface distributions of the Lower Eutaw along a line of section generally parallel to strike. Cross section B-B' illustrates the subsurface and surface distribution of Lower Eutaw strata along a line of section generally parallel to dip (Plate 3). The Lower Eutaw Member attains an isolated maximum thickness of about 125 feet in hole number 16 (Plate 3, U. S. Army Corps of Engineers hydraulic site 35, NE/4, SE/4, SW/4, Sec. 33, T.4S., R.10E.). Here about 125 feet of Lower Eutaw strata overlie a coarse-grained facies of the McShan Formation with similar lithologies and electrical log characteristics (Plate 3). Thus it is possible that McShan equivalent strata in this well occupy lowermost portions of what is designated as the Lower Eutaw Member. The Lower Eutaw Member is between 90 and 110 feet thick in the remainder of test wells in this area of Tishomingo County (Plate 3) and is, in general, 100 feet thick or less county wide. The Lower Eutaw Member unconformably overlies the McShan Formation in southern Tishomingo County (Figure 84) and overlaps the Tuscaloosa Group to the north, eventually resting unconformably on Paleozoic strata in extreme northern areas of Tishomingo County (Figure 89). Plate 1 illustrates this successive northward onlap of the Lower Eutaw, along strike of the Cretaceous beds. The Lower Eutaw Member unconformably overlies Paleozoic strata to the north in Hardin County and the Tuscaloosa Group in south-central

Figure 89 - Angular chert fragments and clays in a weathered zone of the Fort Payne Formation, unconformably overlain by a thin (2 feet) gravel interval, thinly interbedded marine sand and clay, and horizontal-, ripple-, and trough cross-bedded glauconitic sands of the Lower Eutaw Member. Pickax is 26 inches in length. Location: SE/4, SE/4, SW/4, Sec. 26, T.1S., R.10E.

Wayne County, Tennessee (Russell and Parks, 1975). Lower Eutaw beds overlap Tuscaloosa gravels and unconformably overlie Paleozoic rocks in Lauderdale County, Alabama (Russell, 1975). The Lower Eutaw Member is reported to be 200 to 250 feet thick to the south, in neighboring Itawamba County (Vestal and Knollman, 1947). The Lower Eutaw Member is 110 to 170 feet thick to the southwest, in Prentiss County, and unconformably overlies fine-grained laminated sands and silty clays of the McShan Formation (Parks et al., 1960).

The Lower Eutaw Member is 180 to 550 feet thick downdip, in the subsurface of Mississippi, with minimum thicknesses in Montgomery, Grenada, Yalobusha, and Lafayette counties, and attains maximum thicknesses in Sunflower County. The Lower Eutaw Member contains an abundance of red-brown shale and pyroclastic material in the subsurface at Humphreys, Sharkey, Sunflower, and western Yazoo counties, Mississippi (McGlothlin, 1944). The Lower Eutaw Member is 120 to 150 feet thick in the subsurface at Neshoba and Kemper counties, Mississippi; it continues eastward in the subsurface of Alabama with similar thicknesses in the subsurface of Sumter and Greene counties and is exposed at the surface in Tuscaloosa County, Alabama (Eargle, 1946).

The Lower Eutaw Member is composed of very fine- to medium-grained, glauconitic, micaceous, moderately to very well-sorted, subangular to sub-rounded, quartz sand, with frequent thin beds and laminae of medium-gray, micaceous silt and light- to dark-gray clay. Thin beds and lenses of chert gravel are common in the lowermost 20 feet, especially in northernmost Tishomingo County where the Lower Eutaw interval unconformably overlies the Paleozoic rocks. Figure 89 illustrates the erosional contact between the Fort Payne Formation and the Lower Eutaw Member, as angular chert blocks, common in uppermost weathered Fort Payne intervals, are overlain by 2 to 3 feet of Lower Eutaw gravel and thinly interbedded, glauconitic sand and dark gray, clayey silt. Gravels in the Lower Eutaw interval are often intermixed with angular, unaltered chert fragments in this contact zone in weathered outcrop. Coarser grained sands are typical of lowermost Eutaw strata. Sediments generally fine upward through the Eutaw sequence, with an upward increase in occurrences of thin beds and laminae of shaly, silty clay (Figure 90).

The marine sands of the Lower Eutaw Member are characteristically planar to trough cross-bedded, with frequent zones of ripple bedded, fine-grained, glauconitic, micaceous sand (Figure 91). Thin clay beds and laminae often separate cross-bed sets. Massive bedding is also frequent in exposures of the Lower Eutaw Member, especially in the lower half of the member, although the massive appearance is often due to effects of weathering in outcrop. Colors vary primarily as a function of the degree of weathering of the glauconite grains. Lower Eutaw sands are generally medium- to light olive-gray in fresh, subsurface samples, and various hues of reddish-brown in surface exposures. The pelletal, dark olive-gray, glauconite grains frequently comprise more than 15 percent of sands contained in Lower Eutaw subsurface samples collected during the present study.

Figure 91 illustrates trough cross-bedding, characteristic of the Lower Eutaw in outcrop, and Figure 92 shows a measured section at this location. Lower Eutaw sands are generally fine- to medium-grained, glauconitic, micaceous, and light- to dark reddish-brown in color. Excellent Lower Eutaw exposures can be observed in roadcuts and borrow pits along Highway 30 between Tishomingo and Paden, Sections 8, 9, 15, and 16, T.5S., R.10E. A borrow pit on the south side of Highway 30, in SE/4, SE/4, SW/4, Sec. 9, T.5S., R.10E., exposes trough cross-bedded, medium-grained sands, with frequent large (1 mm), pelletal, glauconite grains. These grains have a light yellowish-green, translucent appearance similar to smaller glauconite grains that frequently occur in finer sediments comprising the McShan Formation. Intervals of horizontally interbedded marine sands and silty clays occur locally throughout the Lower Eutaw interval (Figure 93). The unconformity separating the Lower Eutaw from the underlying McShan Formation

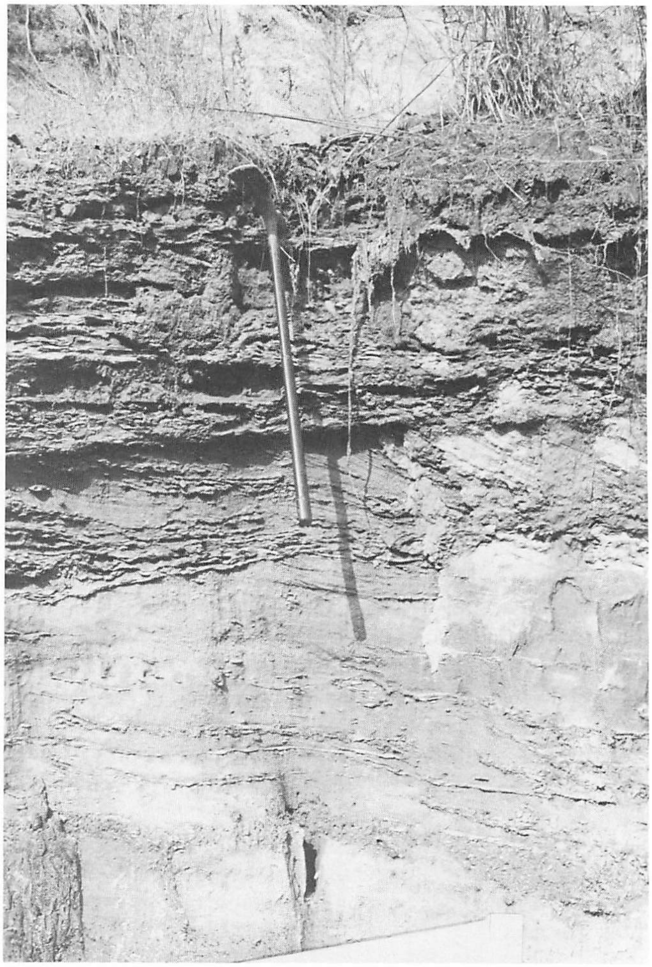


Figure 90 - Trough cross-bedded, fine- to medium-grained, glauconitic, micaceous sands, with medium gray silty clay interbeds in uppermost portions of the Lower Eutaw Member. Pickax is 26 inches in length. Location: NW/4, SE/4, SE/4, Sec. 17, T.4S., R.10E.

is often subtle in weathered outcrop, but fresh exposures occur in roadcuts along the Old Natchez Trace in the SW/4, Sec. 16, SE/4, Sec. 17, and the NE/4, Sec. 20, T.5S., R.10E. Figure 84 illustrates the McShan-Lower Eutaw boundary in a small sandpit on the southeast side of the dirt road in NW/4, NE/4, NE/4, Sec. 20, T.5S., R.10E. The Lower Eutaw is distinguished from the underlying McShan Formation primarily on the basis of the coarser sediments and higher energy, fluvial cross-bedding characteristic of Lower Eutaw (Figure 84). Figure 85 describes the sequence in measured section.

Petrified wood occurs frequently in lowermost portions of the Eutaw (Figure 94). The Lower Eutaw Member is conformably overlain by massively bedded sand of the Tombigbee Sand Member (Figure 95). Burrows of the marine decapod *Callianassa* sp. are common in uppermost portions of the Lower Eutaw, especially at and near the contact with the overlying Tombigbee Sand Member, although clay-filled molds of the burrows occur occasionally throughout the Lower Eutaw interval (Figure 86). No additional fossils were ob-

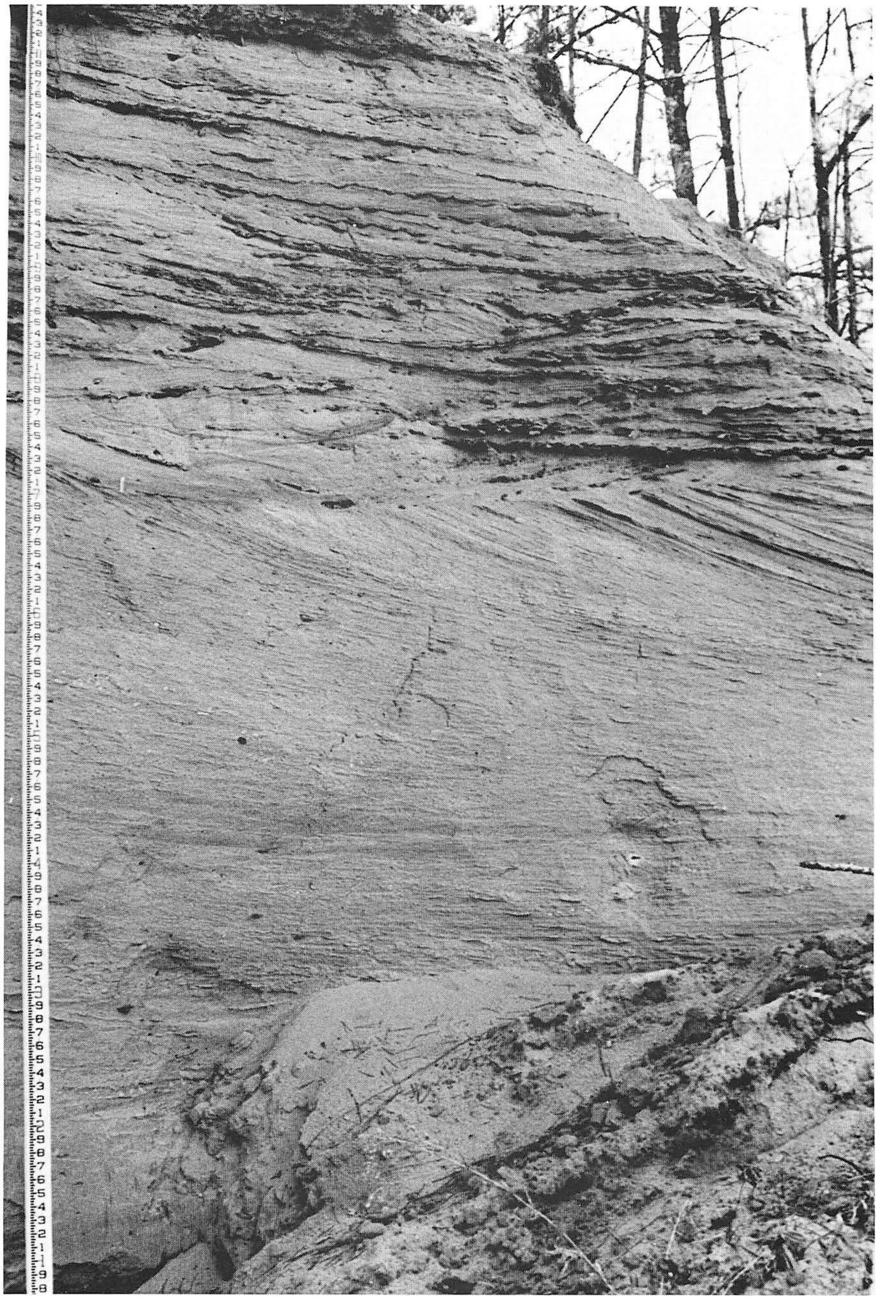


Figure 91 - Trough cross-bedded and ripple-bedded, medium- to fine-grained, glauconitic, micaceous, Lower Eutaw sands in a fining upward fluvial sequence. Scale in feet and 1/10 increments. Location: SE/4, SE/4, SW/4, Sec. 9, T.5S., R.10E.

served in the Lower Eutaw Member. The only fossil remains reported from Lower Eutaw strata in Mississippi are plant remains that were originally assigned to Tuscaloosa strata by Berry (1919) and subsequently assigned to the Lower Eutaw interval by Stephenson and Monroe (1940).

Tombigbee Sand Member

The Tombigbee Group was defined by Hilgard (1860) to include all strata between the Eutaw and Rotten Limestone (Selma) groups of that classification. Smith and Johnson (1887) named the Eutaw as a formation comprising all beds between the underlying Tuscaloosa and the overlying Rotten Limestone. Smith et al. (1894) assigned the name Selma Group to replace the name Rotten Limestone. The strata comprising the Tombigbee were included in the Eutaw Formation of the Smith and Johnson (1887) classification, but not recognized as a member of the Eutaw Formation (Figure 67). Stephenson (1914) retained the name Tombigbee Sand as a member designation to describe the massive bedded marine sands between underlying typical Eutaw strata and the overlying Coffee Sand. The Coffee Sand was classified as the

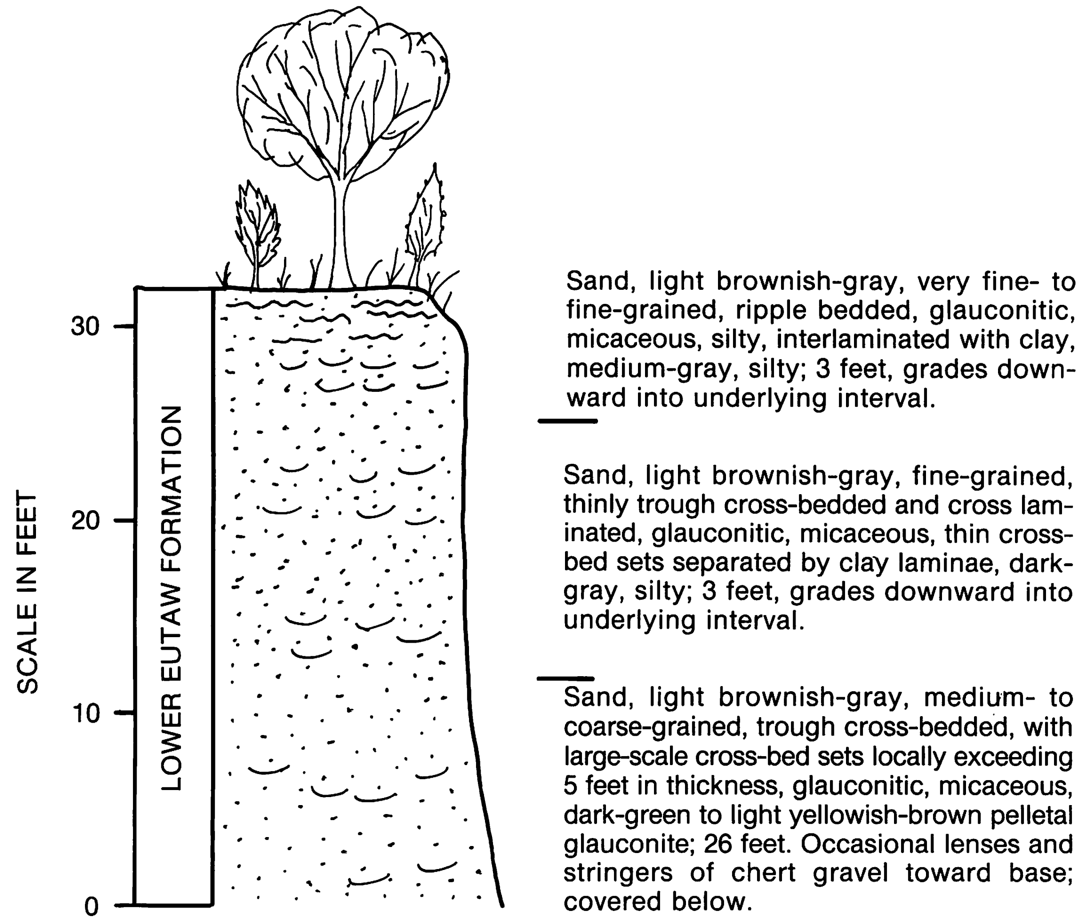


Figure 92 - Measured section of the Lower Eutaw exposed in and near a recent borrow pit located on the south side of State Highway 30, approximately 35 feet above the contact with the underlying McShan Formation. Location: SE/4, SE/4, SW/4, Sec. 9, T.5S., R.10E.

uppermost member of the Eutaw Formation in the Stephenson (1914) classification. The type exposure of the Tombigbee Sand occurs at Plymouth Bluff on the Tombigbee River in Lowndes County, Mississippi, and the type region is the vicinity of the town of Columbus (Stephenson, 1914). Stephenson and Monroe (1938) recognized a widespread unconformity between the Tombigbee Sand and the overlying Selma Chalk and restricted the Coffee Sand, previously included as a member of the Eutaw Formation, to the Selma Chalk. The lower third of the thick sequence of Selma Chalk in west-central Alabama and east-central Mississippi merges and intertongues into the Coffee Sand in northwestern Mississippi (Stephenson and Monroe, 1938). The Coffee Sand is the only geologic unit in the Selma Group that overlies the Tombigbee Sand in Tishomingo County. To the south, near Tupelo, Mississippi, the Mooreville Tongue (Mooreville Chalk) intertongues with and underlies a very fossiliferous phase of the Coffee Sand (Tupelo Tongue).

The erosional contact between the Tombigbee Sand and the overlying Coffee Formation is subdued in weathered outcrops of Tishomingo County, and often a thin, irregular ironstone layer separates the massive-bedded Tombigbee sands from the interlaminated sands and clays of the overlying Coffee Formation. Parks et al. (1960) described this erosional boundary in Prentiss County. The Tombigbee-Coffee contact is disconformable to the north, in Tennessee, as conglomeratic zones in the basal Coffee Sand overlie highly weathered Eutaw strata (Russell et al., 1983). The erosional boundary continues southward through Tishomingo County. The lower Coffee intertongues with the Mooreville Chalk in Itawamba County (Vestal and Knollman, 1947).

The Tombigbee Sand Member conformably overlies the Lower Eutaw Member (Figures 95 and 96). Thin clay beds and laminae in upper portions of the Lower Eutaw Member resist downward movement of iron-bearing solutions borne by downward percolating meteoric water through glauconite-bearing Tombigbee sands, resulting in thin beds and laminae of iron oxide cemented sandstone at the contact. Evidence of burrowing activity is preserved in these lowermost, ironstone-bearing Tombigbee sands, as ferruginous cemented sandstone molds. These molds are the result of burrowing activity of the marine decapod *Callianassa*, whose fossil burrows occur in strata ranging in age from the Jurassic through Recent time (Weimer and Hoyt, 1964). *Callianassa* burrows occur throughout the Tombigbee Sand Member and in the overlying Coffee Formation, but are most abun-

Figure 93 - Thinly interbedded, fine-grained, glauconitic, micaceous sands and silty clays of the Lower Eutaw Member. Pickax is 26 inches in length. Location: NE/4, NE/4, NW/4, Sec. 22, T.3S., R.10E.

Figure 94 - Petrified wood in lowermost portions of the Lower Eutaw Member. Pickax is 26 inches in length. Location: SW/4, SE/4, SE/4, Sec. 26, T.6S., R.9E.

dant in ferruginous zones near the contacts with underlying Lower Eutaw and overlying Coffee strata. Burrowing activity reworked the marine Tombigbee Sand strata to the extent that, except for rare, faint cross-bedding near the lower contact, all evidence of bedding in the Tombigbee Sand Member has been erased. The characteristic massive appearance of the Tombigbee Sand in outcrop easily distinguishes the unit from the cross-bedded sands and clays characteristic of the Lower Eutaw Member (Figure 97). The massively bedded Tombigbee Sand lithofacies grades laterally into the thin bedded sand and clay lithofacies characteristic of the Lower Eutaw Member northward, in Hardin County, Tennessee (Russell and Parks, 1975). The outcrop belt of the Tombigbee Sand continues south and east in a broad arc across northeastern Mississippi and central Alabama and into Georgia.

The Tombigbee Sand Member is composed of very fine- to medium-grained (chiefly fine-grained), very well-sorted, glauconitic, micaceous sand with minor amounts of silt and clay. The unit is massively bedded, and ranges in color from medium gray in fresh exposures to various hues of yellowish and reddish-brown in weathered exposures. The Tombigbee Sand Member is consistently 90 to 100 feet thick in southern and central portions of Tishomingo County, and thins northward to a minimum exposed thickness of about 60 feet in northernmost portions of the county. The Tombigbee Sand averages 100 feet thick in Itawamba County (Vestal and Knollman, 1947), and is 75 to 85 feet thick in Prentiss County (Parks et al., 1960). The Tombigbee Sand Member varies in thickness along strike to the east in Alabama, attaining minimum thicknesses of 25 feet at Pickensville, Pickens County, Alabama, and 35 feet in the Warrior River Valley, and is missing on the south side of Sipsey River Valley, Greene County, Alabama (Monroe et al., 1946). The Tombigbee Sand continues downdip in the subsurface of Mississippi and Alabama with thicknesses ranging from 10 to 75 feet in the subsurface of Neshoba and Kemper counties, Mississippi, and Sumter and Greene counties, Alabama (Eargle, 1946). The minimum thickness in the cross sections of Eargle (1946) occurs in the subsurface of Neshoba County, where only 10 feet of Tombigbee strata are reported from the J. P. Evans, Oliver Number 1 test well.

Test holes drilled in northwestern Tishomingo County for the present study indicate a northward thinning of Tombigbee Sand strata. Test hole AP-1 penetrated 99 feet of medium light-gray, fine-grained, very well-sorted, glauco-

Figure 95 - Trough cross-bedded, glauconitic sands of tne Lower Eutaw Member grade upward, through a 2-foot interval, into massive, bioturbated sands of the Tombigbee Sand Member of the Eutaw Formation. Pickax at the contact is 26 inches in length. Location: NW/4, SE/4, SE/4, Sec. 17, T.4S., R.10E.

nitic, micaceous sands comprising the Tombigbee Sand interval in the NW/4 of Sec. 4, T.3S., R.9E. Test hole AP-3, located about 5 miles to the northeast in SE/4 of Sec. 10, T.2S., R.9E., penetrated 68 feet of Tombigbee strata. Test hole AP-2, located 5.2 miles northeast of AP-3, encountered only 57 feet of Tombigbee strata. The glauconite content in subsurface samples of the Tombigbee Sand ranges from about 3 to 20 percent, and mica contents range from about 2 to 15 percent. The glauconite in the Tombigbee Sand is pelletal in form, and is dark olive green to black when fresh. The glauconite grains generally fall into the fine-grained sand category (1/8-1/4 mm), although the pellets occasionally exceed 1 mm in length. The Tombigbee Sand contains appreciable amounts of white mica (up to 15 percent), with occasional trace amounts of biotite mica. A general increase in glauconite content occurs toward the base of the Tombigbee. This increase continues in the Lower Eutaw where up to 25 percent glauconite was noted in test hole samples. Appreciable amounts of silt and clay (up to 25 percent in subsurface samples) are contained as matrix in the Tombigbee Sand. Clay content increases sharply in passing from Tombigbee to Lower Eutaw strata in the subsurface. Plate 1 shows the locations of test holes and the areal distribution of the Tombigbee Sand Member at the surface of Tishomingo County. Cross section A-A' (Plate illustrates occurrences of the Tombigbee Sand along a line of section generally parallel to strike, and cross section B-B' (Plate 3) illustrates the Tombigbee profile parallel to dip. The strike of the Tombigbee Sand Member is generally due north, and varies between N. 0° E. and N. 15° E. county-wide. Dip is to the west at about 30 feet per mile (Plate 3) with minor variations.

The Tombigbee Sand is quite distinctive in outcrop due to the steep slopes supported by the well-sorted sands, and the massive appearance due to its lack of distinct bedding (Figure 97). The contact of the Tombigbee Sand Member with the underlying Lower Eutaw Member is gradational through a thin interval of laminated sands in the lowermost Tombigbee Sand. Figure 95 shows the general appearance of this contact in outcrop. Weathering of glauconite imparts a reddish to yellowish brown color in outcrop, and frequently the Tombigbee Sand is dark reddish-brown to maroon in highly weathered areas. The best exposures of the Tombigbee Sand Member in Tishomingo County occur in roadcuts along U. S. Highway 72 in the vicinity of Burnsville (T.3S., R.9 and 10E.) and along State Highway 365, which runs parallel to the Alcorn County line and generally along strike in T.3S. and T.4S., R.9E. Roadcuts of State Highway 364 expose the contact between the Lower Eutaw and Tombigbee Sand members in the NW/4, SE/4, SE/4, Sec. 17, T.4S., R.10E. (Figure 95). Figure 96 describes the Tombigbee Sand in measured section. The southernmost occurrences of the Tombigbee Sand at the surface of Tishomingo County are small outliers that occupy hilltops in the NW/4, NE/4, Sec. 35, T.5S., R.9E. (Plate 1).

The Tombigbee Sand Member is included in basal portions of the *Exogyra ponderosa* zone described by Stephenson (1914). This faunal zone extends upward and includes the lower half of the Selma Chalk in the eastern Gulf Coastal Plain. The diverse fauna described from the Tombigbee Sand in Lowndes, Clay, Monroe, and Prentiss counties, Mississippi, is absent in Tishomingo County. Evidence of bioturbation in the form of ferruginous-cemented sand molds and clay-lined burrow tubes in unconsolidated sands characterize the Tombigbee Sand in well preserved exposures (Figure 98). These tubular structures (*Ophiomorpha nodosa* Lundgren) were identified by Weimer and Hoyt (1964) as borings of the decapod crustacean *Callianassa* sp.

The Coffee Formation unconformably overlies the Tombigbee Sand Member of the Eutaw Formation (Figures 99 and 100). This unconformity is not apparent in weathered outcrop, and zones of massive bedded sands in Coffee strata, as well as apparent laminations in uppermost Tombigbee strata, cause difficulty in tracing the contact in southernmost areas of occurrence. The abrupt lithologic boundary is marked by a thin zone of iron-cemented sandstone laminae, and often by a single thin (1 inch) ironstone layer. Figure 99 illustrates the general appearance of the Tombigbee-Coffee erosional boundary that separates the bioturbated, massive, marine Tombigbee sands from overlying, thinly in-

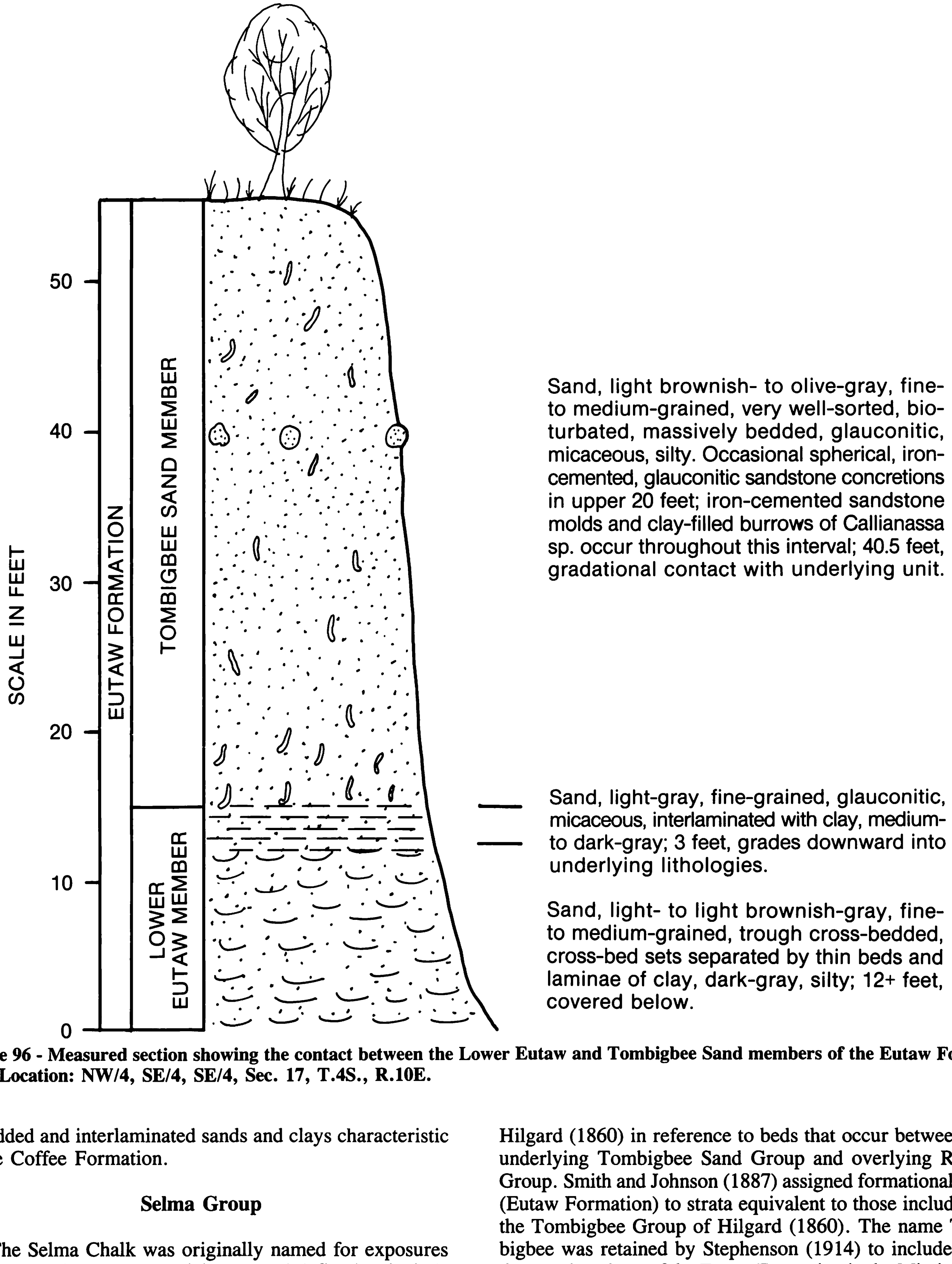


Figure 96 - Measured section showing the contact between the Lower Eutaw and Tombigbee Sand members of the Eutaw Formation. Location: NW/4, SE/4, SE/4, Sec. 17, T.4S., R.10E.

terbedded and interlaminated sands and clays characteristic of the Coffee Formation.

Selma Group

The Selma Chalk was originally named for exposures at Selma, Dallas County, Alabama, and defined to include all strata above the Coffee Sand and below the Ripley Group in Smith et al. (1894). This sequence had previously been described in Mississippi as the Rotten Limestone Group in Hilgard (1860) in reference to beds that occur between the underlying Tombigbee Sand Group and overlying Ripley Group. Smith and Johnson (1887) assigned formational rank (Eutaw Formation) to strata equivalent to those included in the Tombigbee Group of Hilgard (1860). The name Tombigbee was retained by Stephenson (1914) to include only the massive phase of the Eutaw Formation in the Mississippi-Alabama region. The Coffee Sand of Safford (1864) was retained as the uppermost member of the Eutaw Formation (Stephenson, 1914), until Stephenson and Monroe (1938)

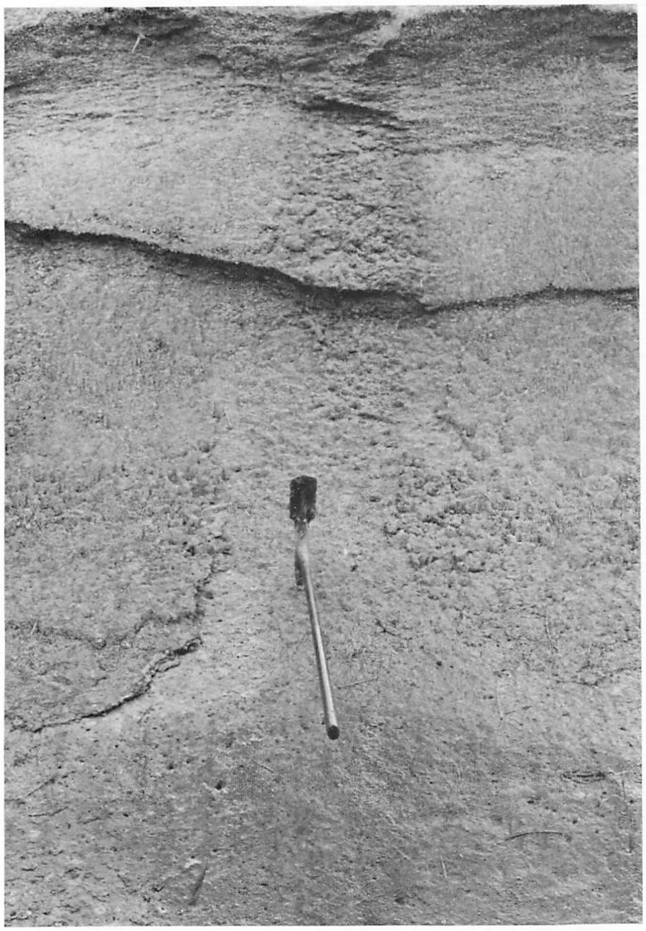


Figure 97 - Outcrop appearance of the bioturbated, glauconitic sands comprising the Tombigbee Sand Member of the Eutaw Formation. Pickax is 26 inches in length. Location: SW/4, SE/4, SE/4, Sec. 17, T.4S., R.10E.

Figure 98 - Clay-filled burrows of the marine decapod *Callianassa* sp. occur in the massive, bioturbated Tombigbee Sand Member. Quarter for scale. Location: NW/4, SE/4, SE/4, Sec. 17, T.4S., R.10E.

recognized the Coffee Sand strata as a lowermost phase of the Selma Chalk, which overlies the Mooreville Chalk or the Tombigbee Sand Memberin northern Mississippi (Figure 67). The lower third of the thick Selma Chalk sequence that underlies west-central Alabama and east-central Mississippi merges and intertongues northwestward in Mississippi into the Coffee Sand. Although the Coffee Sand is described as being of formational rank and included in the Selma Chalk, the Selma was not discussed specifically as a group in Stephenson and Monroe (1938). The Selma was assigned group rank in the subsurface of Mississippi by McGlothlin (1944) and Eargle (1946). The term Selma Group was initially utilized on the geologic map of Mississippi by Belt et al. (1945), and in subsequent literature describing Selma lithologies that underlie northeastern Mississippi and western Alabama (McGlothlin, 1944, Eargle, 1946, Monroe et al., 1946).

The Coffee Formation is the uppermost unit of Cretaceous age that occurs in Tishomingo County. A complete section of the formation is not present as it is truncated by erosion, and Tennessee River Terrace deposits disconformably overlie the unit in northernmost portions of the county.

Coffee Formation

Safford (1864) assigned the name Coffee in reference to strata exposed in bluffs of the Tennessee River near Coffee Landing in Hardin County, Tennessee, and described this stratigraphic interval as the lowermost of the Cretaceous beds exposed in western Tennessee. In 1911, L. W. Stephenson (*in* Veatch and Stephenson, 1911) divided strata previously included in the Coffee Sand in Tennessee and the Eutaw Formation in Mississippi into the Tombigbee Sand Member and an upper Coffee Sand Member of the Eutaw Formation. The Tombigbee and Coffee members are included in the *Exogyra ponderosa* faunal zone of Stephenson (1914). Stephenson (1914) recognized the merging of chalky and non-chalky Selma strata along strike, such that the Tombigbee Sand Member is overlain by the Selma Chalk in central and western Alabama and east-central Mississippi and by the Coffee Sand in northern Mississippi. The stratigraphic sequence described by Stephenson (1914) for northern Mississippi is shown in Figure 67. The Coffee Sand was excluded from the Eutaw Formation and placed in the Selma Chalk in Stephenson and Monroe (1938).

The Coffee Formation is the only unit in the Selma Group that occurs in Tishomingo County. The northernmost exposures of the Coffee Formation occur near the Kentucky-Tennessee state line and continue southward across western Tennessee into Mississippi (Russell and Parks, 1975). Surface exposures of the Coffee Formation continue southward

Figure 99 - Erosional boundary between the massive, bioturbated marine sands of the Tombigbee Sand Member of the Eutaw Formation and the overlying, thinly bedded sands of the Coffee Formation. Pickax is 26 inches in length. Location: NW/4, NW/4, SE/4, Sec. 31, T.2S., R.10E.

from Tennessee through Alcorn, Prentiss, and Tishomingo counties. The Coffee Sand is replaced by the main body of chalky Selma strata in southern Lee and northwestern Itawamba counties. The Tupelo Tongue is a very fossiliferous phase representing the southernmost extension of the Coffee Formation; it was named by Stephenson (1917) for exposures in the vicinity of Tupelo, Lee County, Mississippi. The Coffee Formation loses its identity to the south as it merges and intertongues with chalky facies of the Selma Group.

The areal distribution of the Coffee Formation at the surface of Tishomingo County is shown on Plate 1. The main body of Coffee exposure occurs west of the Tennessee-Tombigbee Waterway and north of T.4S., although outliers occupy hilltops for a distance of several miles east and south of the main outcrop belt. Woodall Mountain is along the eastern limit of outlying occurrences of the Coffee Formation. Strike trends N. 10° E. to N. 20° E. along an arcuate outcrop belt and the dip is to the west at about 30 feet per mile. The outcrop belt of the Coffee Formation attains a maximum width of 8 miles in northwestern Tishomingo County.

The Coffee Formation overlaps the Eutaw Formation, and lies unconformably upon Paleozoic rocks in northern Decatur County, Tennessee (Russell and Parks, 1975). The Coffee Formation is 200 feet thick to the north in Hardin and McNairy counties, Tennessee (Russell and Parks, 1975). The Coffee Formation outcrop belt continues southward from Tennessee, through central Alcorn County, northwestern Tishomingo County, central Prentiss County, and the north half of Lee County, Mississippi. The basal 150 feet of the Coffee Formation occurs at the surface of northwestern Tishomingo County (Plate 1). Southward, in Prentiss County, a maximum thickness of 275 feet of Coffee Formation strata occurs between the disconformably underlying Tombigbee Sand Member and the disconformably overlying Demopolis Formation (Parks et al., 1960). The Coffee Formation decreases in thickness to about 100 feet where the southward extension is represented by the Tupelo Tongue in central Lee County, and is missing farther south where the Tupelo Tongue merges and intertongues with chalky Selma facies (Stephenson and Monroe, 1940).

The Coffee Formation is composed of very fine- to medium-grained, micaceous, glauconitic, quartz sand, thinly interbedded and interlaminated with light- to medium-gray, silty clay. Bedding is generally thin and horizontal with frequent zones of small-scale, planar and trough cross-bedding and cross lamination (Figure 101). Colors vary in outcrop, from light- to medium-gray when fresh, to grayish orange-pink, light brownish-gray and various shades of reddish-brown when weathered. The glauconite content generally varies between 2 and 5 percent, and the mica content varies between 2 and 6 percent in subsurface samples from test holes drilled for the present study. The Coffee Formation was penetrated in test holes AP-1, AP-2, and AP-3. The sands are very loose and generally less than 1/4 mm in size, although frequent zones of medium (up to 1/2 mm) size grains are common, and thin lenses and beds of chert gravel occur in lowermost portions of the Coffee Formation. Thin clay beds and laminae separate the fine-grained sand beds. The dark olive gray glauconite grains are pelletal, and generally 1/8 to 1/4 mm long. White mica flakes are small, generally less than 1/2 mm in diameter. Weathered zones continue downward to as much as 80 feet, as hues of reddish-brown grade downward to shades of gray in test holes drilled for the present study. The upper 80 feet of the Coffee sands in test hole AP-1 are moderate orange-pink and reddish-orange in color, and clays are white and light pink in color. Quartz grains are subangular, and the sands are well sorted. The clay content in drill samples varied from 10 to 60 percent.

The Coffee Formation is a thinly interbedded and interlaminated sand and clay sequence, with zones of cross-bedding and massive bedding in coarser sands increasing southward along the outcrop belt in Tishomingo County. Clays are not as lignitic in the Coffee Formation in Tishomingo County as those reported from Tennessee in Wade (1920), where clay beds are often black and contain abundant comminuted plant fragments, lignitized logs, wood fragments, and silicified logs. Occasional dark gray carbonaceous clay

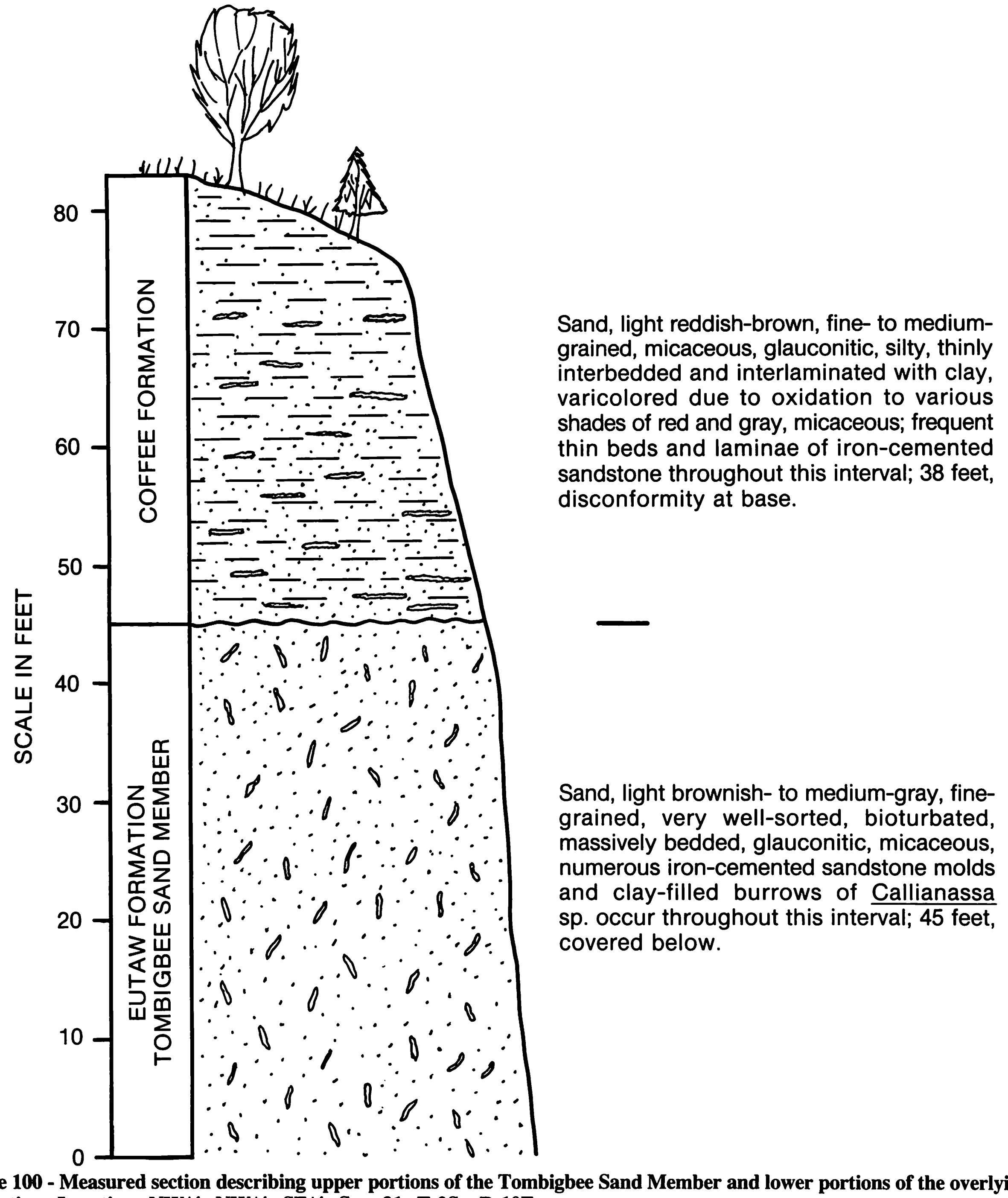


Figure 100 - Measured section describing upper portions of the Tombigbee Sand Member and lower portions of the overlying Coffee Formation. Location: NW/4, NW/4, SE/4, Sec. 31, T.2S., R.10E.

laminae occur, although no carbonized or silicified logs were observed during the present study. Thin beds of bentonite occur in the Coffee Formation of Prentiss County (Parks et al., 1960). No occurrences of bentonite were observed in Coffee strata during the field work for the present study.

Fossil preservation is not good in the Coffee Formation in Tishomingo County. Occasional limonitic tubular structures that represent burrowing activity of the marine decapod *Callianassa* occur in ferruginous zones in lower portions of the Coffee Formation (Figure 101). Stephenson and Monroe (1940) reported five species of marine mollusks from fossiliferous ironstone concretions in cuts of Southern Railway, 2 miles northwest of the town of Burnsville, in the SW/4, SE/4, NE/4, Sec. 33, T.2S., R.9E. (Collection 6461). These cuts have become overgrown with vegetation and slumping of the sands has covered lowermost portions of many of the exposures. Very good exposures are afforded in more recent borrow pit excavations made for the use of Coffee sands for fill material during construction of U. S.

Highway 72. The Coffee Formation is well exposed in borrow pits located in the SW/4, SE/4, SW/4, Sec. 4, T.3S., R.9E., and eastward in the NE/4, SE/4, SE/4, Sec. 3 and the NW/4, SW/4, SW/4, Sec. 2, T.3S., R.9E., on the south side of U. S. Highway 72. Figure 101 illustrates the irregular and cross-bedded, partially bioturbated sand beds, separated by clay laminae along bedding planes, in a sandpit located in the NW/4, SW/4, SW/4, Sec. 2, T.3S., R.9E. The underlying Tombigbee Sand supports steep valley walls of gulleys in lower portions of the sand pit (Figure 102). The Coffee Formation is more evenly bedded, and *Callianassa* burrows are less common in exposures to the northeast in Tishomingo County. Figure 103 illustrates the outcrop appearance of thinly interbedded and interlaminated sands and clays of the Coffee Formation exposed in the NW/4, NW/4, SE/4, Sec. 31, T.2S., R.10E. Figure 100 shows a measured section which begins near the location of Figure 103 and continues eastward through exposures of the underlying Tombigbee Sand. Bedding in the Coffee Formation is generally thicker (although less distinct in weathered outcrops) in northwestern Tishomingo County and has frequent occurrences of planar to trough cross-bedding, with occasional massive bedding. Ferruginous sandstone beds occur frequently in lower Coffee beds, near the contact with the underlying Tombigbee Sand. A zone of iron-cemented, irregular and thinly-bedded sandstone that occurs in lowermost Coffee beds is exposed near the top of Woodall Mountain. This ironstone interval forms a resistant caprock that has prevented downward erosion of less resistant, unconsolidated sands below, preserving the highest elevation in Mississippi (806 feet). Zones of ironstone in lower Coffee beds form a useful, traceable stratigraphic horizon by which lower Coffee strata can be correlated through poorly exposed areas. Figure 104 shows the zone of thinly bedded, iron-cemented sandstones, exposed in westernmost Tishomingo County in the SW/4, SW/4, NW/4, Sec. 21, T.2S., T.9E. This ironstone zone diminishes in thickness to a single, thin bed of ironstone separating bedded Coffee sands from unconformably underlying, massive sands in the Tombigbee Sand Member (Figure 103). The absence of bedding, increase in glauconite content, and sharp increase in frequency of occurrences of *Callianassa* burrows in very well-sorted, underlying Tombigbee lithologies in the field.

Occasional molds of mollusks are preserved in ferruginous cemented sandstone laminae at the base of the Coffee Formation. Molluscan taxa collected from basal Coffee strata exposed in roadcuts on both sides of State Highway 364 in the NE/4, NW/4, NW/4, Sec. 19, T.4S., R.10E., and the SE/4, SE/4, SE/4, Sec. 13, T.4S., R.9E., are shown in Figure 105. Fossil specimens collected from these outcrops include species of the genera *Trigonia, Veniella, Crassatella, Cyprimeria, Neithea, Aphrodina,* and *Turritella.*

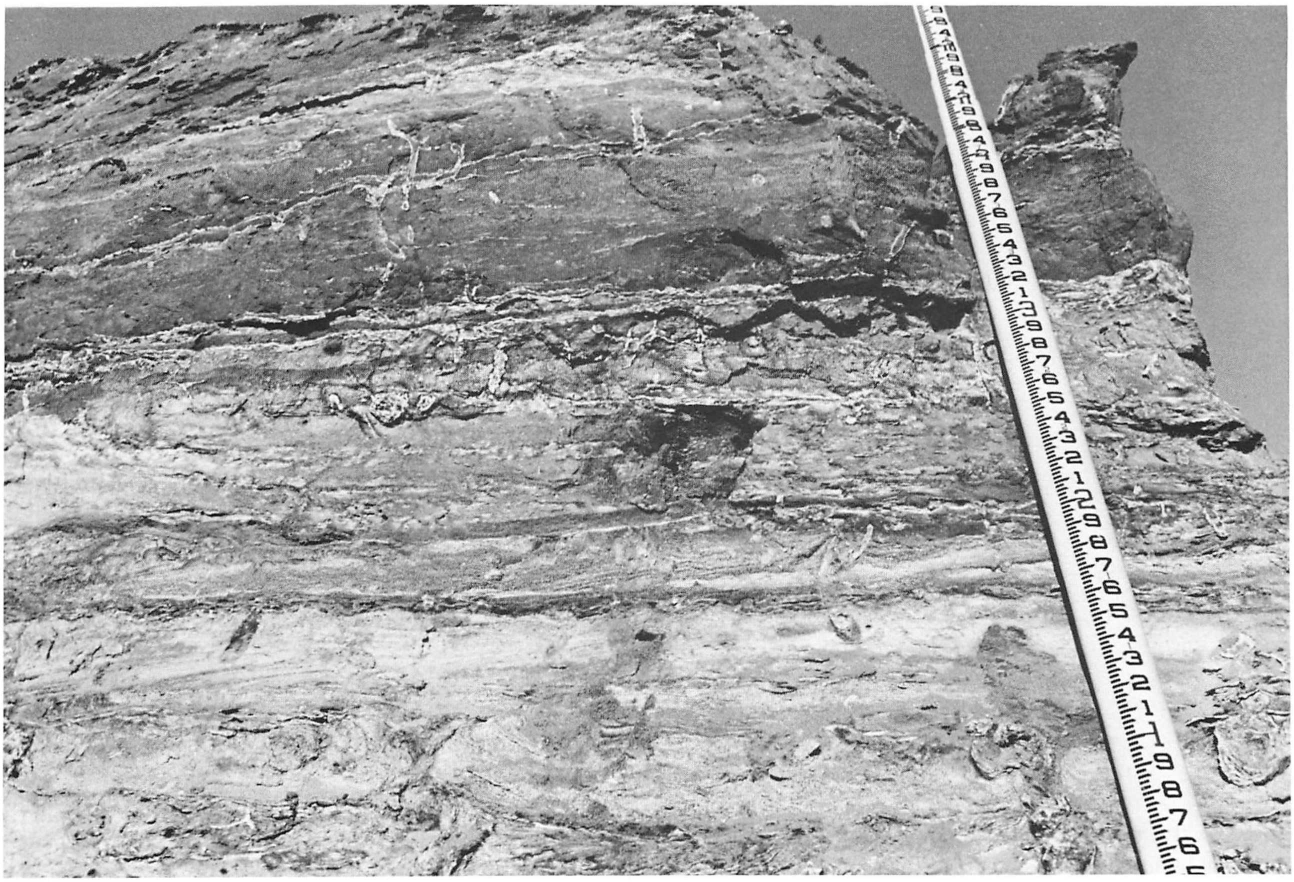


Figure 101 - Lowermost interval in the Coffee Formation is characterized by irregularly bedded and cross-bedded, fine- to medium-grained, bioturbated sand and clay. Scale in feet and 1/10 intervals. Location: NW/4, SW/4, SW/4, Sec. 2, T.3S., R.9E.

Figure 102 - The well-sorted sands of the Tombigbee Sand Member support steep to vertical slopes (foreground). The pinnacle of overlying loosely consolidated sands of the Coffee Formation remains from excavations for roadfill in the construction of U. S. Highway 72. Person is standing on the contact. Location: NW/4, SW/4, SW/4, Sec. 2, T.3S., R.9E.

Figure 103 - Thinly interbedded and interlaminated, cross-bedded, fine- to medium-grained, glauconitic, micaceous sands and silty clays impart an evenly bedded appearance to the Coffee Formation in intervals less affected by bioturbation. Pickax is resting on a thin bed of ironstone that separates the underlying Tombigbee Sand Member from the overlying 30-foot interval of the Coffee Formation at this relatively unweathered exposure. Pickax is 26 inches in length. Location: NW/4, NW/4, SE/4, Sec. 31, T.2S., R.10E.

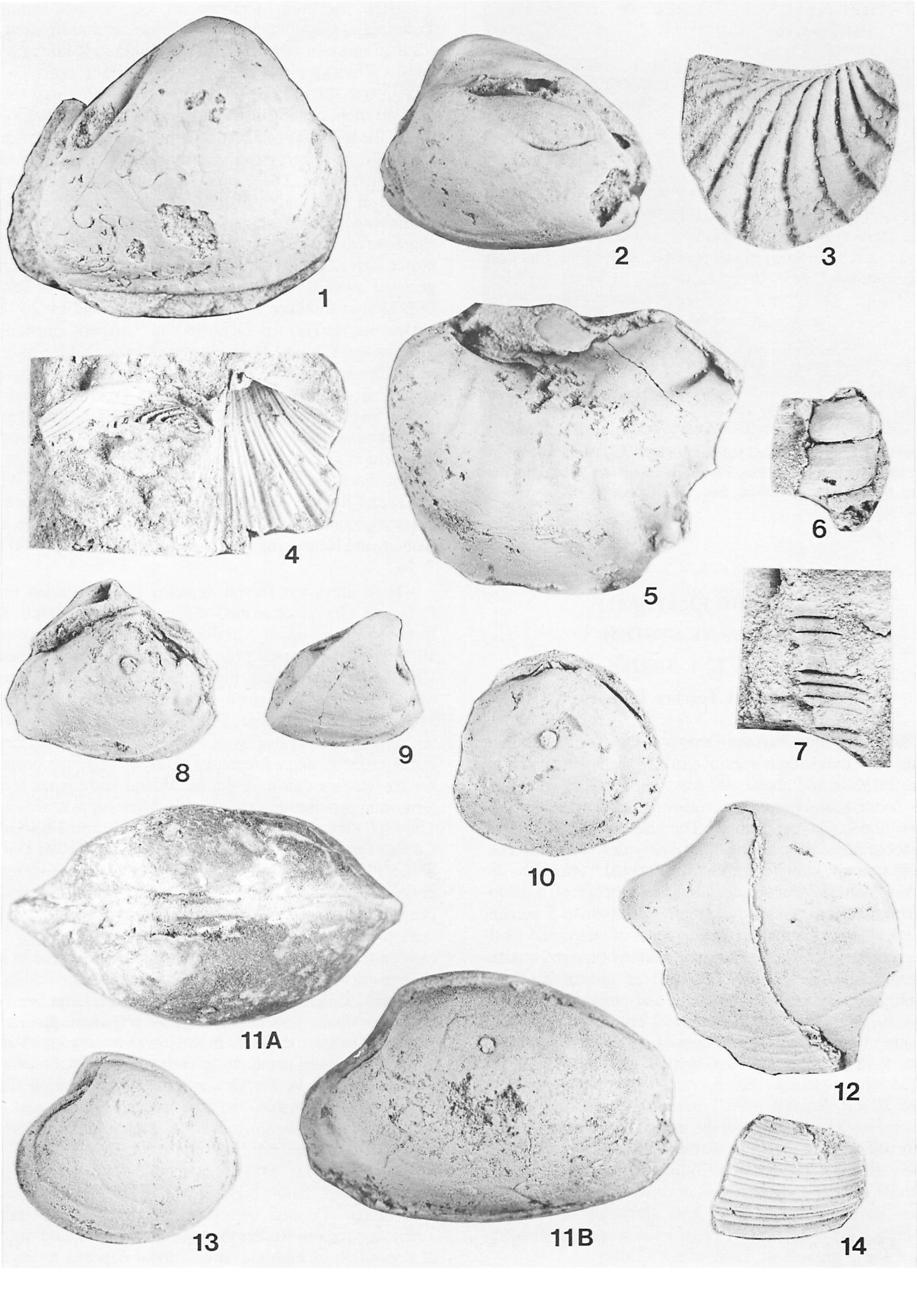
Figure 104 - Iron-cemented sandstone beds in lowermost interval of the Coffee Formation. Pickax is 26 inches in length. Location: SW/4, SW/4, NW/4, Sec. 21, T.2S., R.9E.

CENOZOIC ERATHEM
QUATERNARY SYSTEM
PLEISTOCENE SERIES
High Elevation Terrace Deposits

High Elevation Terrace Deposits occur in Tishomingo County as fluvial sequences of gravel, sand, silt, and clay at elevations at and above 600 feet. The terraces consist of cross-bedded sands and very well-rounded chert, quartzite, quartz, and sandstone pebbles. The principal constituent of the pebble population is chert, probably derived from Tuscaloosa gravels, which were initially derived from Paleozoic cherts in Alabama, Tennessee, and Mississippi (see Tuscaloosa Group section). Quartzite comprises less than 5 percent of the pebble population, and occurrences of quartz and sandstone pebbles are rare. The ultimate source of quartz, quartzite, and sandstone pebbles, as well as quartz sands, is probably Pennsylvanian sandstones and conglomerates exposed in Alabama and Tennessee. These gravels were deposited initially as stream deposits of Upper Cretaceous fluvial systems (Tuscaloosa Group) and subsequently reworked into present terrace deposits by the ancestral Tennessee River. Russell (1987) described pathways of the ancestral stream systems and the mineralogies of the resulting fluvial deposits. High Elevation Terrace Deposits occur at the surface of Tishomingo County as isolated exposures of fluvial gravels and sands that occupy hilltops in the Tennessee River drainage basin and along the Tennessee-Tombigbee drainage divide. Plate 1 illustrates the distribution of these gravels in Tishomingo County.

High elevation terraces in central and southern Tishomingo County contain less gravel and more sand and silt than those in northernmost Tishomingo County, which consist almost entirely of chert and quartzite gravel with a silty quartz sand matrix. The central and southern terrace deposits often contain chert and quartzite pebble conglomerates in the lowermost 15 feet, which grade upward into quartz sand, silt, and clay, oxidized to various shades of reddish-brown in outcrop. These deposits occur south of the general latitude of Iuka, and probably represent slightly less energetic fluvial environments than the thicker gravel sequences characteristic of terraces exposed in the vicinity of the Tennessee River. These lithologies are mapped separately on the geologic map (Plate 1) as Qth (High Elevation Terrace Deposits) in southern and central portions and as Qtt (Tennessee River Terrace Deposits) in northern portions of Tishomingo County. High elevation terraces are preserved on hilltops west of the Tennessee River in northern Tishomingo County, and exposures continue into Tennessee. High elevation fluvial gravels are not preserved on hilltops east of the Tennessee River (Russell, 1975), indicating the northeastward migration of the Tennessee River. These high elevation fluvial terraces are described in Tennessee (Wade, 1917, and Russell and Parks, 1975), where the terraces attain maximum development in McNairy, Hardin, Decatur, Benton, and Henry counties, with thicknesses of up to 70 feet.

High elevation fluvial deposits were included in the Lafayette Gravel described throughout the Coastal Plain Province in the upper Mississippi Embayment, as well as all other physiographic provinces in the middle and eastern United States and along the Atlantic seaboard, as a series of coalescing alluvial plain deposits related to the ancestral Mississippi, Cumberland, Ohio, and Tennessee rivers (Potter, 1955a). Mineralogies of the gravels were described in Potter (1955a), and a preglacial (Tertiary) age was proposed for the gravels that underlie Smithland and higher terrace terrains in uppermost portions of the Mississippi Embayment. The high elevation fluvial deposits exposed in Tishomingo County cannot be correlated with pre-loess gravels that underlie Pleistocene wind-transported silts (loess) along the periphery of the Mississippi alluvial plain in Mississippi, because loess deposits do not extend eastward from the Mississippi alluvial valley as far as Tishomingo County. The easternmost occurrences of loess deposits reported in Mississippi are the very thin deposits in Alcorn County, described in Stephenson and Monroe (1940) as brown loam overlying the Selma Chalk. Fisk (1951) assigned a Quaternary (Pleistocene) age to loess deposits in the lower Mississippi Valley, so the underlying pre-loess gravels are at least Pleistocene or older in age. A Tertiary age for high elevation fluvial deposits is questionable, and time-stratigraphic deposits were described in the literature in Mississippi and Tennessee as Tertiary (?) Quaternary (Russell, 1968, Russell, 1975, and Russell and Parks, 1975). No datable fossil remains have been reported from high elevation fluvial deposits in Tishomingo County or elsewhere in the Mississippi-Tennessee region. Rather than questionably extend the time of deposition of high elevation fluvial deposits to the Ter-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tiary, a Pleistocene age is assigned to terrace deposits that occur in Tishomingo County.

The maximum thickness of high elevation fluvial deposits encountered in Tishomingo County occurs in test hole AP-6, wherein 56 feet of iron-stained chert and quartzite gravels and sands occur in the NW/4, NW/4, NE/4, Sec. 26, T.1S., R.10E. Tennessee River Terrace Deposits unconformably overlie marine sands and clays of the Eutaw and Coffee formations in northern portions of Tishomingo County (Figure 106). Surface exposures occur in gravel pits where terrace gravels have been excavated for use as road beds and fill material. Gravel deposits in the Pine Flat area of Tishomingo County are generally 30 to 50 feet in thickness. Figure 107 illustrates the outcrop appearance of Tennessee River Terrace Deposits in the Pine Flat area, near the site of AP-2, in the SW/4, SE/4, SE/4, Sec. 19, T.1S., R.10E. Coarse chert and quartzite gravels characteristic of the high elevation fluvial deposits in northernmost Tishomingo County (Figure 108) are designated on Plate 1 (sheet 1) as Tennessee River Terrace Deposits (Qtt). High elevation fluvial gravels assume various shapes; chert pebbles are generally spherical or slightly elongate, and quartzite and rare sandstone pebbles are flattened and elongate, assuming oblate and, occasionally, bladed forms. Figure 109 is a measured section of terrace gravels pictured in Figure 107.

Southward in Tishomingo County, fluvial terrace deposits occur as isolated chert and quartzite gravels that cap hilltops along the west side of Bear Creek valley east of Iuka (Figure 110), and southward into Itawamba County. High elevation terrace gravels occupy broad, flat hilltops in the vicinity of Horsehoe Bend southeast of the town of Tishomingo, where the gravels truncate Upper Cretaceous marine sands and Lower Mississippian sandstone (Plate 1, sheet 2). Test hole AP-11 penetrated quartzite bearing chert gravels above glauconitic, marine sands and clays of the Eutaw Group. This stratigraphic sequence is exposed in cuts of secondary roads crossing tributaries of Bear Creek, in E/2, Sec. 1, T.6S., R.10E., SE/4, Sec. 36, T.5S., R.10E., and NW/4, Sec. 6, T.6S., R.11E. These gravels overlie the Hartselle Formation in a roadcut of the Natchez Trace, in SE/4, NE/4, SW/4, Sec. 30, T.5S., R.11E. Test hole AP-10, located southwest of the town of Golden in NW/4, SE/4, SE/4, Sec. 14, T.7S., R.10E., penetrated 24 feet of an upward-fining sequence of light-brown to moderate orange-pink, quartz and quartzite bearing, chert gravel in a matrix of silty quartz sand, with a well-cemented basal conglomerate, above glauconitic marine beds of the Eutaw Group. This sequence is exposed in nearby roadcuts located in SE/4, Sec. 12, T.7S., R.10E., as a thin (less than 20 feet thick) veneer of cemented, quartzite-bearing, chert gravels above weathered, glauconitic, Eutaw Group strata. These fluvial terraces continue southward, occupying broad, flat hilltops along the Tennessee-Tombigbee drainage divide, extending to the south into Itawamba County. High elevation fluvial deposits unconformably overlie Eutaw strata in isolated areas along lines of section illustrated on Plate 2 (sheet 1) and Plate 4.

Figure 106 - Unconsolidated, very light brown, micaceous, glauconitic sand of the Coffee Formation unconformably overlain by iron-cemented chert, quartzite pebble conglomerate comprising basal portions of Tennessee River Terrace Deposits. Pickax is 26 inches in length. Location: NE/4, SW/4, NE/4, Sec. 19, T.1S., R.10E.

Gravels and sands in High Elevation Terrace Deposits have been incorporated into sediments comprising younger fluvial terraces that occur at lower elevations, adjacent to major streams in Tishomingo County.

Low Elevation Terrace Deposits

Low Elevation Terrace Deposits occur adjacent to the present course of streams, above present flood plain elevation, and below the older, high elevation terraces, throughout Tishomingo County and to the north in Tennessee. The

Figure 105 - Fossil specimens preserved at the base of the Coffee Formation: 1 - *Cucullaea (Idonearca)* sp., internal mold, X 1; 2 - *Cucullaea (Idonearca)* sp., internal mold, X 1.3; 3 - *Trigonia* sp., external mold, X 1.2; 4 - *Cucullaea (Idonearca)* sp. hinge at left and *Neithea (Neitheaps)* sp. external mold at right, X 1.2; 5 - *Trigonia* sp., internal mold, X 1.3; 6 - *Turritella* sp., internal mold, X 1.5; 7 - *Turritella* sp., external mold, X 1.6; 8 - *Crassatella* sp., internal mold, X 1.2; 9 - *Veniella* sp., internal mold, X 1.3; 10 - *Cyprimeria* sp., internal mold, X 1; 11 - *Aphrodina* sp.?, internal mold, X 1.1; 12 - *Cyprimeria* sp., internal mold, X 1.2; 13 - *Aphrodina* sp., internal mold, X 1.5; 14 - *Aphrodina* sp., external mold, X 1. Location: NE/4, NW/4, NW/4, Sec. 19, T.4S., R.10E.

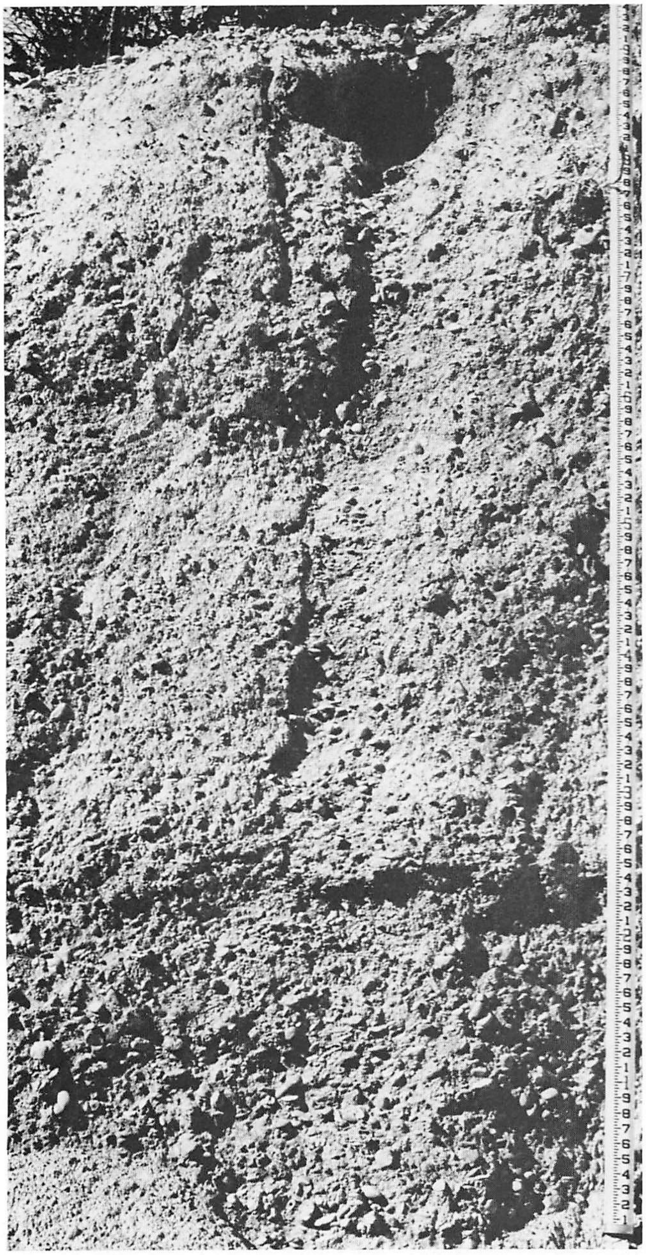

Figure 107 - Fluvial gravels and sands in Tennessee River Terrace Deposits occur as well-rounded chert and quartzite pebbles in a matrix of quartz sand. Scale in feet and 1/10 increments. Location: SW/4, SE/4, SE/4, Sec. 19, T.1S., R.10E.

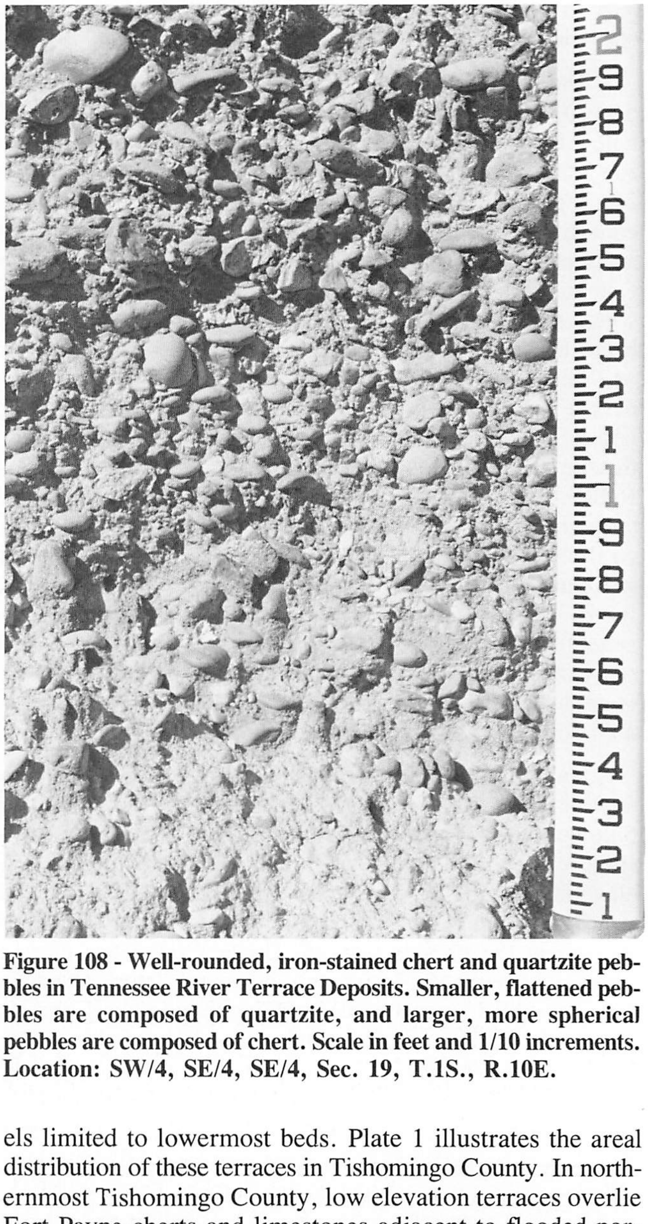

Figure 108 - Well-rounded, iron-stained chert and quartzite pebbles in Tennessee River Terrace Deposits. Smaller, flattened pebbles are composed of quartzite, and larger, more spherical pebbles are composed of chert. Scale in feet and 1/10 increments. Location: SW/4, SE/4, SE/4, Sec. 19, T.1S., R.10E.

distribution of these low elevation terraces in northeastern Tishomingo County, northwestern Lauderdale County, Alabama, and southeastern Hardin County, Tennessee, is shown on a geologic map of the T.V.A. Power Plant site by Russell (1975). This map indicates that occurrences are limited primarily to the west side of the Tennessee River, within areas of Tishomingo and Hardin counties that are included in that study area.

The low elevation terraces are primarily composed of thin intervals (less than 40 feet thick) of quartz sand, silt, and clay, with occurrences of quartzite-bearing chert gravels limited to lowermost beds. Plate 1 illustrates the areal distribution of these terraces in Tishomingo County. In northernmost Tishomingo County, low elevation terraces overlie Fort Payne cherts and limestones adjacent to flooded portions of Yellow Creek, Indian Creek, and Tennessee River valleys (Plate 1, sheet 1). Occurrences of low elevation terraces continue southward, with most frequent occurrences limited to the west side of Mackeys Creek, Cripple Deer Creek, and Bear Creek valleys (Plate 1, sheets 1 and 2), below 550 feet in elevation, where they unconformably overlie Cretaceous beds. Low elevation terraces are directly related to present stream courses. Basal terrace gravels occupy hillsides adjacent to streams and slope toward the present flood plains, truncating underlying beds. The best exposures of low elevation terraces occur in roadcuts on the north side of Cold Mill Creek, in central portions of Sec. 5 and 6, T.2S., R.10E., and in roadcuts of State Highway 365 between the towns of Cross Roads and Burnsville (Plate 1, sheet 1). Bedding is indistinct and appears massive, and oxidation produces a dark reddish-brown color in weathered outcrop. Basal beds of the low elevation terraces contain thin

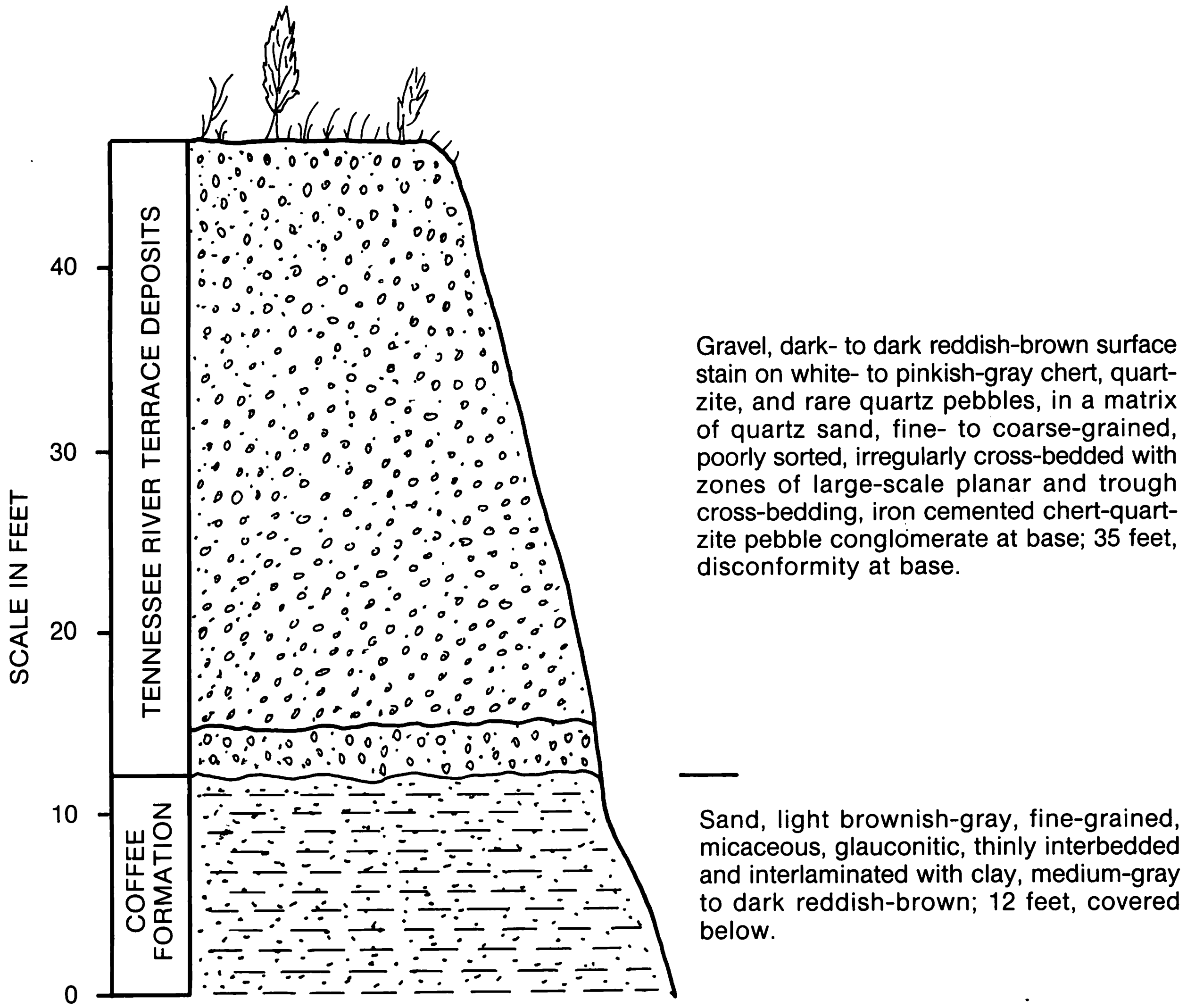

Figure 109 - Measured section showing the contact between the Coffee Formation and unconformably overlying fluvial gravels and sands comprising the Tennessee River Terrace Deposits. Location: SW/4, SE/4, SE/4, Sec. 19, T.1S., R.10E.

beds and stringers of gravel. Figure 111 illustrates the outcrop appearance where basal terrace beds truncate the Tombigbee Sand in SE/4, NW/4, SE/4, Sec. 6, T.2S, T.10E. Figure 112 illustrates this sequence in measured section. The topography developed on the low elevation terraces is characteristically smooth and gently sloping, providing broad areas of little or no relief very suitable for pasture land and cultivation for row crops. Low elevation terraces are encountered in the northern portion of the line of section shown on Plate 2 (sheet 1).

Sediments comprising low elevation terraces are derived from High Level Terrace Deposits, Tuscaloosa gravels, and the unconsolidated marine sands comprising Upper Cretaceous strata that were incorporated into the sediment load of migrating streams. The terraces are highly weathered where exposed, and generally blend with weathered in situ Cretaceous beds in areas where basal gravels are absent. Occurrences of Low Elevation Terrace Deposits continue westward into Alcorn and Prentiss counties, southward into Itawamba County, and eastward along the west side of Bear Creek valley into Franklin County, Alabama. Low Elevation Terrace Deposits reach maximum development along the west side of Bear Creek valley, where they truncate Tuscaloosa gravels and marine sands of the Eutaw Group in their updip limits and occupy broad areas of little or no relief in the vicinity of Dennis, Belmont and Golden (Plate 1, sheet 2). Low elevation terraces in this area consist of fining upward fluvial sequences of cross-bedded chert and quartzite gravels in the lowermost 15 feet, overlain by horizontal and cross-bedded, fine- to coarse-grained, poorly sorted quartz sand, irregularly interbedded with silty clays in uppermost portions. Exposures are generally weathered to dark reddish- to orangish-brown. Bedding is indistinct and massive in appearance, except where ironstone laminae occur along bedding planes such that original bedding patterns are preserved. Sands and gravels comprising low elevation fluvial terraces rise gradually from the very flat terrain of flood plains deposited by Recent and present stream processes. Low elevation fluvial terraces are preserved primarily on the west

Figure 110 - Chert and quartzite pebbles in High Elevation Terrace Deposits. Chert pebbles are spherical and slightly elongate, and quartzite and rare sandstone pebbles are elongate and flattened, assuming oblate and bladed forms. Rock hammer is 12 inches long. Location: SE/4, NW/4, SW/4, Sec. 2, T.3S., R.11E.

Figure 111 - Quartz sands containing lenses, stringers, and thin beds of chert and quartzite gravel in lowermost intervals comprise the Low Elevation Terrace Deposits. The pickax is at the erosional boundary between the Tombigbee Sand Member and overlying low elevation fluvial gravels. Pickax is 26 inches in length. Location: SE/4, NW/4, SE/4, Sec. 6, T.2S., R.10E.

sides of present stream valleys throughout Tishomingo County, although less frequent occurrences of low terraces occupy the east valley slopes. The toes of many low elevation terraces have been removed as streams migrated toward the valley walls, and recent erosion and downslope movement has dissected the terrace remnants, exposing underlying beds in the tributary valleys. The very flat topography of Recent alluvium associated with modern stream development can be broadly delineated on topographic maps, and separated in a general way from the broad, gently sloping hills underlying the low elevation fluvial deposits. Distinctive lithologies that characterize these deposits accurately distinguish them in the field. Organic-rich flood plain sediments generally occur at or below the present zone of saturation (or flood level of present streams) and are less oxidized than the highly weathered, generally coarser sediments comprising basal portions of the low elevation terraces.

RECENT SERIES

Alluvium

Alluvium occupies the low, flat-lying areas of stream valleys, in and adjacent to present stream courses. Recent flood plains attain maximum development in lower portions of the stream valleys, and become thinner and narrower in areal extent as upstream limits are approached. Alluvium is generally missing in uppermost reaches of present stream courses where intermittent and spring-fed tributaries flow on bedrock or on coastal plain sediments. Plate 1 illustrates the areal distribution of Recent Alluvium in the stream valleys of Tishomingo County.

Recent alluvial deposits occurring in Tishomingo County consist primarily of a fining upward sequence of gravels, sands, and silty clays that attains a maximum thickness of about 30 feet county-wide. Significant areas of alluvium are presently covered by floodwaters of Pickwick and Bay Springs lakes. Lowermost portions of the alluvial sequence in Tishomingo County contain well-rounded pebbles and cobbles of chert, quartzite, sandstone, quartz, and occasionally limestone derived locally from Paleozoic bedrock, and incorporated into the sediment load as erosional stream processes remove and transport materials downstream as channel lag deposits. The finer sediments are transported downstream in more swiftly moving waters. During stream migration, the channel moves laterally, and areas previously occupied by the channel become the site of less energetic deposition in which progressively finer sediments accumu-

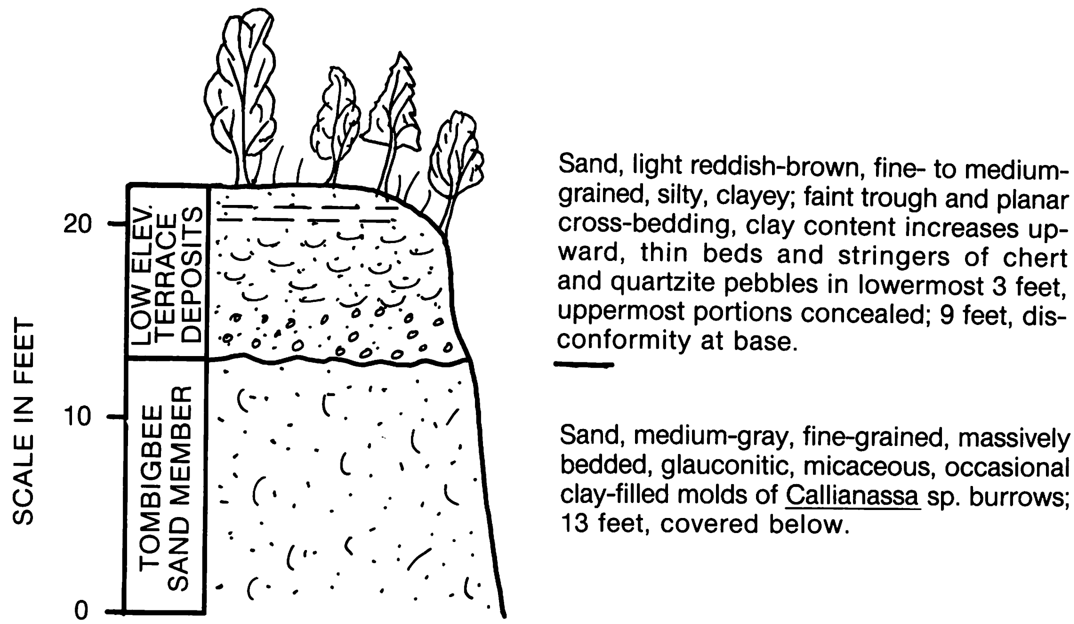

Figure 112 - Measured section showing the contact between the Tombigbee Sand Member and unconformably overlying Low Elevation Terrace Deposits shown in Figure 111. Location: SE/4, NW/4, SE/4, Sec. 6, T.2S., R.10E.

late. Organic-rich silts and clays, containing large amounts of comminuted vegetable matter, are deposited as fine fractions of the stream sediment load settle out in ponded floodwaters. Cross-bedded gravels comprise the lowermost 5 to 10 feet of alluvium in Tishomingo County, and grade upward into planar- to trough cross-bedded and horizontally bedded quartz sands, thinly interbedded and interlaminated with lenses and beds of organic-rich silt and clay in the uppermost portions. Flood plain sediments generally occur at or below the zone of frequent saturation, and soils are not as oxidized as those that develop on adjacent, low elevation terraces, or upon in situ strata that occupy valley walls and hilltops. The lower oxidation potential prevalent in flood plain environments imparts a characteristic gray color to flood plain sediments, whereas increased oxidation potential imparts a reddish-brown color to sediments that occur above the zone of frequent saturation.

The width of Recent Alluvium (flood plain deposits) that occurs in Tishomingo County varies from 0 in uppermost reaches of the streams to a maximum of about 2.5 miles at the confluence of Yellow and Little Yellow creeks east of the town of Burnsville (Plate 1, sheet 1). The flood plain becomes very narrow, and is occasionally missing along those portions of Bear Creek that are deeply entrenched in bedrock. Lines of weakness imposed by fractures in the Hartselle sandstone and underlying Paleozoic beds have largely controlled the course of Bear Creek, and downcutting of Bear Creek has, through time, sculptured vertical sandstone cliffs that have restricted the lateral migration of Bear Creek within a very narrow flood plain in the Horseshoe Bend area (Sec. 31, T.5S., R.11E.) and southward for a distance of 7 miles along Bear Creek valley. The flood plain of Bear Creek widens as the Hartselle sandstone dips into the subsurface in the NE/4, NE/4, NE/4, Sec. 13, T.6S., R.10E., and attains a maximum width of 1.4 miles in Sec. 25, T.6S., R.10E., and Sec. 30, T.6S., R.11E., in southeastern Tishomingo County (Plate 1, sheet 2).

Flood plains are utilized extensively for cropland and grazing areas for livestock in Tishomingo County. The organic-rich soils that develop on Recent alluvial deposits are potentially highly productive, although the threat of flooding precludes their use for crops that require well-drained soils.

Flooding is a natural cyclic stream process. The times between episodes can be measured on an annual basis, and times between major floods are measured in tens or hundreds of years. Stream valleys located in Tishomingo County have developed primarily as a function of semiannual, annual, biannual, and 10-year flood intervals. The less frequently occurring episodes of major 100-year and 200-year floods are more destructive, and lend more toward the erosion and removal of accumulated soils. Evidence of flooding in Tishomingo County includes isolated pockets of gravel deposited as channel lag associated with interwoven branches, small trees, and other organic debris carried in floodwaters and deposited along the water line on valley slopes as floodwaters retreated. Recent alluvial (flood plain) deposits comprise approximately 10 percent of the land area of Tishomingo County. Occurrences of Recent Alluvium along lines of cross sections described in the present study appear on Plates 2 through 4.

STRUCTURAL GEOLOGY

Paleozoic strata of northeastern Mississippi occupy the southwest extremity of a widespread carbonate facies, which extends from the Appalachian Mountains in Alabama northwestward beyond the Nashville Dome in Tennessee (Thomas, 1972a). The lower Paleozoic sequence that occurs in the subsurface of northeastern Mississippi consists primarily of carbonate rocks, which intertongue with clastic rocks (Ouachita facies) in the subsurface of northwestern Mississippi (Thomas, 1972a). The upper Paleozoic rocks of northeastern Mississippi comprise a regressive shallow marine clastic facies (Thomas, 1972a). Total thicknesses of shallow inland marine sediments that accumulated in the stable continental interior basin during Paleozoic time exceed 17,000 feet (Pike, 1968). This large oil and gas producing structural feature is acclaimed in the literature as the Black Warrior Basin. The Black Warrior Basin is described in the subsurface of northern Mississippi and northwestern Alabama in Mellen (1947 and 1953) as a large triangular area of approximately 35,000 square miles of Paleozoic sediments bounded southeastward by the western margin of the Appalachian Mountains system and southwestward by the buried Ouachita Mountains system. The basin extends northward to the Nashville and Ozark domal structures, and is genetically associated with the McAlester-Arkansas Valley Basin and the Cumberland Plateau geosyncline of east-central Tennessee (Mellen, 1953). The Black Warrior Basin was the site of marine and terrigenous-clastic sedimentation in Cambrian through Pennsylvanian time. The Lower Devonian Ross Formation is the oldest (Helderbergian) interval in the Black Warrior Basin sequence preserved at the surface of Mississippi (Tishomingo County), and the Upper Mississippian (Chesterian) Hartselle Formation is the youngest. Younger strata of Late Mississippian and Pennsylvanian ages, which occur at the surface of northwestern Alabama and in the subsurface of Mississippi and Alabama, are absent from the stratigraphic sequence exposed in Tishomingo County. Elsewhere in the basin, a two thousand foot thickness of middle and upper Cambrian limestones, shales, and sandstones occurs in the Rome and Conasauga formations, and the unconformably overlying Knox dolomite is over 3300 feet-thick (estimated) locally (Mellen, 1953). The overlying Silurian limestones, siliceous limestones, and novaculitic cherts comprising the Wayne and Brownsport groups attain a maximum thickness of about 350 feet in northwestern Alabama (Pike, 1968) and Tishomingo County, Mississippi (Plate 2, sheet 2).

The depositional center of the basin had shifted to the west and southwest by Devonian time and the thickest accumulations of Devonian carbonate rocks (800 feet thick) occur in the subsurface of northern Mississippi (Pike, 1968). The region was uplifted to the north and beveled by erosion during Late Devonian time, such that the beveled Paleozoic surface truncated progressively older stıata northward. Variable thicknesses of strata originally deposited above the Lower Devonian Ross Formation were removed locally in northeastern Mississippi during this period of erosion, prior to deposition of the lower Chattanooga Shale in Late Devonian time. The Chattanooga overlies the Lower Devonian (Helderbergian) Ross Formation disconformably in Tishomingo County.

During Late Devonian time, the majority of the land area of the eastern United States consisted of three tectonic elements: a geosyncline (exogeosyncline), complementary landmass to the east, and a tectonically stable interior platform (continental interior) (Conant and Swanson, 1961). The exogeosyncline and complementary landmass were tectonically active, but the stable interior platform of northeastern Mississippi received widespread deposition of carbonaceous marine shales (Chattanooga Formation) in a slowly transgressing sea during Late Devonian time (Conant and Swanson, 1961).

The regional setting and tectonic evolution of geosynclines that occupied North America during Ordovician, Silurian, and Devonian times are discussed in Kay (1951). The axis of maximum sediment accumulation in this Devonian exogeosynclinal basin extends northeastward from eastern Tennessee, through Virginia, West Virginia, Pennsylvania, and into New York (Conant and Swanson, 1961). A maximum known thickness of 10,000 feet of Middle and Upper Devonian sedimentary rocks occurs in eastern West Virginia (Conant and Swanson, 1961). Thicknesses of Upper Devonian strata rarely exceed 100 feet in areas (including Tishomingo County) located on the tectonically stable interior platform, near the southwest margin of the Chattanooga sea (Conant and Swanson, 1961).

In Early Mississippian time, the sea transgressed from north to south, and sediments that now comprise the Fort Payne and Tuscumbia formations accumulated above the carbonaceous Chattanooga marine shale in the Black Warrior Basin of northeastern Mississippi (Pike, 1968). Sea level rose worldwide in Late Devonian and Early Mississippian time, and reached a global highstand in Osagean and early Meramecian time (Vail et al., 1977); marine sediments comprising the Fort Payne and Tuscumbia intervals accumulated on a tectonically stable marine continental shelf. In Late Mississippian time the interbedded limestones, shales, and sandstones of the Chesterian Series were deposited unconformably on Lower Mississippian (Fort Payne and Tuscumbia) strata (Pike, 1968).

During Late Mississippian time, the northern rim of the Black Warrior Basin constituted a stable platform comprised of a western portion that received primarily terrigenous clastic sediment input, and an eastern portion (East Warrior platform of Thomas, 1979) that consisted of a shallow marine shelf carbonate sequence (Cleaves, 1983). Cleaves and Broussard (1980) and Cleaves (1983) described the four cycles of deltaic progradation and the various marine-clastic lithologies and facies comprising the Upper Mississippian Chesterian series in northeastern Mississippi. This interval includes the Pride Mountain and Hartselle formations of Tishomingo County. Shallow marine carbonate sedimentation prevailed eastward on the East Warrior platform during this (Late Mississippian) time, as evidenced by the oolitic and bioclastic limestones comprising the Monteagle limestone sequence described in northeastern Alabama in Thomas (1972b). The thick sequence of marine-clastic sediments comprising the Pride Mountain and Hartselle formations was deposited as deltas prograded southeastward onto a tectonically stable marine shelf that occupied the northern perimeter of the Black Warrior Basin during Late Mississippian time (Cleaves, 1983). A substantial lowering of global eustatic sea level early in Late Mississippian time is indicated by the relative changes in global sea level described in Vail et al. (1977). Southeastward deltaic progradation onto the stable northern shelf resulted in deposition of a predominantly clastic sequence comprising the Parkwood and Floyd formations (western shelf) and a largely carbonate sequence comprising the Pride Mountain, Monteagle, Hartselle, and Bangor formations (eastern shelf) in northern portions of Mississippi and Alabama (Cleaves and Broussard, 1980, and Cleaves, 1983). The sediments comprising Chesterian age delta systems were probably derived from the Ozark Uplift (Cleaves, 1983).

Accumulations in excess of 10,000 feet of Pottsville sediments occurred as a result of downwarp of the Black Warrior Basin early in Pennsylvanian time, accompanied by uplift of orogenic belts to the southeast and southwest (Pike, 1968). The Ouachita Orogenic Belt supplied sediments from the southwest, and the clastic wedge comprising the Pottsville Group prograded northward and northeastward into the subsiding foreland basin (Cleaves, 1983). The basin was uplifted after Pennsylvanian time, and no Permian sedimentation occurred (Pike, 1968).

During Triassic and Jurassic time, thicknesses in excess of 10,000 feet of Pennsylvanian and Mississippian sediments were removed as a result of uplift (Central Mississippi Uplift) and subsequent erosion in central Mississippi, along the southern margin of the basin (Morgan, 1970). Thick sequences (over 13,000 feet) of terrigenous basinfill clastic sediments (predominantly Pottsville strata) are preserved near the axis of the Black Warrior Basin (Cleaves, 1981).

Tishomingo County occupies the northern perimeter of the Black Warrior Basin, described in Cleaves (1981) as the Interior Shelf Undeformed Zone. This zone lacks the extensive normal faulting present southward in the basin. Regional dip in these northern portions of the Black Warrior Basin homocline is to the southwest at about 1/2 degree, and steepens toward the axis of the basin. Variable thicknesses of strata of Mississippian and Pennsylvanian age have been eroded from the Interior Shelf sedimentary rock sequence of northeastern Mississippi, and the Hartselle Formation is the youngest Paleozoic unit exposed at the surface of Tishomingo County. The overlying Bangor Limestone occurs to the south in the subsurface of Mississippi and Alabama.

Southward downwarp of the basin occurred early in the Mesozoic Era, and the northward transgression of the sea initiated Gulf Coastal Plain deposition (Pike, 1968). Subsequent structural activity and associated periods of erosion and non-deposition removed any lower Mesozoic strata deposited in the study area, and Upper Cretaceous fluvial gravels and marine sands overlie Mississippian strata unconformably in Tishomingo County.

Early in Late Cretaceous time, a large structural dome occupied the northern Mississippi Embayment area. Rocks of Cambrian, Ordovician, Silurian, and Devonian age were exposed on the eroded crest of the broad dome, which stood nearly 1000 feet above sea level (Stearns and Marcher, 1962). Downwarping of the dome and initial development of the Mississippi Embayment syncline commenced in Late Cretaceous time, although major development of the syncline did not take place until Eocene time (Stearns and Marcher, 1962). The large structural dome has been depressed beneath the Mississippi Embayment as a result of Cretaceous and subsequent periods of structural movement, and is presently recognized as the Pascola structural arch located between the Ozark and Nashville domes in western and central Tennessee (Stearns and Marcher, 1962). The present course of the Mississippi River generally follows the axis of the southward-plunging Mississippi Embayment syncline. The syncline is filled with as much as 3000 feet of Upper Cretaceous and younger strata (Stearns and Marcher, 1962).

Paleozoic strata dip southwestward from the Nashville Dome into the Black Warrior Basin in northeastern Mississippi (Mellen, 1947). Dip steepens progressively from less than 40 feet per mile in northern Mississippi to over 300 feet per mile to the southwest, in deeper portions of the basin (Thomas, 1972a). Tishomingo County is located on upper portions (hinge zone) of the eastern (westward dipping) limb of the Mississippi Embayment syncline. The slight regional dip of Paleozoic strata in Tishomingo County is influenced by the southwestern flank of the Nashville Dome and the eastern flank of the Mississippi Embayment syncline. The Paleozoic strata of Tishomingo County are essentially flat-lying and horizontally bedded, and dip is to the south-southwest at about 1/2 degree. Slight irregularities in bedding cause major variations in strike of beds that have a dip of less than about 5 degrees, and the very shallow dip of units that occur in Tishomingo County is best described in terms of feet per mile. Average (county-wide) strike of Paleozoic strata is about N. 70° W., and regional dip is to the south-southwest at 30 to 50 feet per mile, with local variations imposed by very gentle folds and local undulations.

Upper Cretaceous strata occupy the majority of the land surface of Tishomingo County. These Coastal Plain units are distributed in broadly arcuate belts, extending across the surface of northeastern Mississippi in a north-south to southeast direction. Regional strike is generally north-south in areas including Tishomingo, Alcorn, Prentiss, Lee and Itawamba counties of northeastern Mississippi. A change of strike occurs southward, in eastern Mississippi and western Alabama, such that strike of Coastal Plain strata is in an essentially east-west direction across central Alabama. Strike of Cretaceous strata varies between N. 10° W. and N. 20° E. in Tishomingo County, and dip is westward at 25 to 40 feet per mile. Structural attitude of Cretaceous beds varies locally due to the slight relief along erosional contacts and local settling of sediments, especially in areas underlain by the larger paleovalleys. Figure 75 illustrates the variations in strike as contoured on the upper Tuscaloosa surface. The distribution of geologic units that occur in the deeper subsurface, and their structural relationship with units exposed at the surface of Tishomingo County, are shown on the cross sections given on Plates 2, 3, and 4.

Correlations of stratigraphic intervals that occur in the deeper subsurface of Tishomingo County are based on samples, descriptive logs, geophysical logs, and other available subsurface data from petroleum test wells drilled in Tishomingo County. Deeper wells are widely spaced, and stratigraphic boundaries projected between control points are indicated in the cross sections by dashed lines. Sample descriptions for several of the petroleum test wells drilled in Tishomingo County were supplied for the present study by Frederic F. Mellen. County-wide formational classification of deeper subsurface intervals, below those exposed at the surface of Tishomingo County, is not attempted in the present study due to the scarcity of data from those intervals. These intervals are indicated on the cross sections (Plates 2, 3, and 4) as the Ordovician, Silurian, and Devonian systems, undifferentiated. Much subsurface well data supplied for this study was accumulated during the course of previous geologic investigations concerning the Tennessee-Tombigbee Waterway and surrounding areas, performed by the U. S. Army Corps of Engineers in cooperation with the U. S. Geological Survey. Stratigraphic test wells were drilled by the Bureau of Geology in those areas of Tishomingo County with least subsurface control. A list of test wells that appear on the stratigraphic-structural cross sections is given in Table 3. The locations of test wells utilized in the present study appear in Figure 113.

The subsurface and surface distribution of geologic units that occur in Tishomingo County is shown along a north-south line of cross section on Plate 2, sheets 1 and 2. Plate 3 illustrates the subsurface and surface distribution of strata along an east-west trending line of cross section, near and parallel to the axis or deeper portions of a westward-opening paleovalley that occurs in the subsurface of central Tishomingo County. Plate 4 illustrates the distribution of geologic units along a southwest to northeast-trending line of cross section through areas occupied by a Paleozoic ridge that extends southwestward from east-central Tishomingo County.

The Knox Group occurs below intervals correlated on the cross sections. The top of the Knox Group occurs at about 770 feet below sea level in well 2 of Plate 2, and dips southward to about 1160 feet below sea level in the subsurface of central Tishomingo County, in well number 5 of Plate 2. The approximate subsurface distribution of overlying strata of Ordovician, Silurian, and Devonian age is shown on Plates 2, 3, and 4.

Variable thicknesses of Paleozoic strata are truncated by the erosional surface at the base of the Tuscaloosa Group. The rocks are deeply incised by paleochannels that contain great thicknesses (over 400 feet locally) of Tuscaloosa fluvial sediments. A paleochannel preserved in the subsurface of northern Tishomingo County comprises the county-wide northward limit of Tuscaloosa occurrences (Figure 75). Eutaw strata overlap the Tuscaloosa gravels northward, and overlie the Paleozoic rocks disconformably. Eutaw or McShan strata overlie Paleozoic rocks, locally, where the Tuscaloosa thins over pinnacles of Hartselle sandstone preserved in southern Tishomingo County. Figure 74 illustrates the variations in thickness of Tuscaloosa fluvial sediments county-wide. Plate 5, a contour map on the top of the Paleozoic, illustrates the surface and subsurface distribution of the uppermost erosional Paleozoic surface in Tishomingo County. The county-wide surface distribution of Paleozoic sedimentary rocks is shown on this map by the screened (shaded) areas. The erosional Paleozoic surface beneath the Tuscaloosa fluvial sediments truncates progressively older Paleozoic strata in a westward direction beneath the paleovalley in central Tishomingo County as illustrated on Plate 3. The regional topography of the Paleozoic surface also reflects the structural attitude of more deeply buried subsurface horizons, as shown on the aeromagnetic map (Figure 114). The striking similarity between the aeromagnetic characteristics and the regional Paleozoic surface topography indicates that Late Cretaceous fluvial systems may have established their courses along lines or zones of weakness imposed by pre-existing structures, such as fractures, faults, depressions, or zones (facies) occupied by less dense, more easily eroded Paleozoic strata. The subsurface Paleozoic rock structure is masked by the thick sequence of Upper Cretaceous strata, especially in deeply buried structural lows (or paleovalleys) containing thick sequences of chert gravel. No faulting was detected in the subsurface or at the surface of Tishomingo County. The gently folded, essentially flat-lying Paleozoic rocks are highly fractured, but any slight vertical displacements observed during the present study are attributable to local slumping. Large blocks of Paleozoic rocks become displaced as a result of separation along lines of fracture and subsequent downslope gravitational movement (gliding) of the block over underlying shales or otherwise less resistant strata. Contorted bedding is common in the Chattanooga Formation as a result of gravity movement along planes of weakness offered by the location of less competent shales of the Chattanooga Formation between the very competent, less easily deformed limestones and cherts of the Ross and Fort Payne formations.

A prominent system of fractures extends throughout the entire Paleozoic sequence exposed in Tishomingo County. The fractures are essentially vertical and the prominent directions of fracture generally vary within 10° county-wide. The strike of the two dominant trends are consistently about N. 55° W. and N. 40° E., with local deviations up to ± 5°. In northern portions of the county, the dominant fracture pattern that extends through the limestones and cherts comprising the Fort Payne Formation generally trends N. 52° W. and N. 40° E. Stereonet projections of prominent directions of fracture in the Fort Payne Formation measured in exposures along the shoreline of the Yellow Creek embayment result in two dominant trends of N. 54° W. ± 5° and N. 38° E. ± 5° (Johnson, 1975). Fracture directions measured during the present study average about N. 55° W. ± 5° and N. 40° E. ± 5° in exposures of the Ross Formation in northernmost Tishomingo County. Average directions of about N. 52° W. ± 5° and N. 40° E. ± 5° occur in exposures of the Fort Payne Formation in northern and central Tishomingo County, and N. 50° W. ± 5° and N. 45°

Table 3 - Test holes utilized in the cross sections shown on Plates 2, 3, and 4 of this report.

Number	Operator	Well	Location
1	Mississippi Bureau of Geology	Test Hole AP-6	NW/4, NW/4, NE/4, Sec. 16, T1S-R10E
2	Tennessee Valley Authority	Core Hole 51-C-3	NE/4, NE/4, NW/4, Sec. 35, T1S-R10E
3	Tennessee Valley Authority	Core Hole A	NE/4, SW/4, NE/4, Sec. 2, T2S-R10E
4	Mississippi Bureau of Geology	Test Hole AP-5	SW/4, SW/4, NW/4, Sec. 26, T2S-R10E
5	Levan and Akers	No. 1 J. D. Whitaker	Cent. NW/4, NW/4, Sec. 23, T3S-R10E
6	J. B. Levan et al.	No. 1 J.M. Russell	SW/4, NW/4, SE/4, Sec. 3, T4S-R10E
7	U.S. Army Corps of Engineers- U.S. Geological Survey	Hydrologic Site 24-A	SE/4, SE/4, SW/4, Sec. 19, T4S-R10E
8	U.S. Army Corps of Engineers- U.S. Geological Survey	Hydrologic Site 32	NW/4, SE/4, NW/4, Sec. 6, T5S-R10E
9	Mississippi Bureau of Geology	Test Hole AP-7	NW/4, SE/4, SE/4, Sec. 30, T5S-R10E
10	Mississippi Bureau of Geology	Test Hole AP-9	NW/4, SW/4, SW/4, Sec. 19, T6S-R10E
11	Cities Service Oil Co.	No. 1 Allen	SE/4, SW/4, SW/4, Sec. 1, T7S-R9E
12	U.S. Army Corps of Engineers- U.S. Geological Survey	Hydrologic Site SW2-1	NW/4, SW/4, SE/4, Sec. 10, T5S-R9E
13	U.S. Army Corps of Engineers- U.S. Geological Survey	Hydrologic Site 31	NW/4, SW/4, SE/4, Sec. 1, T5S-R9E
14	U.S. Army Corps of Engineers- U.S. Geological Survey	Hydrologic Site 33-C	SE/4, NE/4, NE/4, Sec. 6, T5S-R10E
15	U.S. Army Corps of Engineers- U.S. Geological Survey	Hydrologic Site 34	NE/4, NE/4, NW/4, Sec. 5, T5S-R10E
16	U.S. Army Corps of Engineers- U.S. Geological Survey	Hydrologic Site 35	NE/4, SE/4, SW/4, Sec. 33, T4S-R10E
17	U.S. Army Corps of Engineers- U.S. Geological Survey	Hydrologic Site SE1-1	SW/4, NW/4, NW/4, Sec. 35, T4S-R10E
18	U.S. Army Corps of Engineers- U.S. Geological Survey	Hydrologic Site SE2-1	NE/4, NW/4, SW/4, Sec. 25, T4S-R10E
19	Mellen and Gear	No. A1 E.K. Wood	NW/4, SE/4, SE/4, Sec. 21, T4S-R11E
20	Hawkeye Oil and Gas Co.	No. 1 Frederick, 15-16	NE/4, SW/4, SE/4, Sec. 15, T4S-R11E
21	Mellen and Gear	No. 1 Alsobrook	SE/4, SW/4, NW/4, Sec. 10, T4S-R15W
22	Mississippi Bureau of Geology	No. 1 Highland Church	NE/4, SE/4, NE/4, Sec. 26, T5S-R10E
23	Mississippi Oil and Refining Co.	Mollie Morgan, No. 1 Southward	SE/4, NW/4, NE/4, Sec. 18, T5S-R11E

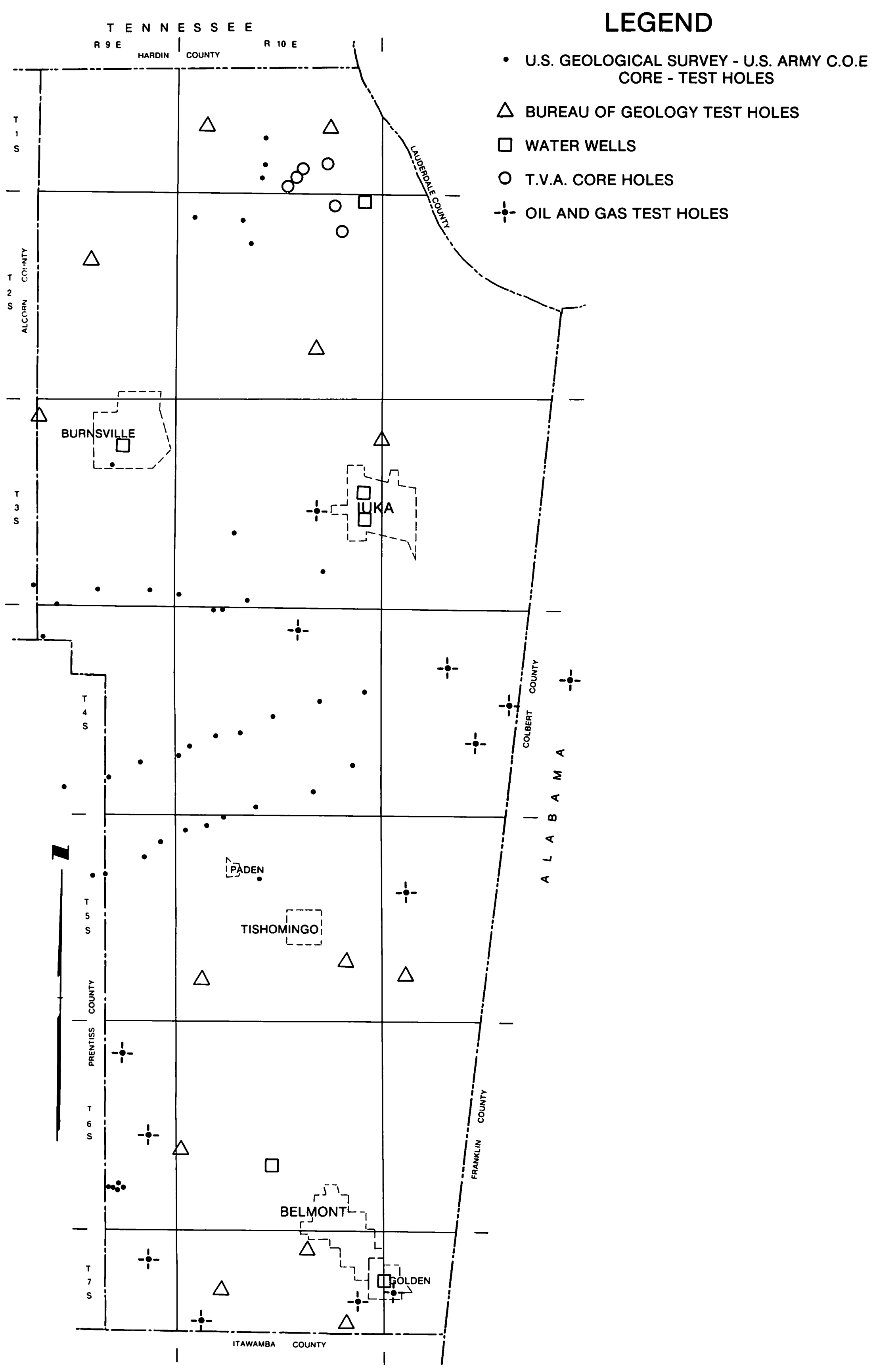

Figure 113 - Locations of test holes utilized in this report.

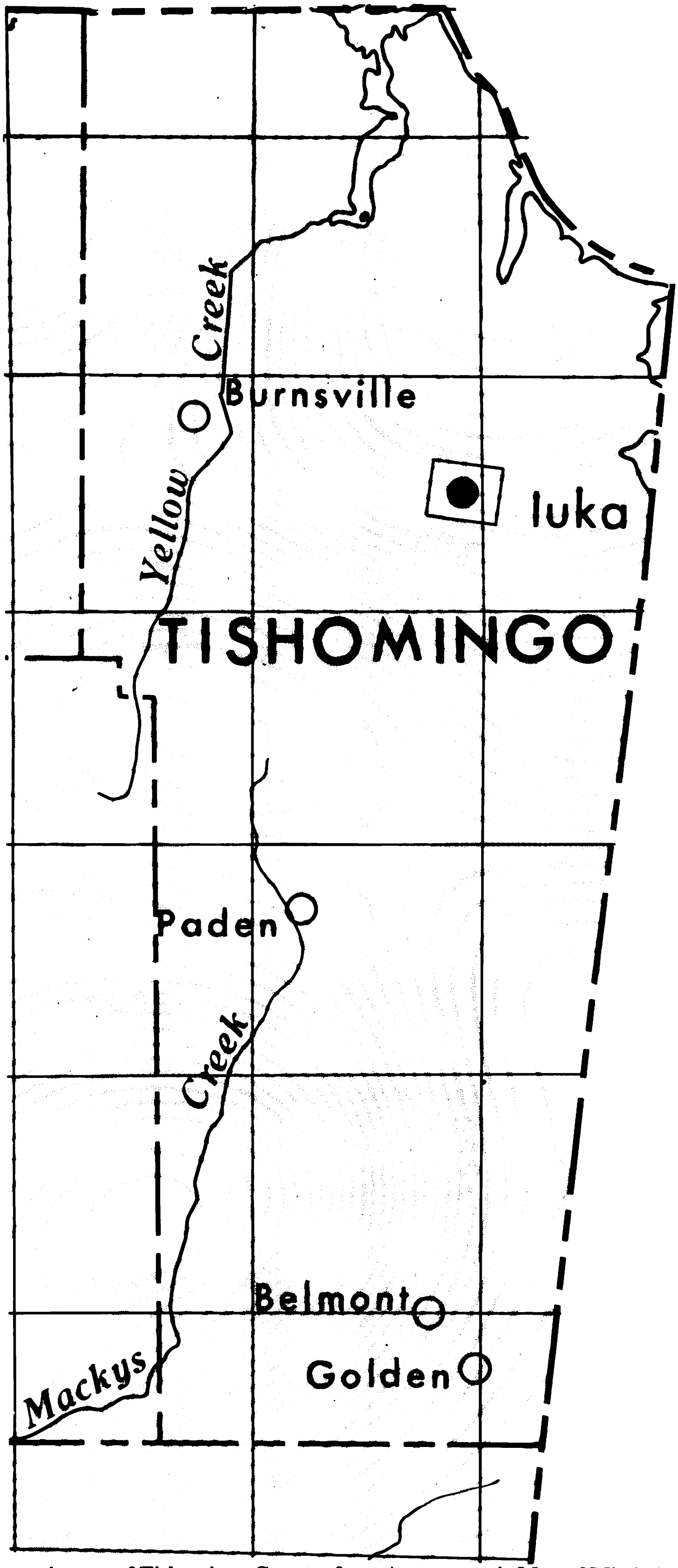

Figure 114 - Regional aeromagnetic map of Tishomingo County; from Aeromagnetic Map of Mississippi, Bendix Field Engineering Corporation, U.S. Department of Energy, Contract no. DE-AC07-76GJ01664. Contour interval is 20 nanoteslas (1 nanotesla = 1 gamma).

E. ± 5° in exposures of the Hartselle Formation in central and southern portions of the county. Variations in average directions of fracture in the joint system are within about 10° county-wide, and deviations of up to 5° occur locally in any given formation. Directional trends are average values only, and are included here for qualitative evaluation. Results of the detailed joint system study and stereonet analysis of fracture patterns in the Yellow Creek embayment area indicate that the joint system formed as a result of stresses that produced the Pascola Arch, located in Tennessee (Johnson, 1975).

The fractured sandstones comprising the Hartselle Formation occupy uppermost portions of a southwest-northeast trending ridge preserved in southern Tishomingo County (Plate 5 and Figure 114). This Upper Mississippian interval is truncated northward by a thick sequence of Tuscaloosa fluvial sediments, which occupy a westward opening alluvial valley preserved in the subsurface of central Tishomingo County. North of this area another broad southwest-northeast trending ridge occurs in the subsurface of northern Tishomingo County. The structural attitude of strata that occupy the ridge systems and truncation (absence) of equivalent strata in the central depressed areas (paleovalleys) indicate that these features are primarily erosional remnants preserved below a thick sequence of Tuscaloosa fluvial gravels and sands (Plates 2 and 3). Although the present configuration of the Paleozoic surface probably reflects structures present at the onset of fluvial and marine deposition in Late Cretaceous time (anticlines, synclines, domes, depressions, faulting or folding), local relief on the uppermost Paleozoic surface is primarily a product of widespread and intense erosion rather than tectonic stresses. Consequently, the terms ridge (paleoridge) and valley (paleovalley) are utilized rather than anticline or syncline, respectively, in order to describe these features locally in Tishomingo County. Plate 4 illustrates the stratigraphic and structural relationships of strata that occupy the ridge (paleoridge) that occupies southern Tishomingo County. The southwest extension of this ridge is manifested at the surface of Tishomingo County by the presence of Hartselle sandstones in the stream valleys of Perry Branch, Jourdan Creek, Rock Creek, and Mackeys Creek (Plate 1, sheet 2). The sharp bends in the course of Bear Creek occur as a result of downcutting of the stream along planes of weakness provided by fractures in the sedimentary rocks. Structural control of the course of Bear Creek by this joint system is very pronounced along portions of Bear Creek located between the NE/4 of Sec. 25, T.5S., R.10E., and the NE/4 of Sec. 13, T.6S., R.10E., where each leg of the stream is parallel to a local direction of fracture in the Hartselle sandstones. Bear Creek is deeply incised within steep valley walls in all areas wherein the stream course intersects the sedimentary rocks comprising uppermost portions of the Paleozoic ridge in southern Tishomingo County. Streams are less affected by the joint system present in the Paleozoic rocks elsewhere in the county, and stream courses generally parallel the northerly strike of the Coastal Plain strata (Plate 1).

ECONOMIC GEOLOGY

Potential commercial development of the many natural resources available in Tishomingo County was enhanced by the increased commercial accessibility provided to northeastern Mississippi and adjoining regions by completion of the Tennessee-Tombigbee Waterway by the U. S. Army Corps of Engineers in January of 1985. The waterway provides a navigable route between the Tennessee, Ohio, and upper Mississippi rivers, and the Black Warrior-Tombigbee River system, which terminates at the port of Mobile. Barge traffic is provided a direct route from the Tennessee River impoundment of Pickwick Lake southward to Demopolis, Alabama. Barge tows enter the Black Warrior-Tombigbee River system at Demopolis, Alabama. The Tennessee-Tombigbee Waterway is 234 miles long, and is the latest addition to approximately 25,500 miles of inland and coastal waterways in the United States (Green, 1985). The surface distribution of natural resources available in the Paleozoic sedimentary rock sequence, in the form of building stone, limestone, tripoli, and residual clays, are limited in Mississippi to Tishomingo County.

The Hartselle Formation is composed of well-cemented, fine- to medium-grained, quartz sandstone (quartz arenite) that is very suitable for building stone. These sandstones are extensively utilized in the construction of buildings and houses, especially in the Tishomingo County area. Several small quarries, most of which are presently abandoned, are located along Bear Creek valley, but large quantities of the cliff-forming, very competent sandstones remain unproduced, especially along portions of Bear Creek, Cedar Creek, and Mackeys Creek valleys and tributaries. This sandstone interval occurs at and near the surface of Tishomingo County as a narrow belt of exposures that extends southwestward from the well-known sandstone cliffs along Bear Creek valley in the vicinity of Tishomingo State Park to the vicinity of Bay Springs Lock and Dam. Laterally persistent thicknesses and lithologies and the inherent natural beauty and durability of Hartselle sandstones have been pointed out in earlier geologic literature (Logan, 1911; Morse, 1930 and 1935) concerning the Tishomingo County area. Sandstone excavated during construction of Bay Springs Lock and Dam was utilized as riprap along nearby portions of the waterway. Figure 66 illustrates one of many structures in Tishomingo State Park constructed from the beautiful sandstones of the Hartselle Formation. The sandstone sequence is consistently 25 to 30 feet thick in outcrop, although the lower contact is frequently concealed beneath talus generated by downslope movement of large sandstone blocks. The unit attains a maximum thickness of 64 feet in the shallow subsurface of southwestern Tishomingo County.

The thick limestone sequence comprising the Tuscumbia Formation offers vast quantities of carbonate rock suitable for all applications requiring the finest naturally occurring limestone available statewide. Limestone excavated from the Tuscumbia Formation was utilized for riprap along the shores of the Tennessee-Tombigbee Waterway in northeastern Mississippi. Tuscumbia limestones are utilized extensively for gravel, concrete, agricultural lime, building stone, flagstone, and many other uses. The Tuscumbia limestone sequence is exposed at the surface of east-central Tishomingo County, near the mouth of Cripple Deer Creek (Plate 1, sheet 2). The unit is truncated to the west by the erosional surface at the base of the Tuscaloosa Group, and westerly increasing thicknesses of Coastal Plain sediments (gravel, sand, and clay) overlie the Tuscumbia Formation disconformably. Plate 3 illustrates the shallow subsurface distribution of the Tuscumbia Formation in eastern Tishomingo County. Limestones comprising the Tuscumbia Formation locally contain varying amounts of chert, especially in lowermost intervals. The unit attains a maximum exposed thickness of 201 feet in the limestone quarry (Vulcan Materials Company) located on the north side of Cripple Deer Creek valley (Plate 1, sheet 2). A measured section of the Tuscumbia Formation is given in Figure 44, and specific bedding characteristics and lithologies are discussed in the Tuscumbia Formation section of this report. Large quantities of commercial grade limestone remain undeveloped in Tishomingo County. Limestones comprising lower portions of the Fort Payne Formation are widely exposed along the shores of Pickwick Lake in northern Tishomingo County (Plate 1), although the relatively low carbonate content, and substantial percentages of sand, silt, and clay present in the limestones, have deterred commercial development of Fort Payne limestones in this area.

Vast amounts of gravel aggregate and sand occur in the Coastal Plain strata of Tishomingo County. Large quantities of gravel are provided primarily by surficial occurrences of the Tuscaloosa Group and High Elevation Terrace Deposits in Tishomingo County. Tuscaloosa gravels are comprised primarily of very well-rounded pebbles and small cobbles of chert, in a matrix of varying amounts of sand, silt, and clay. Quartzite and quartz pebbles comprise small percentages of Tuscaloosa gravels in southeastern Tishomingo County. Tuscaloosa gravels are mined commercially throughout northeastern Mississippi and utilized extensively for gravel aggregate in the construction of roadways, railroad ballast, concrete aggregate and many other uses requiring naturally occurring gravel. Gravel mined from High Elevation Terrace Deposits has also been extensively utilized as concrete aggregate and in the construction of roadways throughout Tishomingo County.

The lower half (lowermost 60 to 100 feet) of the Tuscaloosa fluvial sequence is primarily composed of gravel, sand, and silt. These sediments generally fine upward, although varying thicknesses of gravel-bearing strata occur locally throughout the Tuscaloosa sequence. Gravel-bearing Tuscaloosa strata frequently exceed 100 feet of thickness, especially in eastern portions of the outcrop belt located in Tishomingo County near the Alabama state line (Plate 1). Specific lithologies and bedding characteristics of this unit are discussed in the section of this report entitled Tuscaloosa Group. Gravel-bearing strata in the High Elevation Terrace Deposits are primarily limited to lower portions of High Elevation Terrace Deposits (Qth on Plate 1, sheets 1 and 2), which occur in central and southern portions of Tishomingo County. These strata are generally 30 to 55 feet thick in northern Tishomingo County, and occupy the lower 10 to 20 feet in the remainder of these deposits county-wide. Large quantities of gravel have been quarried in the Tuscaloosa and High Elevation Terrace outcrop belts as evidenced by the many active and abandoned gravel pits, although vast quantities of gravel remain for commercial development.

Sand is locally excavated and widely utilized in the construction of roads, foundations, and other construction operations requiring fill material. Large amounts of sand were excavated from the Eutaw and Coffee formations and utilized in the recent construction of U. S. Route 72 through central Tishomingo County. Well-sorted, fine-grained sand in lowermost Eutaw strata exposed near Tishomingo are developed for foundry mold sands. The Eutaw Formation locally contains large percentages of pelletal glauconite. Vast quantities of sand occur at and near the surface of Tishomingo County throughout the Cretaceous stratigraphic interval, although the majority of sand developed commercially is contained within the McShan, Eutaw, and Coffee formations. Plate 1 (sheets 1 and 2) illustrates the outcrop distributions of these units in Tishomingo County.

Variable thicknesses of residual, in situ clays are preserved locally beneath Coastal Plain sediments at and near the surface of Tishomingo County. These clays contain large percentages of aluminum, and are composed of the clay mineral kaolinite. The residual clays are primarily of local extent, and much of the original thickness of the clays was incorporated into overlying sediments as Tuscaloosa fluvial systems dissected the Paleozoic surface in Late Cretaceous time. The clays locally contain variable amounts of unaltered parent material. X-ray characteristics and mineralogy of the residual clays are discussed in the Clay Minerals section of this report. These residual clays were described by Mellen (1937) as the Little Bear Residuum. This residual clay is locally preserved on uppermost surfaces of the Fort Payne, Tuscumbia, and Pride Mountain formations in Tishomingo County. X-ray characteristics of the residual clays indicate that the silty clays that frequently occur as matrix material and in stratified layers in Tuscaloosa strata were derived from the residual clays and reworked by Tuscaloosa fluvial systems. Tuscaloosa clays and the residual clay deposits are of local extent, and both contain varying amounts of impurities in the form of sand, silt, or unaltered parent material. No known commercial production of Tuscaloosa or residual clays exists at present in Tishomingo County. Mineralogies, chemical composition, and origin of the clays are discussed in the clay section of this report.

Four clay samples (designated in this report as sample numbers 1, 2, 3, and 5) were submitted to the Alabama Mineral Resources Institute for preliminary testing in order to determine potential uses and physical properties. Two of the samples (numbers 1 and 2) are representative of residual clays developed in situ on the Paleozoic sedimentary rocks, and two (numbers 3 and 5) of uppermost intervals of the Tuscaloosa Group. The results of preliminary firing tests completed on the four samples are given in tables 4 through 7. Preliminary test results of samples 1, 3, and 5 indicated

Mineral Resources Institute
Preliminary Clay Evaluation

MRI Number 167-204

Date Received 6-30-88 Date reported 8-12-88

Sender's Name Mississippi Geological Survey

Sender's Identification Sample #1 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 21.5 Working Properties Plastic

Color Beige Drying shrinkage, percent 2.5 Dry Strength Good

Slow firing test:

Temp. °C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	10 YR 9/2	3	5.0	25.9	40.7	1.57
1,050	10 YR 9/1	3	5.0	26.4	41.2	1.56
1,100	10 YR 9/1	3	5.0	25.4	39.7	1.57
1,150	10 YR 9/1	3	5.0	23.9	38.7	1.62
1,200	10 YR 9/1	4	5.0	22.3	36.8	1.64
1,250	10 YR 9/1	4	5.0	22.1	37.0	1.68

pH 3.7 HCL Effervescence None Other tests ____

Preliminary Bloating Test: Negative

Table 4 - Preliminary firing test results of clay sample number 1, collected from residual clay developed on limestone in the Pride Mountain Formation. Location: SW/4, NW/4, NE/4, Sec. 8, T.5S., R.11E.

potential use as structural clay products, and samples 1 and 2 showed fairly good refractory properties. The results of extrusion tests performed on samples 3 and 5 indicate that these clay samples do not meet ASTM standards for building brick at or below 1200 degrees centigrade. It is possible that these clays are suitable for building brick at higher temperatures. Extrusion tests were not performed on clay samples 1 or 2, due to considerably higher percent absorptions and apparent porosities in comparison to samples 3 and 5. Clay tests completed for this report are preliminary in nature and will not suffice for plant or process design. These results do not preclude the use of the clay material in mixes. Bulk densities, porosities, percent absorptions, percent linear shrinkages, hardnesses, and colors at temperatures ranging from 1000°C to 1250°C are given for each sample in tables 4 through 7. Sample numbers correspond with those utilized in the mineralogy section (Gann, 1988) of this report.

Tripoli is another resource generated by diagenesis of the Paleozoic sedimentary rocks. Tripoli is very finely divided, or pulverulent, silica, with individual particle diameters that range from .002 millimeter in deposits located in northeastern Mississippi, northwestern Alabama, and southern Tennessee, to .01 millimeter in deposits located near Seneca, Missouri (Spain et al., 1938). Tripoli deposits of Tishomingo County are part of a belt of exposures that extends from northeastern Wayne County, Tennessee, southward into northwestern Alabama and northeastern

Mineral Resources Institute
Preliminary Clay Evaluation

MRI Number 167-205

Date Received 6/30/88 Date reported 8/12/88

Sender's Name Mississippi Geological Survey

Sender's Identification Sample #2 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 18.2 Working Properties Plastic

Color Rust Drying shrinkage, percent 2.5 Dry Strength Fair

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	7.5 YR 8/6	2	2.5	22.5	37.1	1.67
1,050	7.5 YR 8/4	2	2.5	23.1	37.5	1.63
1,100	7.5 YR 9/2	3	2.5	23.2	36.3	1.64
1,150	7.5 YR 9/2	3	2.5	23.6	37.6	1.64
1,200	7.5 YR 9/2	3	2.5	23.5	37.8	1.61
1,250	7.5 YR 8/2	3	2.5	23.3	38.1	1.63

pH 4.8 HCL Effervescence None Other tests

Preliminary Bloating Test: Negative

Table 5 - Preliminary firing test results of clay sample number 2, collected from residual clay developed on chert contained in upper portions of the Fort Payne Formation. Location: NW/4, SW/4, SW/4, Sec. 10, T.3S., R.11E.

Mississippi. Tripoli was mined from Tishomingo County in the early 1900's (Logan, 1911) from a deposit located in the NE/4, SW/4, SW/4, Sec. 26, T.2S., R.11E. Tripoli was dug by hand and transported by tram from the underground mine to a plant on the Riverton Branch of Southern Railway in Alabama, where the material was prepared for market (Morse, 1930). The tripoli mine was closed because the workmen were stricken by tuberculosis, induced by breathing the angular silica dust particles (Morse, 1930). Wet mining would eliminate dust generated during extraction of the tripoli. A map of the abandoned silica mine is shown in Figure 37. Figures 35 and 36 illustrate the appearance of the tripoli mine and exposures of the tripoli generated by the tunneling (mining) process. About 1600 short tons of material were removed from the main shaft of the mine (Figure 36) (Vestal, *in* Spain et al., 1938). Tripoli was primarily utilized as an abrasive in scouring powders, soaps, polishing and buffing products, and, to a lesser extent, in the manufacture of glassware (Spain et al., 1938). Tripoli occurs in Tishomingo County as a pulverulent, siliceous phase of the Fort Payne Formation. Tripoli deposits of northeastern Mississippi occur primarily in the vicinity of the abandoned mine, although large quantities remain unproduced in and near the mine. Tripoli deposits are local in nature, and generally restricted restricted to areas where diagenesis of Fort Payne strata was enhanced by the collapse of underground solution features and the subsequent leaching in near-surface horizons.

The sandstone and limestone intervals that occur in lower

Mineral Resources Institute
Preliminary Clay Evaluation

MRI Number 167-206

Date Received 6/30/88 Date reported 8/12/88

Sender's Name Mississippi Geological Survey

Sender's Identification Sample #3 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 15.1 Working Properties Plastic

Color Dark Tan Drying shrinkage, percent 4.0 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	5 YR 8/4	3	5.0	15.8	29.5	1.86
1,050	5 YR 8/4	3	5.0	15.8	29.7	1.87
1,100	7.5 YR 8/4	4	5.0	15.3	28.9	1.88
1,150	7.5 YR 8/4	4	5.0	14.7	27.8	1.90
1,200	7.5 YR 8/4	4	5.0	14.4	26.4	1.93
1,250	10 YR 9/2	5	5.0	14.6	25.0	1.94

pH 3.6 HCL Effervescence None Other tests

Preliminary Bloating Test: Negative

Table 6 - Preliminary firing test results of clay sample number 3, collected from the Tuscaloosa Group ten feet below the contact with the overlying McShan Formation. Location: NE/4, NE/4, SE/4, Sec. 2, T.4S., R.11E.

portions of the Pride Mountain Formation locally contain small amounts of bitumen residue that remained in the sedimentary rocks after volatile hydrocarbon molecules escaped. The amount of petroleum residue in the lower Pride Mountain intervals increases eastward. Petroliferous sandstones and limestones in the lower Pride Mountain Formation that occur near Margerum, Alabama, have been quarried and utilized in the production of highway asphalt (Morse, 1930). The overlying sandstones in the Hartselle Formation locally contain small amounts of petroleum residue. The Tanyard Branch and Mynot Sandstone members of the Pride Mountain Formation are designated as the Lewis Sand and Evans Sand, respectively, in the petroleum industry (see correlation chart, Figure 31). The Lewis and Evans sandstone intervals are important oil and gas producing horizons in the Black Warrior Basin of Mississippi and Alabama. The overlying sandstone sequence comprising the Hartselle Formation is also a potential oil producing horizon, and attains an oil saturation maximum of 60 percent in the subsurface of Alabama (Beavers and Boone, 1976). Only very small amounts of petroleum residue occur in these intervals in the subsurface or at the surface of Tishomingo County, due to the absence of a protective overburden cap that would have prevented escape of the volatile hydrocarbons. The Hartselle Formation is the youngest Paleozoic sedimentary rock unit that occurs in Tishomingo County, as overlying Mississippian and Pennsylvanian strata were removed by erosion prior to and during deposition of Tuscaloosa fluvial sediments. Oil and gas are produced from Mississippian (Chesterian) and Pennsylvanian strata to the south in the Black Warrior

Mineral Resources Institute
Preliminary Clay Evaluation

MRI Number 167-207

Date Received 6/30/88 Date reported 8/12/88

Sender's Name Mississippi Geological Survey

Sender's Identification Sample #5 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 15.0 Working Properties Plastic

Color Gray Drying shrinkage, percent 2.5 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	10 YR 9/2	3	2.5	18.7	33.1	1.78
1,050	10 YR 9/2	3	5.0	18.8	33.4	1.78
1,100	10 YR 9/2	3	5.0	18.3	32.7	1.78
1,150	10 YR 9/1	4	5.0	18.5	33.4	1.78
1,200	10 YR 9/1	4	5.0	18.8	33.0	1.76
1,250	10 YR 9/1	5	5.0	18.6	32.9	1.77

pH 3.3 HCL Effervescence Slight Other tests

Preliminary Bloating Test: Negative

Table 7 - Preliminary firing test results of clay sample number 5, collected from the Tuscaloosa Group six feet below the contact with the overlying McShan Formation. Location: SE/4, NE/4, NW/4, Sec. 33, T.3S., R.15W., at the Mississippi-Alabama state line.

Basin of Mississippi in nearby Monroe, Clay, and Lowndes counties (Corinne Field). No oil or gas wells have been produced commercially in Tishomingo County. All petroleum test wells drilled to date were abandoned due to little or no commercial hydrocarbon potential. Uppermost intervals of the Knox Group comprise the deepest intervals penetrated by petroleum test wells drilled in Tishomingo County. Potential commercial petroleum reserves may be present in deeper (Ordovician and Cambrian) stratigraphic horizons, or in subtle structural traps that remain undiscovered in the Mississippian (Osagean, Meramecian, and Chesterian series) stratigraphic sequence. Shallow anticlines, synclines, and small shallow domes occur locally in the otherwise flat-lying Paleozoic sedimentary rocks of Tishomingo County. Although no significant displacement of Paleozoic strata that would indicate faulting could be determined from subsurface or surface data collected during the course of the present study, this does not preclude the existence of faulting or otherwise potentially favorable structural trends in the subsurface of Tishomingo County. Perhaps geologic data gathered from future petroleum test well drilling programs or other data gathered from deep-subsurface geological studies will reveal potential commercial oil and gas reserves.

TEST HOLE RECORDS

The following described samples are catalogued and stored in the Bureau of Geology sample library, and are available for public observation. These test holes are preceded by the prefix AP, which is a code designation reserved for samples from Tishomingo County. The following are descriptions of samples collected from the subsurface of Tishomingo County during drilling operations performed in order to study the subsurface lithostratigraphy and structure. These holes were drilled primarily in the northern and southern portions of Tishomingo County. Data from test holes drilled by the U. S. Corps of Engineers in cooperation with the U. S. Geological Survey during groundwater investigations regarding the Tennessee-Tombigbee Waterway provided good subsurface lithostratigraphic information in central portions of the county. Oil and gas test wells provided information about geologic units that occur at greater depths. The shallow test wells were drilled in order to correlate geologic units exposed at or near the surface. Figure 113 illustrates the distribution of test holes utilized in this study.

AP-1

Location: South side of dirt road, north of abandoned Coffee Sand borrow pit, and immediately east of Tishomingo-Alcorn County line, at SW/4, SW/4, NW/4, Sec. 4, T.3S., R.9E.

Elevation: 590 feet (Topographic map)

Date: March 24, 1987

Purpose: Drilled 300 feet for stratigraphic information. Electrical log from 18 to 298 feet.

Depth	Thickness	Description
		Coffee Formation
102	102	Sand, moderate reddish-orange to grayish orange-pink, fine- to medium-grained, well-sorted, subangular quartz, glauconitic, micaceous, with frequent occurrences of thin beds and laminae of clay, grayish orange-pink to light-gray, silty.
		Eutaw Formation-Tombigbee Sand Member
201	99	Sand, medium light-gray to pale yellowish-brown, fine- to medium-grained, subangular quartz, very well-sorted, glauconitic, micaceous, silty, clayey.
		Eutaw Formation-Lower Eutaw Member
297	96	Sand, light olive-gray, very fine- to medium-grained, subangular quartz, moderately sorted, glauconitic, micaceous, with frequent thin beds and laminae of clay, medium-gray, silty.
		Tuscaloosa Group
300	3	Gravel, chert, very light- to dark-gray, white, and various hues of red, very well-rounded, in a matrix of sand, very light-gray, fine- to coarse-grained, poorly sorted, silty, clayey.

AP-2

Location: Floor of gravel pit worked in Tennessee River terrace deposits, south side of dirt road in SE/4, SE/4, SE/4, Sec. 19, T.1S., R.10E.

Elevation: 650 feet (Topographic Map)

Date: March 25, 1987

Purpose: Drilled 210 feet for stratigraphic information. Electrical log from 10 to 208 feet.

Depth	Thickness	Description
		Tennessee River Terrace Deposits
18	18	Gravel, moderate yellowish-brown, very well-rounded chert, quartzite, and rare quartz pebbles, in a matrix of sand, moderate reddish-brown, fine- to coarse-grained, poorly sorted, subrounded quartz, silty, clayey, thin ironstone layers at base.
		Coffee Formation
69	51	Sand, pale yellowish-orange to grayish orange-pink, very fine- to medium-grained, subangular quartz, glauconitic, micaceous, with frequent occurrences of thin beds and laminae of clay, grayish orange-pink to very light-gray, silty, micaceous.
		Eutaw Formation-Tombigbee Sand Member
126	57	Sand, medium light-gray, fine-grained, very well-sorted, glauconitic, micaceous, silty. Frequent occurrences of ironstone laminae near base.
		Eutaw Formation-Lower Eutaw Member
204	78	Sand, medium light- to light olive-gray, very fine- to medium-grained, glauconitic, micaceous,

Depth	Thickness	Description
		and clay, thinly bedded and laminated, micaceous, silty. Thin bed of chert gravel at base.
		Fort Payne Formation
210	6	Chert, medium- to light-gray, very dense.

AP-3

Location: North side of dirt road in SW/4, SW/4, SE/4, Sec. 10, T.2S., R.9E.

Elevation: 610 feet (Topographic map)

Date: March 26, 1987

Purpose: Drilled 260 feet for stratigraphic information. Electrical log from 0 to 256 feet.

Depth	Thickness	Description
		Coffee Formation
94	94	Sand, pale reddish-brown to grayish orange-pink, fine- to medium-grained, well-sorted, glauconitic, micaceous, silty, with frequent occurrences of thinly bedded and laminated clay, light brown to grayish orange-pink, micaceous. Thin bed of small chert pebbles at base.
		Eutaw Formation-Tombigbee Sand Member
162	68	Sand, medium light- to light-gray, fine- to medium-grained, very well-sorted, glauconitic, micaceous, zone of thin ironstone laminae at base.
		Eutaw Formation-Lower Eutaw Member
256	94	Sand, light- to medium light-gray, fine- to medium-grained, glauconitic, micaceous, silty, thinly interbedded and interlaminated with clay, medium-gray, micaceous, in upper portions. Thin bed of dark gray, greenish-gray, and dark reddish-brown chert gravel at base.
		Fort Payne Formation
260	4	Chert, medium- to light-gray, dense.

AP-4

Location: East side of dirt road in NW/4, NW/4, NW/4, Sec. 7, T.3S., R.11E.

Elevation: 580 feet (Topographic map)

Date: March 31, 1987

Purpose: Drilled 80 feet for stratigraphic information. Electrical log from 10 to 80 feet.

Depth	Thickness	Description
		Eutaw Formation-Lower Eutaw Member
36	36	Sand, grayish red, very fine-grained, glauconitic, micaceous, silty, thinly interbedded with clay, medium gray, micaceous.
		Tuscaloosa Group
63	27	Gravel, chert, very light gray to white, very well-rounded, in a matrix of silt, very light gray, clayey, sandy.
		Fort Payne Formation
80	17	Chert, light gray, weathered, in a matrix of clay, very light gray to white, kaolinitic, silty.

AP-5

Location: North side of dirt road in SW/4, SW/4, NW/4, Sec. 26, T.2S., R.10E.

Elevation: 650 feet (Topographic map)

Date: April 1, 1987

Purpose: Drilled 158 feet for stratigraphic information. Electrical log from 30 to 154 feet.

Depth	Thickness	Description
		Eutaw Formation-Tombigbee Sand Member
57	57	Sand, pale reddish-brown to light olive gray, fine-grained, very well-sorted, glauconitic, micaceous.
		Eutaw Formation-Lower Eutaw Member
155	98	Sand, light olive- to yellowish-gray, fine- to medium-grained, glauconitic, micaceous, thinly interbedded with clay, medium-gray, micaceous, silty, sandy.
		Tuscaloosa Group
158	3	Gravel, white to very light-gray chert pebbles, very well-rounded, in a matrix of silt, very light-gray to white, sandy, clayey.

AP-6

Location: East side of dirt road in NW/4, NW/4, NE/4, Sec. 26, T.1S., R.10E.

Elevation: 610 feet (Topographic map)

Date: April 2, 1987

Purpose: Drilled 56 feet for stratigraphic information. Electrical log from 7 to 44 feet.

Depth	Thickness	Description
		Tennessee River Terrace Deposits
56	56	Gravel, dark yellowish-orange to light-brown, very well-rounded chert and quartzite pebbles, iron staining on pebbles, in a matrix of sand, coarse-grained, silty, clayey. Ironstone cemented conglomerate at base.

AP-7

Location: West side of closed dirt road in NW/4, SE/4, SE/4, Sec. 30, T.5S., T.10E.

Elevation: 510 feet (Topographic map)

Date: May 5, 1987

Purpose: Drilled 270 feet for stratigraphic information. Electrical log from 7 to 266 feet.

Depth	Thickness	Description
		Eutaw Formation-Lower Eutaw Member
90	90	Sand, grayish orange to pale yellowish-brown, medium- to fine-grained, glauconitic, micaceous, thinly interbedded with clay, medium-gray, silty, sandy. Frequent thin intervals of chert pebble beds in lower 20 feet.
		McShan Formation
160	70	Sand, grayish orange-pink to pale yellowish brown, very fine- to fine-grained, glauconitic, micaceous, interlaminated with clay, very light- to medium-gray, micaceous, silty.
		Tuscaloosa Group
251	91	Silt, very light-gray, sandy, clayey, interbedded with gravel, dark gray to white, very well-rounded chert pebbles, occasional very well-rounded sandstone pebbles in lower 10 feet. Frequent occurrences of dark gray carbonaceous clays in lowermost 40 feet. Chert pebble conglomerate at base.
		Pride Mountain Formation
270	19	Shale, medium olive-gray, hard, laminated, silty.

AP-8

Location: Behind abandoned house on west side of dirt road in SE/4, SW/4, SW/4, Sec. 8, T.7S., R.10E.

Elevation: 620 feet (Topographic map)

Date: May 6, 1987

Purpose: Drilled 100 feet for stratigraphic information. Electrical log from 7 to 98 feet.

Depth	Thickness	Description
		Eutaw Formation-Lower Eutaw Member
25	25	Sand, moderate reddish orange, fine- to coarse-grained, glauconitic, micaceous, silty, thinly interbedded with clay, medium gray, micaceous.
		McShan Formation
84	59	Sand, grayish-pink to grayish-orange, fine-grained, glauconitic, micaceous, interlaminated with clay, grayish-pink, micaceous, silty, sandy. Thin iron-cemented sandstone at base.
		Tuscaloosa Group
100	16	Gravel, light gray to white, very well-rounded chert pebbles in a matrix of silt, medium-gray, micaceous, clayey.

AP-9

Location: South side of dirt road in NW/4, SW/4, SW/4, Sec. 19, T.6S., R.10E.

Elevation: 510 feet (Topographic map)

Date: May 7, 1987

Purpose: Drilled 160 feet for stratigraphic information. Electrical log from 7 to 160 feet.

Depth	Thickness	Description
		Eutaw Formation-Lower Eutaw Member
48	48	Sand, light-brown to moderate orange-pink, medium-grained, micaceous, glauconitic, occasional small chert pebbles at base.

		McShan Formation
92	44	Sand, grayish orange-pink to very pale-orange, fine- to medium-grained, well-sorted, micaceous, glauconitic, thinly interbedded and interlaminated with clay, grayish pink, micaceous, silty. Ironstone laminae at base.
		Tuscaloosa Group
112	20	Gravel, light gray to white and medium- to dark-gray, very well-rounded chert pebbles and cobbles in a matrix of silt, very light-gray to white, clayey, kaolinitic, micaceous, sandy.
		Hartselle Formation
134	22	Sandstone, light gray to white, fine-grained, silica-cemented quartz arenite.
		Pride Mountain Formation
160	26	Shale, medium gray, siltstone, and clay, laminated, sandy.

AP-10

Location: Northwest side of State Highway 25, in NW/4, SE/4, SE/4, Sec. 14, T.7S., R.10E.

Elevation: 620 feet (Topographic map)

Date: May 12, 1987

Purpose: Drilled 175 feet for stratigraphic information. Electrical log from 7 to 171 feet.

Depth	Thickness	Description
		High Elevation Terrace Deposits
24	24	Gravel, light-brown to moderate orange-pink, very well-rounded chert, quartzite and quartz pebbles in a matrix of sand, fine- to coarse-grained, silty, clayey.
		Eutaw Formation-Lower Eutaw Member
85	61	Sand, grayish orange-pink, fine- to medium-grained, micaceous, glauconitic, silty, thinly interbedded and interlaminated with clay, medium-gray, silty, micaceous, thin ironstone laminae at base.
		McShan Formation
128	43	Sand, medium light-gray, very fine- to fine-grained, micaceous, glauconitic, interlaminated with clay, medium- to dark-gray, micaceous, silty, sandy.
		Tuscaloosa Group
175	47	Silt, very light-gray to white, clayey, sandy, grades downward into chert gravel, moderate orange-pink stained surfaces, in a matrix of silt, very light-gray, clayey, sandy.

AP-11

Location: South side of dirt road 3/4 mile west of Forest Grove Church, 1/2 mile north of Horseshoe Bend, SE/4, NW/4, SE/4, Sec. 30, T.5S., R.11E.

Elevation: 630 feet (Topographic map)

Date: May 13, 1987

Purpose: Drilled 100 feet for stratigraphic information. Electrical log from 7 to 100 feet.

Depth	Thickness	Description
		High Elevation Terrace Deposits
8	8	Gravel, light- to pale reddish-brown, chert and quartzite pebbles, very well-rounded, iron-stained surfaces on pebbles, in a matrix of sand, fine- to coarse-grained, silty, clayey, ironstone-cemented conglomerate at base.
		McShan Formation
34	26	Sand, medium light-gray, medium-grained, glauconitic, micaceous, thinly interbedded and laminated with clay, medium- to dark-gray, micaceous, silty, sandy.
		Tuscaloosa Group
68	34	Silt, very light-gray to white, clayey, sandy, grades downward into gravel, very well-rounded chert pebbles and cobbles in a matrix of silt, very light-gray to white, clayey, sandy, micaceous.
		Hartselle Formation
93	25	Sandstone, very light-gray, fine-grained, silica-cemented quartz arenite.
		Pride Mountain Formation
100	7	Shale, medium light- to olive-gray, laminated siltstone and clay, dark-gray, silty, sandy, micaceous.

AP-12

Location: South of dirt road in SE/4, NW/4, SE/4, Sec. 3, T.7S., R.10E.

Elevation: 535 feet (Topographic map)

Date: May 14, 1987

Purpose: Drilled 220 feet for stratigraphic information. Electrical log from 7 to 216 feet.

Depth	Thickness	Description
		Eutaw Formation-Lower Eutaw Member
21	21	Sand, moderate reddish- to light-brown, fine- to coarse-grained, glauconitic, micaceous, thinly interbedded and interlaminated with clay, medium-gray, silty, sandy, ironstone laminae at base.
		McShan Formation
62	41	Sand, medium light-gray, fine-grained, micaceous, glauconitic, interlaminated with clay, dark gray, silty, sandy, micaceous, ironstone laminae at base.
		Tuscaloosa Group
220	158	Gravel, grayish orange-pink to light-gray, very well-rounded chert pebbles in a matrix of silt, very light-gray to white, clayey, sandy, micaceous, with frequent well-cemented conglomeratic zones. Occasional intervals of dark-gray carbonaceous clay in lowermost portions. Frequent zones of white, kaolinitic, silty clay throughout.

REFERENCES CITED

Beavers, W. M., and P. A. Boone, 1976, Depositional environments and petroleum potential of the asphaltic Hartselle Sandstone in north Alabama: Gulf Coast Association of Geological Societies, Transactions, v. 26, p. 10-16.

Belt, W. E., et al., 1945, Geologic Map of Mississippi: Mississippi Geological Society, scale 1:500,000.

Berry, E. W., 1919, Upper Cretaceous floras of the eastern Gulf region in Tennessee, Mississippi, Alabama and Georgia: U. S. Geological Survey, Professional Paper 112, 177 p.

Bicker, A. R., 1979, The Mississippian and Pennsylvanian (Carboniferous) Systems in the United States - Carboniferous outcrops of Mississippi: U. S. Geological Survey, Professional Paper 1110-I, p. 37-45.

Born, K. E., and H. B. Burwell, 1939, Geology and petroleum resources of Clay County, Tennessee: Tennessee Division of Geology, Bulletin 47, 188 p.

Boswell, E. H., and B. E. Wasson, 1974, Memorandum on the ground water resources of Yellow Creek State Inland Port Area, Tishomingo County, Mississippi: Yellow Creek State Inland Port Authority, 19 p.

Broussard, M. C., 1978, Chester depositional systems (Upper Mississippian) of the Black Warrior Basin: University of Mississippi, unpublished Masters Thesis, 164 p.

Butts, C., 1910, General Geology, *in* E. F. Burchard, C. Butts, and E. C. Eckel, Iron ores, fuels, and fluxes of the Birmingham district, Alabama: U. S. Geological Survey, Bulletin 400, p. 11-25.

Butts, C., 1926, Paleozoic rocks, p. 41-230, *in* G. I. Adams, C. Butts, L. W. Stephenson, and C. W. Cooke, Geology of Alabama: Geological Survey of Alabama, Special Report no. 14, p. 41-230.

Campbell, G., 1946, New Albany Shale: Geological Society of America Bulletin, v. 57, p. 829-908.

Clarke, J. M., and C. Schuchert, 1899, The nomenclature of the New York Series of geological formations: Science, new series, v. 10, p. 874-878.

Cleaves, A. W., 1981, Resource evaluation of Lower Pennsylvanian (Pottsville) depositional systems of the western Warrior Coal Field, Alabama and Mississippi: Mississippi Mineral Resources Institute, Final Technical Report, no. 81-1, 125 p.

Cleaves, A. W., 1983, Carboniferous terrigenous clastic facies, hydrocarbon producing zones and sandstone provenance, northern shelf of Black Warrior Basin: Gulf Coast Association of Geological Societies, Transactions, v. 33, p. 41-53.

Cleaves, A. W., and M. C. Broussard, 1980, Chester and Pottsville depositional systems, outcrop and subsurface, in the Black Warrior Basin of Mississippi and Alabama: Gulf Coast Association of Geological Societies, Transactions, v. 30, p. 49-60.

Cobb, J. C., and J. L. Kulp, 1960, U-Pb age of the Chattanooga Shale: Geological Society of America Bulletin, v. 71, p. 223-224.

Cochran, F. A., 1969, History of old Tishomingo County, Mississippi Territory: Barnette Letter Shop, Oklahoma City, Oklahoma, 377 p.

Conant, L. C., and W. H. Monroe, 1945, Upper Cretaceous geology of the Tuscaloosa and Cottondale Quadrangles: U. S. Geological Survey, Oil and Gas Investigations Preliminary Map no. 37.

Conant, L. C., and V. E. Swanson, 1961, Chattanooga Shale and related rocks of central Tennessee and nearby areas: U. S. Geological Survey, Professional Paper 357, 91 p.

Crider, A. F., and L. C. Johnson, 1906, Summary of the underground waters of Mississippi: U. S. Geological Survey, Water-Supply Paper 159, 86 p.

DeJarnette, D. L., et al., 1962, Stanfield-Worley Bluff Shelter excavations: Journal of Alabama Archaeology, v. 8, no. 1 and 2, 124 p.

Delo, D. M., 1940, Phacopid trilobites of North America: Geological Society of America, Special Paper no. 29, 135 p.

Dockery, D. T., 1981, Stratigraphic column of Mississippi: Mississippi Bureau of Geology.

Dockery, D. T., and R. K. Merrill, 1984, Lower Devonian (Helderbergian) trilobites from the Ross Limestone in Mississippi: Mississippi Geology, v. 5, no. 2, p. 11-15.

Drahovzal, J. A., 1967, The biostratigraphy of Mississippian rocks in the Tennessee Valley, *in* W. E. Smith (chairman) et al., A field guide to Mississippian sediments in northern Alabama and south-central Tennessee: Alabama Geological Society, 5th Annual Field Trip Guidebook, p. 10-24.

Dunbar, C. O., 1919, Stratigraphy and correlation of the Devonian of western Tennessee: Tennessee Geological Survey, Bulletin 21, 127 p.

Eargle, D. H., 1946, Correlation of the pre-Selma Upper Cretaceous formations between Tuscaloosa County, Alabama, and Neshoba County, Mississippi: U. S. Geological Survey, Oil and Gas Investigations Preliminary Chart No. 20.

Fenneman, N. M., 1938, Physiography of the Eastern United States: McGraw-Hill Book Co., Inc., New York, N.Y., 534 p.

Fisher, D. R., 1987, Regional diagenesis of the Tuscumbia Limestone (Meramecian - Mississippian) in northern Alabama and northeastern Mississippi: University of Alabama, unpublished Masters Thesis, 248 p.

Fisk, H. N., 1951, Loess and Quaternary geology of the lower Mississippi Valley: Journal of Geology, v. 59, p. 333-356.

Foerste, A. F., 1903, Silurian and Devonian limestones of western Tennessee: Journal of Geology, v. 11, p. 554-583.

Fundaburk, E. L., and M. D. Foreman, 1957, Sun circles and human hands; southeastern Indians, art and industries: E. L. Fundaburk, Luverne, Ala., 232 p.

Green, S. R., 1985, An overview of the Tennessee-Tom bigbee Waterway: Environmental Geology and Water Sciences, v. 7, no. 1 and 2, p. 9-13.

Harris, H. B., G. K. Moore, and L. R. West, 1963, Geology and ground-water resources of Colbert County, Alabama: Geological Survey of Alabama, County Report no. 10, 71 p.

Harris, H. B., R. R. Peace, and W. F. Harris, 1963, Geology and ground-water resources of Lauderdale County, Alabama: Geological Survey of Alabama, County Report no. 8, 178 p.

Hass, W. H., 1956, Age correlation of the Chattanooga Shale and the Maury Formation: U. S. Geological Survey, Professional Paper 286, 47 p.

Hayes, C. W., 1891, The overthrust faults of the Southern Appalachians: Geological Society of America Bulletin, v. 2, p. 141-154.

Hilgard, E. W., 1860, Report on the geology and agriculture of the State of Mississippi: State Printer, Jackson, Miss., 391 p.

Jenkins, N. J., and R. A. Krause, 1986, The Tombigbee watershed in southeastern prehistory: University of Alabama Press, University, Ala., 156 p.

Jewell, W. B., 1931, Geology and mineral resources of Hardin County, Tennessee: Tennessee Division of Geology, Bulletin 37, 117 p.

Johnson, V. C., 1975, Fracture patterns of the Yellow Creek Area, Mississippi: Southeastern Geology, v. 16, no. 3, p. 173-177.

Kay, M., 1951, North American geosynclines: Geological Society of America, Memoir 48, 143 p.

Klepser, H. J., 1937, The Lower Mississippian rocks of the Eastern Highland Rim: Abstracts of Doctoral Dissertations, no. 24, Ohio State University Press, p. 181-187.

Logan, W. N., 1911, The structural materials of Mississippi - A preliminary report: Mississippi Geological Survey, Bulletin 9, 78 p.

Lowe, E. N., 1915, Mississippi; its geology, geography, soils and mineral resources: Mississippi Geological Survey, Bulletin 12, 335 p.

Mankin, C. J., coordinator, 1986, Correlation of stratigraphic units in North America: American Association of Petroleum Geologists, Texas-Oklahoma Tectonic Region Correlation Chart.

Marcher, M. V., and R. G. Stearns, 1962, Tuscaloosa Formation in Tennessee: Geological Society of America Bulletin, v. 73, no. 11, p. 1365-1386.

McCafferty, J., 1987, Tishomingo: Southern Magazine, v. 2, no. 2, p. 74-77.

McGlothlin, T., 1944, General geology of Mississippi: American Association of Petroleum Geologists Bulletin, v. 28, no. 1, p. 29-72.

Mellen, F. F., 1937, The Little Bear Residuum: Mississippi Geological Survey, Bulletin 34, 36 p.

Mellen, F. F., 1947, Black Warrior Basin, Alabama and Mississippi: American Association of Petroleum Geologists Bulletin, v. 31, no. 10, p. 1801-1816.

Mellen, F. F., 1953, Mississippi's Black Warrior Basin yields gas condensate - geology is favorable: World Oil, June and July, v. 136 and 137, p. 77-82 and p. 97-114.

Merrill, R. K., 1983, Source of the volcanic precursor to Upper Cretaceous bentonite in Monroe County, Mississippi: Mississippi Geology, v. 3, no. 4, p. 1-6.

Milici, R. C., G. Briggs, L. M. Knox, P. D. Sitterly, and A. T. Statler, 1979, The Mississippian and Pennsylvanian (Carboniferous) Systems in the United States-Tennessee: U. S. Geological Survey, Professional Paper 1110-G, p. 1-38.

Miller, K. H., 1983, Soil survey of Tishomingo County, Mississippi: U. S. Department of Agriculture, Soil Conservation Service, 93 p.

Monroe, W. H., L. C. Conant, and D. H. Eargle, 1946, Pre-Selma Upper Cretaceous stratigraphy of western Alabama: American Association of Petroleum Geologists Bulletin, v. 30, no. 2, p. 187-212.

Morgan, J. K., 1970, The central Mississippi uplift: Gulf Coast Association of Geological Societies, Transactions, v. 20, p. 91-109.

Morse, W. C., 1928, Paleozoic rocks of Mississippi: Journal of Geology, v. 36, p. 31-43.

Morse, W. C., 1930, Paleozoic rocks: Mississippi Geological Survey, Bulletin 23, 212 p.

Morse, W. C., 1935, The Highland Church Sandstone as a building stone: Mississippi Geological Survey, Bulletin 26, 30 p.

Morse, W. C., 1936, Tishomingo State Park - geologic history, *in* W. C. Morse and C. S. Brown, Tishomingo State Park - Geologic History and Botany: Mississippi Geological Survey, Bulletin 32, p. 1-36.

Murray, G. E., 1961, Geology of the Atlantic and Gulf Coastal Plain of North America: Harper and Brothers Publishing Co., New York, N.Y., 692 p.

Parks, W. S., B. E. Ellison, and E. H. Boswell, 1960, Prentiss County geology and ground-water resources: Mississippi Geological Survey, Bulletin 87, 154 p.

Peace, R. R., 1963, Geology and ground water resources of Franklin County, Alabama: Geological Survey of Alabama, Bulletin 72, 55 p.

Pike, S. J., 1968, Black Warrior Basin, northeast Mississippi and northwest Alabama, *in* B. W. Beebe and B. F. Curtis, Editors, Natural gases of North America: American Association of Petroleum Geologists, Memoir 9, v. 2, p. 1693-1701.

Potter, P. E., 1955a, The petrology and origin of the Lafayette Gravel, Part 1, Mineralogy and petrology: Journal of Geology, v. 63, no. 1, p. 1-38.

Potter, P. E., 1955b, The petrology and origin of the Lafayette Gravel, Part 2, Geomorphic History: Journal of Geology, v. 63, no. 2, p. 115-132.

Rice, C. L., E. G. Sable, G. R. Dever, and T. M. Kehn, 1979, The Mississippian and Pennsylvanian (Carboniferous) Systems in the United States - Kentucky: U. S. Geological Survey, Professional Paper 1110-F, p. 1-32.

Russell, E. E., 1965, Stratigraphy of the outcropping Cretaceous sediments below the McNairy Sand of west Tennessee (abstract): University of Tennessee, Dissertation Abstracts, v. 26, no. 4, p. 2139.

Russell, E. E., 1968, Geologic map and mineral resources summary of the Counce Quadrangle, Tennessee: Tennessee Division of Geology, no. GM-MRS-13 SE, 7 p.

Russell, E. E., 1975, Geologic map of the Yellow Creek Nuclear Plant site area, Figure 2.5-8(T), *in* E. E. Russell et al., Yellow Creek Nuclear Plant Preliminary Safety Analysis Report: Tennessee Valley Authority, 71 p.

Russell, E. E., 1987, Gravel aggregate in Mississippi - its origin and distribution: Mississippi Geology, v. 7, no. 3, p. 1-7.

Russell, E. E., D. M. Keady, E. A. Mancini, and C. C. Smith, 1983, Upper Cretaceous lithostratigraphy and biostratigraphy in northeast Mississippi, southwest Tennessee, and northwest Alabama, shelf chalks and coastal clastics: Society of Economic Paleontologists and Mineralogists, Spring Field Trip guidebook, April 7-9, 1983, 72 p.

Russell, E. E., and W. S. Parks, 1975, Stratigraphy of the outcropping Upper Cretaceous, Paleocene, and Lower Eocene in western Tennessee (Including descriptions of younger fluvial deposits): Tennessee Division of Geology, Bulletin 75, 108 p.

Russell, E. E., C. W. Wilson, and J. H. Jewell, 1972, Geologic map and mineral resources summary of the Pickwick Quadrangle, Tennessee: Tennessee Division of Geology, no. GM-MRS-24 SW, 3 p.

Safford, J. M., 1864, On the Cretaceous and Superior Formations of west Tennessee: American Journal of Science, v. 37, ser. 2, p. 360-372.

Safford, J. M., 1869, The Geology of Tennessee: S. C. Mercer, Printer to the State, Nashville, Tenn., 550 p.

Safford, J. M., and J. B. Killebrew, 1876, The Elementary Geology of Tennessee: Nashville, Tenn., 255 p.

Safford, J. M., and J. B. Killebrew, 1900, The Elements of the Geology of Tennessee: Nashville, Tenn., 264 p.

Simmons, M. D., 1985, Unwatering the Divide Cut of the Tennessee-Tombigbee Waterway: a major challenge to construction: Environmental Geology and Water Sciences, v. 7, no. 1 and 2, p. 51-67.

Smith, E. A., 1879, Report of progress for 1877 and 1878: Alabama Geological Survey, Montgomery, Ala., 138 p.

Smith, E. A., 1890, On the geology of the valley regions adjacent to the Cahaba Field, *in* J. Squire, Report on the Cahaba Coal Field: Alabama Geological Survey, Montgomery, Ala., p. 133-180.

Smith, E. A., 1892, Sketch of the geology of Alabama: Alabama Geological Survey, Birmingham, Ala., 36 p.

Smith, E. A., 1894, Geological Map of Alabama: Alabama Geological Survey, Map 1.

Smith, E. A., and L. C. Johnson, 1887, Tertiary and Cretaceous strata of the Tuscaloosa, Tombigbee, and Alabama Rivers: U. S. Geological Survey, Bulletin 43, 189 p.

Smith, E. A., L. C. Johnson, and D. W. Langdon, 1894, Report on the geology of the Coastal Plain of Alabama, with contributions to its paleontology by T. H. Aldrich and K. M. Cunningham: Alabama Geological Survey, Special Report 6, 759 p.

Spain, E. L., F. E. Vestal, F. A. Davis, and M. Johnson, 1938, Tripoli deposits of western Tennessee and Mississippi: Tennessee Valley Authority, Geologic Bulletin no. 8, 18 p.

Stearns, R. G., and C. A. Armstrong, 1955, Post-Paleozoic stratigraphy of western Tennessee and adjacent portions of the upper Mississippi Embayment: Tennessee Division of Geology, Report of Investigations no. 2, 29 p.

Stearns, R. G., and M. V. Marcher, 1962, Late Cretaceous and subsequent structural development of the northern Mississippi Embayment area: Geological Society of America Bulletin, v. 73, no. 11, p. 1387-1394.

Stephenson, L. W., 1914, Cretaceous deposits of the eastern Gulf Coastal Region and species of *Exogyra* from the eastern Gulf Coastal Region and the Carolinas: U. S. Geological Survey, Professional Paper 81, 77 p.

Stephenson, L. W., 1917, Tongue, a new stratigraphic term, with illustrations from the Mississippi Cretaceous: Washington Academy of Sciences Journal, v. 7, p. 243-250.

Stephenson, L. W., and W. H. Monroe, 1938, Stratigraphy of Upper Cretaceous Series in Mississippi and Alabama: American Association of Petroleum Geologists Bulletin, v. 22, no. 12, p. 1639-1657.

Stephenson, L. W., and W. H. Monroe, 1940, The Upper Cretaceous deposits: Mississippi Geological Survey, Bulletin 40, 296 p.

Stockdale, P. B., 1939, Lower Mississippian rocks of the East Central Interior: Geological Society of America, Special Paper no. 22, 248 p.

Stockdale, P. B., 1948, Some problems in Mississippian stratiraphy of the Southern Appalachians: Journal of Geology, v. 56, p. 264-268.

Stuart, G. E., 1972, Who were the mound builders?: National Geographic, v. 142, no. 6, p. 783-802.

Swartz, J. H., 1924, The age of the Chattanooga Shale of Tennessee: American Journal of Science, 5th series, v. 7, p. 24-30.

Thomas, W. A., 1972a, Regional Paleozoic stratigraphy in Mississippi between Ouachita and Appalachian Mountains: American Association of Petroleum Geologists Bulletin, v. 56, no. 1, p. 81-106.

Thomas, W. A., 1972b, Mississippian stratigraphy of Alabama: Geological Survey of Alabama, Monograph 12, 121 p.

Thomas, W. A., 1979, The Mississippian and Pennsylvanian (Carboniferous) Systems in the United States - Alabama and Mississippi: Mississippian Stratigraphy of Alabama: U. S. Geological Survey, Professional Paper 1110-I, p. 1-22.

Thomas, W. A., and H. R. Cramer, 1979, The Mississippian and Pennsylvanian (Carboniferous) Systems in the United States - Georgia: U. S. Geological Survey, Professional Paper 1110-H, p. 1-37.

Vail, P. R., R. M. Mitchum, and S. Thompson, 1977, Seismic stratigraphy and global changes of sea level, Part 4: Global cycles of relative changes of sea level, *in* C. E. Payton, editor, Seismic Stratigraphy applications to hydrocarbon exploration: American Association of Petroleum Geologists, Memoir 26, p. 83-97.

Veatch, O., and L. W. Stephenson, 1911, Preliminary report on the geology of the Coastal Plain of Georgia: Geological Survey of Georgia, Bulletin 26, 466 p.

Vestal, F. E., and H. J. Knollman, 1947, Itawamba County mineral resources: Mississippi Geological Survey, Bulletin 64, 151 p.

Wade, B., 1920, Recent studies of the Upper Cretaceous of Tennessee, *in* B. Wade and C. H. Gordon, Administrative report of the State Geologist, 1919: Tennessee Geological Survey, Bulletin 23, p. 52-64.

Weimer, R. R., and J. H. Hoyt, 1964, Burrows of *Callianassa major* (Say) as geologic indicators of littoral and shallow neritic environments: Journal of Paleontology, v. 38, p. 761-767.

Welch, S. W., 1958, Stratigraphy of Upper Mississippian rocks above the Tuscumbia Limestone in northern Alabama and northeastern Mississippi: U. S. Geological Survey, Oil and Gas Investigations Chart OC-58.

Welch, S. W., 1959, Mississippian rocks of the northern part of the Black Warrior Basin, Alabama and Mississippi: U. S. Geological Survey, Oil and Gas Investigations Chart OC-62.

Weller, S., 1920, The Chester Series in Illinois: Journal of Geology, v. 28, no. 4, p. 281-303.

Weller, S., chairman, 1948, Correlation of the Mississippian formations of North America: Geological Society of America Bulletin, v. 59, p. 91-196.

Williams, R. T., 1976, Cross City Chronicle: Corinth Junior Auxiliary, Corinth, Miss., 68 p.

Wilson, C. W., and K. E. Born, 1936, The Flynn Creek disturbance, Jackson County, Tennessee: Journal of Geology, v. 44, p. 815-835.

Wilson, C. W., 1949, Pre-Chattanooga stratigraphy in central Tennessee: Tennessee Division of Geology, Bulletin 56, 407 p.

Worthen, A. H., 1860, Remarks on the discovery of a terrestrial flora in the Mountain Limestone of Illinois (abstract): American Association for the Advancement of Science, Proceedings, v. 13, p. 312-313.

MINERALOGY AND PETROGRAPHY OF SELECTED TISHOMINGO COUNTY FORMATIONS

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INTRODUCTION

Seven grab and channel samples were collected by the Mississippi Bureau of Geology in Tishomingo County, Mississippi. Four additional drill cores belonging to the Tennessee Valley Authority and the U. S. Army Corps of Engineers originally collected from Tishomingo County were also sampled (see Table 1 of this section). Four additional grab samples were also collected; these were taken from the abandoned underground tripoli mine in the northeastern corner of the county. All of these samples were subsequently delivered to the Geology Department of Millsaps College for investigation. The sample examinations were completed by Dr. Delbert E. Gann, the Chairman of the Department of Geology.

The investigation included the x-ray analysis of the "clay" samples submitted, which were numbered sequentially from 1 to 5 inclusively. Each sample was prepared as an oriented clay mount. The "clay" samples were all collected from surface exposures. A representative x-ray diffractogram of one of these "clay" samples is illustrated in Figure 1. The determined mineralogy included moderately consistent amounts of quartz (SiO_2) and kaolinite ($Al_4Si_4O_{10}(OH)_8$). The grab and core samples were sequentially numbered from 6 to 11 inclusively, prepared as thin-sections, and then subsequently stained with an alizarin red solution, examined and photographed with the petrographic microscope. The thin-section investigation demonstrated that sample numbers 6 and 11 are sublitharenites while most of the remaining samples, numbered sequentially from 7 to 9, are calcareous, cemented, fossiliferous grainstones, and sample number 10 appears to be a calcareous cemented packstone.

Sample numbers 12-15 were collected from an underground "tripoli" mine in the northeast corner of the county. A small portion of one of the samples was examined by means of x-ray diffraction and determined to consist of 100% quartz. The sample was also examined with the aid of the scanning electron microscope.

The grab, channel and core samples are representative of members within the Silurian Decatur Limestone (Sd), Devonian Ross Formation (Dr), Mississippian Fort Payne Formation (Mfp), Mississippian Tuscumbia Formation (Mt), Mississippian Pride Mountain Formation (Mpm), Mississippian Hartselle Formation (Mh), and the Cretaceous Tuscaloosa Group (Kt). The sample collection localities may be identified on the geologic map in the pocket of this report.

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Five samples sequentially numbered from 1 to 5 inclusively were submitted by the Bureau of Geology for investigation of the mineral content. Each sample was air dried, split, and the split disaggregated with an ultrasonic generator. The material was decanted as a slurry and then drawn by vacuum onto a millipore filter (57 mm diameter cellulose with 0.45 μm pore size). The sample was then rolled off the filter paper onto a glass slide and air dried. Each sample prepared in this manner was subsequently scanned with a General Electric XRD-6 diffractometer through 2° - 60° 2θ using a nickel filter, 1° entrance slit, 3° exit slit, and CuKα radiation. The semi-quantitative amount of each mineral identified was determined by measurement of peak intensities of the maximum reflection. The intensities were compared to known standard mixtures of the minerals identified.

The samples to be used as thin section material were sent to an outside laboratory for preparation. The two sandstone samples (nos. 6 and 11) were impregnated with a blue-dyed epoxy and covered with a standard cover-slip. The carbonate samples were prepared in the normal way and left uncovered. The writer subsequently stained the carbonate samples (nos. 7-10) with an alizarin red solution in order to determine the presence or absence of dolomite/calcite.

One of the tripoli samples (no. 12) was mounted as received, after slight disaggregation, into a standard aluminum holder and subsequently examined by means of x-ray diffraction using the same procedures and settings as those used for the five "clay" samples (nos. 1-5).

MINERALOGY

Quartz and kaolinite were the only minerals detected in each of the "clay" samples. The minerals identified and the semi-quantitative abundances of each are reported as Table 2.

CHEMISTRY

The four tripoli samples were also sent to an outside laboratory in order to determine the chemical composition of the material. The compounds are reported as weight percents and trace elements in ppm in Table 3. These analyses indicate the SiO_2 content of the tripoli material to be quite high, with impurities accounting for less than 1 percent in three of the samples, and less than 2 percent in the remaining sample. These values are slightly better than those reported by Rheams and Richter (1988) for similar deposits in northeastern and northwestern Alabama.

PETROGRAPHY

Several thin sections were examined with the petrographic microscope. These samples were numbered from 6 to 11

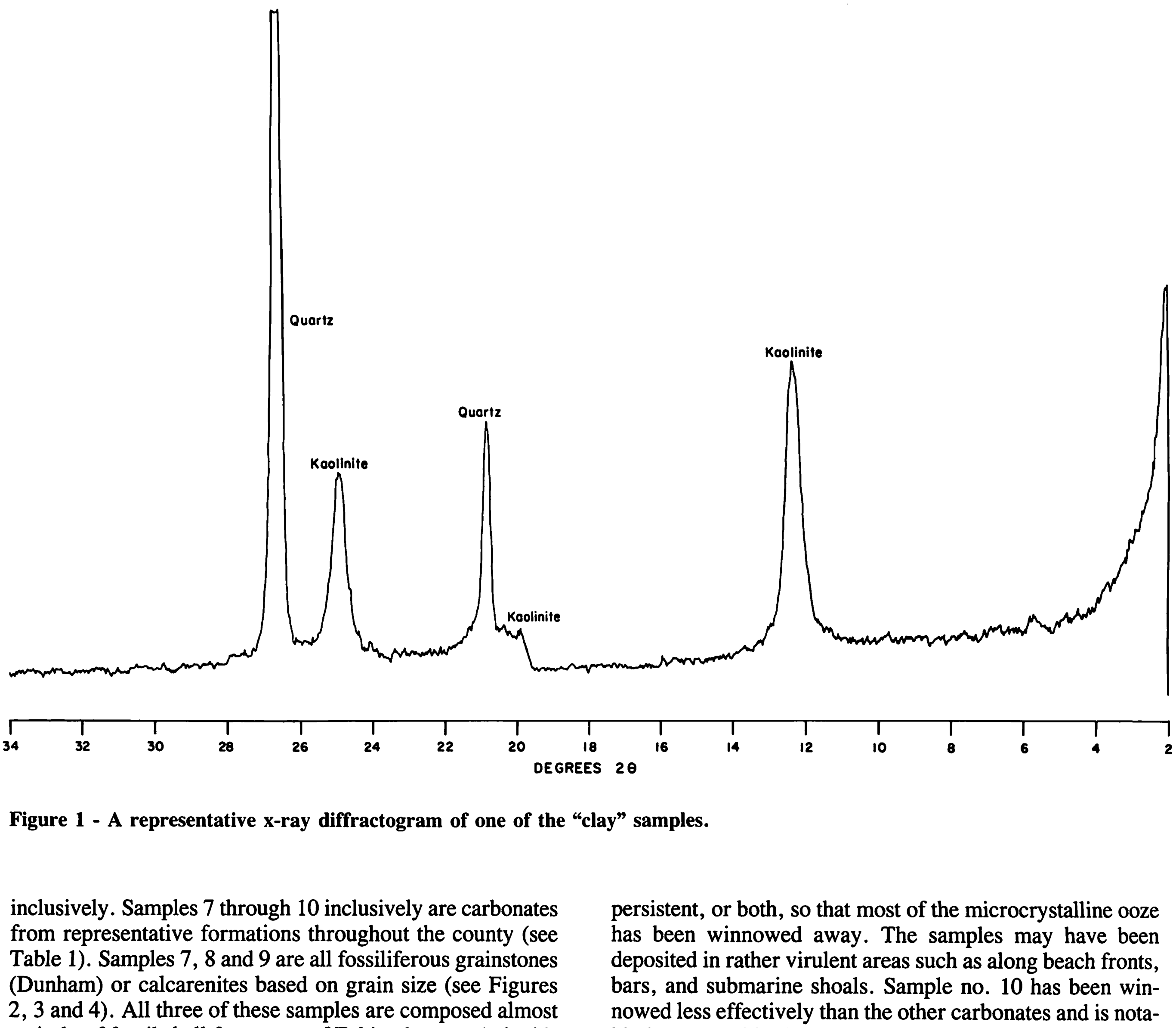


Figure 1 - A representative x-ray diffractogram of one of the "clay" samples.

inclusively. Samples 7 through 10 inclusively are carbonates from representative formations throughout the county (see Table 1). Samples 7, 8 and 9 are all fossiliferous grainstones (Dunham) or calcarenites based on grain size (see Figures 2, 3 and 4). All three of these samples are composed almost entirely of fossil shell fragments of Echinodermata (crinoids and echinoids), Gastropoda, Brachiopoda, Bryozoa, Algae, and Mollusca. Sample 8 (Figure 3) is cemented with interstitial microcrystalline quartz, fibrous chalcedonic quartz, fine-grained equigranular quartz, and more rarely sparry calcite and micrite. Samples 7 and 9 contain the same types of fossil fragments as found in sample 8, but the former's fragments are bound together almost entirely with sparry dolomite cement (Folk's terminology of biosparite is appropriate or Dunham's grainstone) (Figures 2, 3 and 4). Sample 10 is a sparsely fossiliferous sparite (Folk) or packstone (Dunham), or calcilutite with respect to grain size (Figure 5). Some micrite is also present. The sparite grains average 20-30μm in diameter and are very well sorted.

A proposed depositional environment (samples 7, 8 and 9) is difficult to determine with the information presently available, but the lack of abundant micrite and abundance of fossil fragments suggest that currents were either strong, persistent, or both, so that most of the microcrystalline ooze has been winnowed away. The samples may have been deposited in rather virulent areas such as along beach fronts, bars, and submarine shoals. Sample no. 10 has been winnowed less effectively than the other carbonates and is notable because of its lack of fossil debris and more abundant micrite. The presence of micrite suggests a less efficient or less persistent current removal system. A sheltered lagoon or a broad, submarine shelf are likely environments, but some are found also in deeper water offshore.

DIAGENESIS (LIMESTONES)

The diagenetic alteration of the carbonate samples (nos. 7-10) is pervasive and varied. Since each sample represents a different formation they will be discussed individually.

No. 7 - Pride Mountain Formation (Mississippian) (see Figure 2)

Fossil fragments and hash are abundant in this particular sample. Many of the fragments are observed with rims of micrite. The shell material itself consists almost entirely

TABLE 1
Sample Location Data[1]

Sample No.	Core No.	Formation	Location	Type-Depth of Sample
1	-	Mpm (Wagnon Member in this report)	SW/4,NW/4,NE/4,Sec.8,T.5S.,R.11E.	Surface-Channel
2	-	Mfp (Residual Clay)	NW/4,SW/4,SW/4,Sec.10,T.3S.,R.11E.	Surface-Channel
3	-	Kt (upper clay)	NE/4,NE/4,SE/4,Sec.2,T.4S.,R.11E.	Surface-Channel
4	-	Kt (lower clay)	NE/4,SW/4,SW/4,Sec.35,T.3S.,R.11E.	Surface-Channel
5	-	Kt (upper clay)	SE/4,NE/4,NW/4,Sec.33,T.3S.,R.15W.	Surface-Channel
6	DC 204	Mh	SE/4,SE/4,SW/4,Sec.26,T.6S.,R.9E.	Core - 74 feet
7	DC 204	Mpm	SE/4,SE/4,SW/4,Sec.26,T.6S.,R.9E.	Core - 147 feet
8	-	Mt	NW/4,SW/4,SW/4,Sec.22,T.4S.,R.11E.	Surface - Grab
9	TVA51-C-3	Dr	NE/4,NE/4,NW/4,Sec.35,T.1S.,R.10E.	Core - 175 feet
10	TVA51-C-3	Sd[2]	NE/4,NE/4,NW/4,Sec.35,T.1S.,R.10E.	Core - 315 feet
11	-	Mpm	SE/4,SE/4,SE/4,Sec.5,T.5S.,R.15E.	Surface - Grab
12	-	Mfp	SW/4,Sec.26,T.2S.,R.11E.	Underground mine - Channel
13	-	Mfp	SW/4,Sec.26,T.2S.,R.11E.	Underground mine - Channel
14	-	Mfp	SW/4,Sec.26,T.2S.,R.11E.	Underground mine - Channel
15	-	Mfp	SW/4,Sec.26,T.2S.,R.11E.	Underground mine - Channel

1 See geologic map in pocket of this report.
2 Silurian Decatur Limestone not illustrated on the geologic map.

TABLE 2

XRD Mineralogy of Selected Samples from Tishomingo County, Miss.

Sample Number	Mineralogy and Amount (%)[1] Quartz	Kaolinite
1	79.5	20.5
2	79.2	20.8
3	88.6	11.4
4	68.2	31.8
5	73.8	26.2

[1]Amounts are semi-quantitative weight measurement percentages determined by peak intensities and/or peak areas. These values are probably correct within a measurement error of ± 10%.

of calcite. The interstitial pores have been filled with sparry calcite cement, which has then been subsequently partially replaced by dolomite. The original porosity may have been fabric selective, interparticle type, with some intercrystal and partially moldic varieties also present (porosity terminology is that suggested by Choquette and Pray, 1970). Subsequent entry of the sparry carbonate has destroyed much of the original porosity and textures.

No. 8 - Tuscumbia Formation (Mississippian) (see Figure 3)

The representative of this formation is unlike the other three with respect to the predominant cement. Most of the original porosity available consists of fabric selective interparticle and minor moldic varieties. The pores have been rimmed and then subsequently filled with fibrous to microcrystalline quartz (chert and chalcedonic quartz). The bulk of the matrix cement is chert, while remaining pore space is occupied by chalcedony and mega-quartz varieties. Many of the fossils have also suffered partial replacement by the silica. Inclusions of calcite patches within the masses of microcrystalline quartz suggest replacement of pre-existing calcite. Some of the cherty materials occur as irregularly-shaped patches and "grains," while most of it is obviously present at the expense of carbonate shell fragments. Some of the chalcedony consists of fibrous spherulites enclosed within some of these shell fragments. Approximately 40-45% of the rock has been silicified, and another 20-25% has been replaced by dolomite. The proposed cementation sequence appears to be micrite, followed by sparry calcite, dolomite and/or microcrystalline quartz. There appear to be two or possibly even three generations of microcrystalline quartz. The earlier of the silica cements seems to be the cherty variety, while the most recent is the brownish-colored fibrous chalcedony and then the mega quartz, which seems to have filled the last available openings and is usually observed enclosed by the fibrous material.

No. 9 - Ross Formation (Devonian) (see Figure 4)

The sample contains abundant fossil fragments and hash, many of which have been replaced by minor quantities of micrite, sparry calcite and dolomite in that sequence. There are also minor irregular patches of microcrystalline chert-chalcedonic quartz that have been observed replacing shell fragments and themselves in turn replaced by micrite and sparry calcite and dolomite. Some of the sparry calcite rimming a few of the shell fragments is poikilotopic, i.e., consisting of one large calcite envelope possessing the same optical orientation as the shell fragment. Traces of fine-grained glauconite and chlorite were also observed and are also being replaced by the three carbonate cements. Porosity consists of both non-fabric and fabric selective varieties. The original non-fabric porosity consisted of fractures, which have been subsequently filled with microcrystalline chert. The predominant original porosity may have been fabric selective interparticle and some minor moldic types. Fossil fragments for the most part are composed of calcite, but many have also been replaced by dolomite. Rhombohedral dolo-

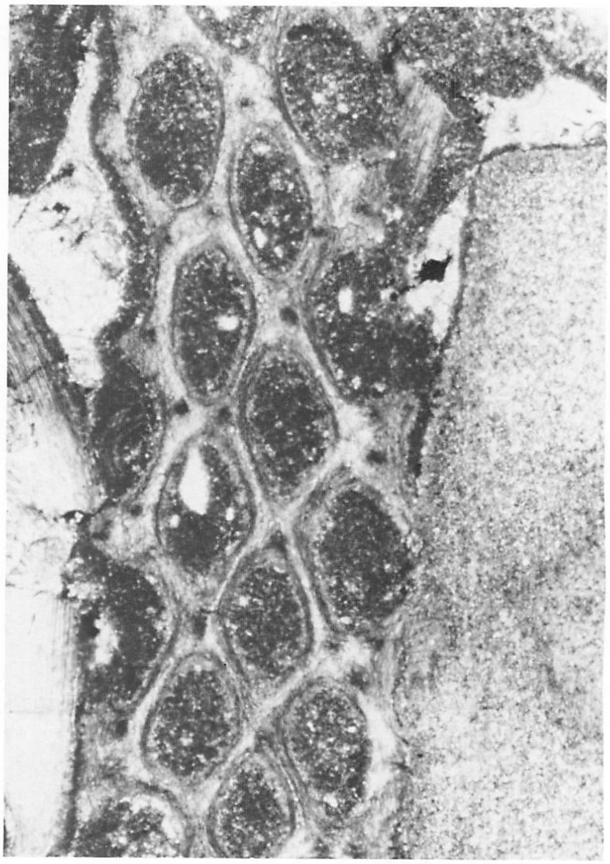
TABLE 3

Chemical Analyses of Selected "Tripoli" Samples From Tishomingo County, Miss.

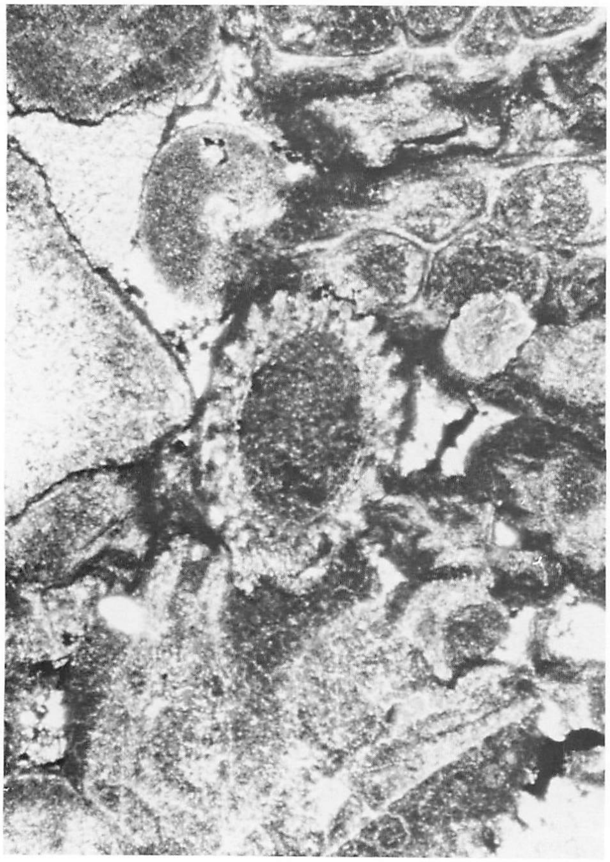
Sample No. %	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	S	K_2O	CaO	TiO_2	MnO	Fe_2O_3	BaO
12	0.02	0.09	0.4	>99.0	0.033	0.003	0.13	0.07	0.07	0.00	0.10	0.003
13	0.01	0.08	1.3	98.4	0.038	0.000	0.13	0.03	0.07	0.00	0.03	0.002
14	0.01	0.07	0.7	>99.0	0.019	0.000	0.10	0.03	0.05	0.00	0.03	0.002
15	0.00	0.07	0.9	>99.0	0.015	0.006	0.10	0.02	0.05	0.00	0.04	0.000

Sample No. ppm	V	Cr	Co	Ni	Cu	W	Zn	As	Pb	U	Mo	Sb	Sn
12	15	20	7	<10	20	<10	19	< 20	15	< 5	< 5	< 50	< 20
13	13	20	5	<10	40	<10	< 10	< 20	< 10	< 5	< 5	< 50	< 20
14	13	17	7	<10	10	<10	< 10	< 20	< 10	< 5	< 5	< 50	< 20
15	13	20	5	<10	34	<10	< 10	< 20	< 10	5	< 5	< 50	< 20

A.



C.



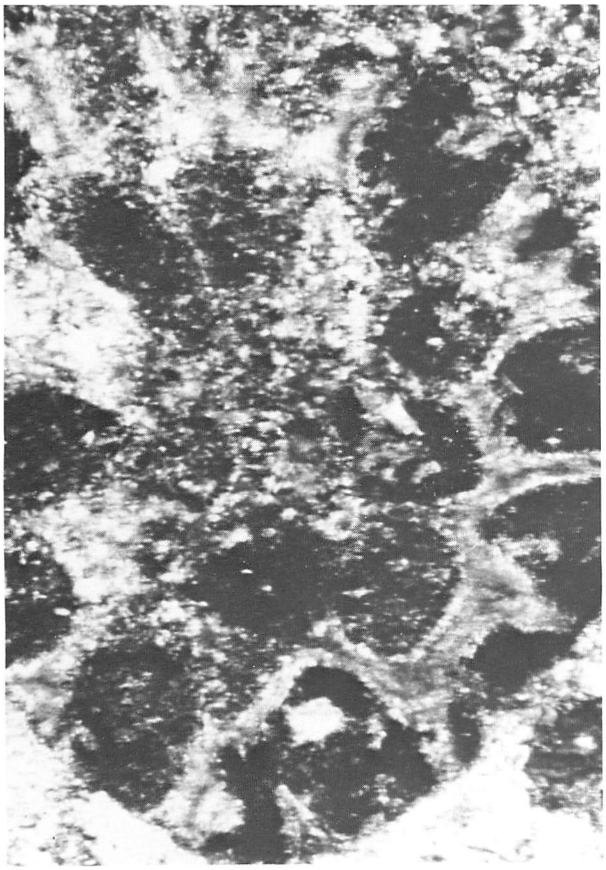
B.

Figure 2 - Photomicrographs of Green Hill Member - Golconda equivalent (Mississippian Pride Mountain Fm.) (DC 204 at 147 feet depth), located in the SE/4, SE/4, SW/4, Sec. 26, T.6S., R.9E. Fossiliferous grainstone. Herein referred to as Sample no. 7.

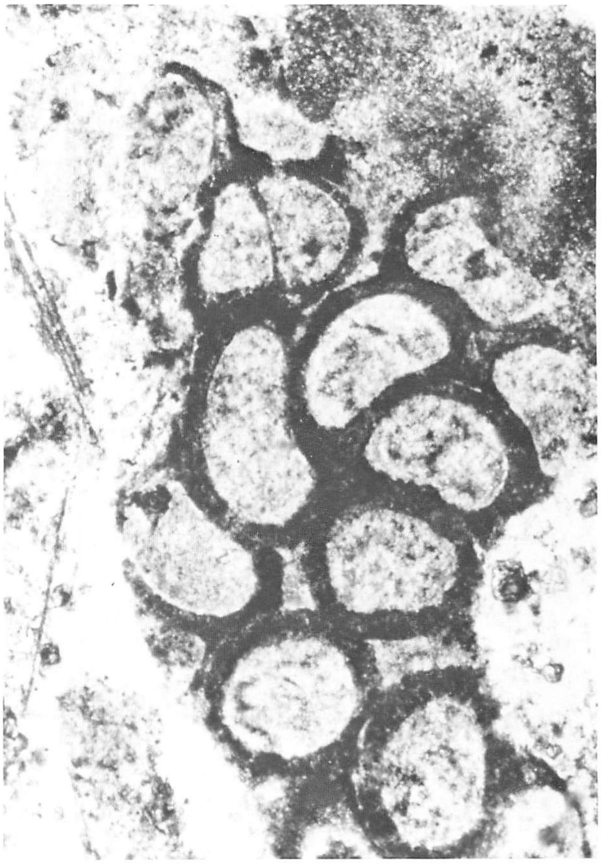
A. Brachiopod spine in the center rimmed and filled with micrite. The large crinoid fragment in the lower right is also rimmed with micrite. The light colored areas by the brachiopod spine and elsewhere are sparry calcite (63X magnification).

B. Echinoid spine in the center. Crinoid debris litters the field. Bryozoan fragments in the upper right corner. Pores are filled with sparry calcite; echinoid interior is filled with micrite (40X magnification).

C. Bryozoan colony showing zooecia filled with micrite and some dolomite. Larger pores adjacent to the colony are filled with sparry calcite (40X magnification).



A.



C.

B.

Figure 3 - Photomicrographs of a fossiliferous grainstone from the Tuscumbia Formation (Mississippian), collected approximately 25 feet above the top of the underlying Fort Payne Formation at a surface outcrop located in the NW/4, SW/4, Sec. 22, T.4S., R.11E. Herein referred to as Sample no. 8.

A. Bryozoan colony almost totally replaced by chert (darkest material) and micrite (somewhat lighter). The lightest colored areas are sparry calcite-filled pores (63X magnification).

B. Large area in the center was formerly an open pore, now filled with microcrystalline chert (fibrous chalcedony and mega-quartz). Numerous scattered dolomite rhombohedrons can be seen in the upper right corner replacing microcrystalline chert. A small amount of micrite rims the large brachiopod fragment at the left of the field (63X magnification).

C. Worm burrows (?) - bryozoan (?) replaced internally with microcrystalline chert and a smaller amount of dolomite. Burrow (?) walls are micrite (40X magnification).

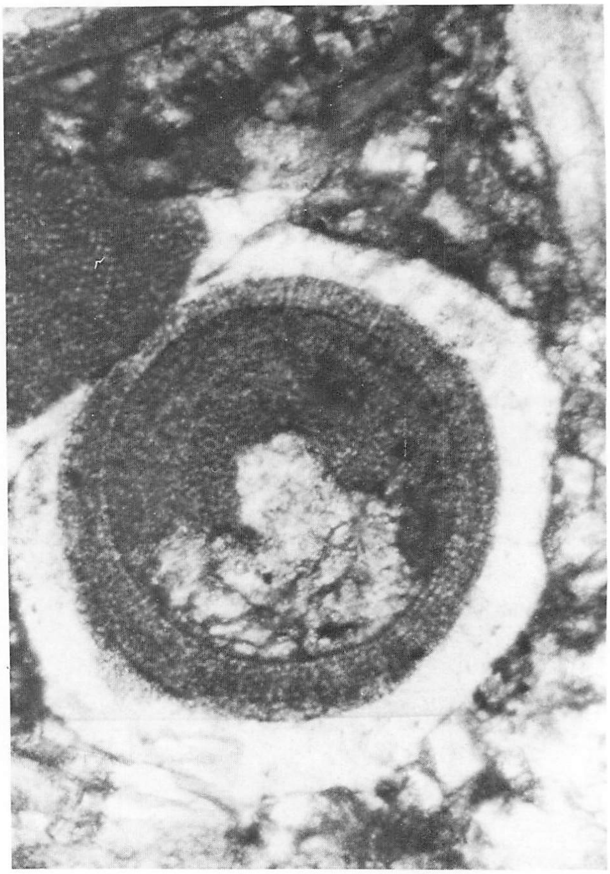


Figure 4 - Photomicrographs of a fossiliferous grainstone from the Ross Formation (T.V.A. core 51-C-3 at 175 feet depth) located in the NE/4, NE/4, NW/4, Sec. 35, T.1S., R.10E. Herein referred to as Sample no. 9.

A. Numerous dolomite rhombohedrons and some minor sparry calcite cement are filling pores and replacing fossil fragments (63X magnification).

B. Crinoid plate internally replaced by sparry calcite, and rimmed by poikilotopic dolomite (40X magnification).

mite crystals are often observed occupying natural voids within shell fragments, while other interstitial areas are mostly occupied by sparry calcite cement. Approximately 35-40% of the rock volume has been replaced by the dolomite.

No. 10 - Decatur Limestone (Silurian) (see Figure 5)

This specimen has been nearly totally replaced by sparry dolomite (approximately 95% by volume). Most of the crystals are anhedral but some are euhedral rhombohedrons that are occasionally zoned. Some of the rhombohedrons are observed enclosing an opaque mineral. Detrital grains of quartz silt and very fine sand are sparingly present and frequently partially replaced by the dolomite. Nearly euhedral grains of detrital zircon are rarely present. Fossil fragments are also sparse, and are found in varying stages of replacement by micrite. It is noteworthy that, although the sample was not oriented, dolomite replacement is obviously more complete on one half of the thin section as compared to the other half, suggesting a location near the invasive dolomite front or alternatively that the dolomite replacement is localized. It is suggested that the original rock was a calcite-cemented (micrite), very fine quartz sandstone or coarse siltstone, which was then subsequently replaced by the dolomite. The sequence of cementation appears to be micritization followed by two generations of dolomitization. Most of the existing porosity is fabric selective with both interparticle and some intracrystal types observed. The remaining samples, nos. 6 and 11, are both detrital sandstones (see Figures 6 and 7). The grain sizes average 110-130μm. Both samples are well sorted, quartz overgrowth cemented, very fine-grained sublitharenites (Folk). The porosity of sample 6 is about 15-20%, while sample 11 averages about 10-15%, and in both cases the porosity is of the interstitial type. Judging from the shape of relict rims within the quartz overgrowth bounded grains, a subrounded (Powers) characteristic prior to cementation seems to be predominant, with a relatively low degree of sphericity (Pettijohn). Quartz is the dominant mineral species (nearly 91%), but lower percentages of rock fragments (7%) and feldspar (2%) are also noteworthy. Rock fragments consist of chert and metamorphic rock fragments. Some interstitial areas are filled with authigenic kaolinite, which may have been more abundant prior to sample preparation due to subsequent plucking. Some of the quartz is the plutonic type, while examples of "metamorphic" quartz are also present. The feldspar consists both of K-feldspar and

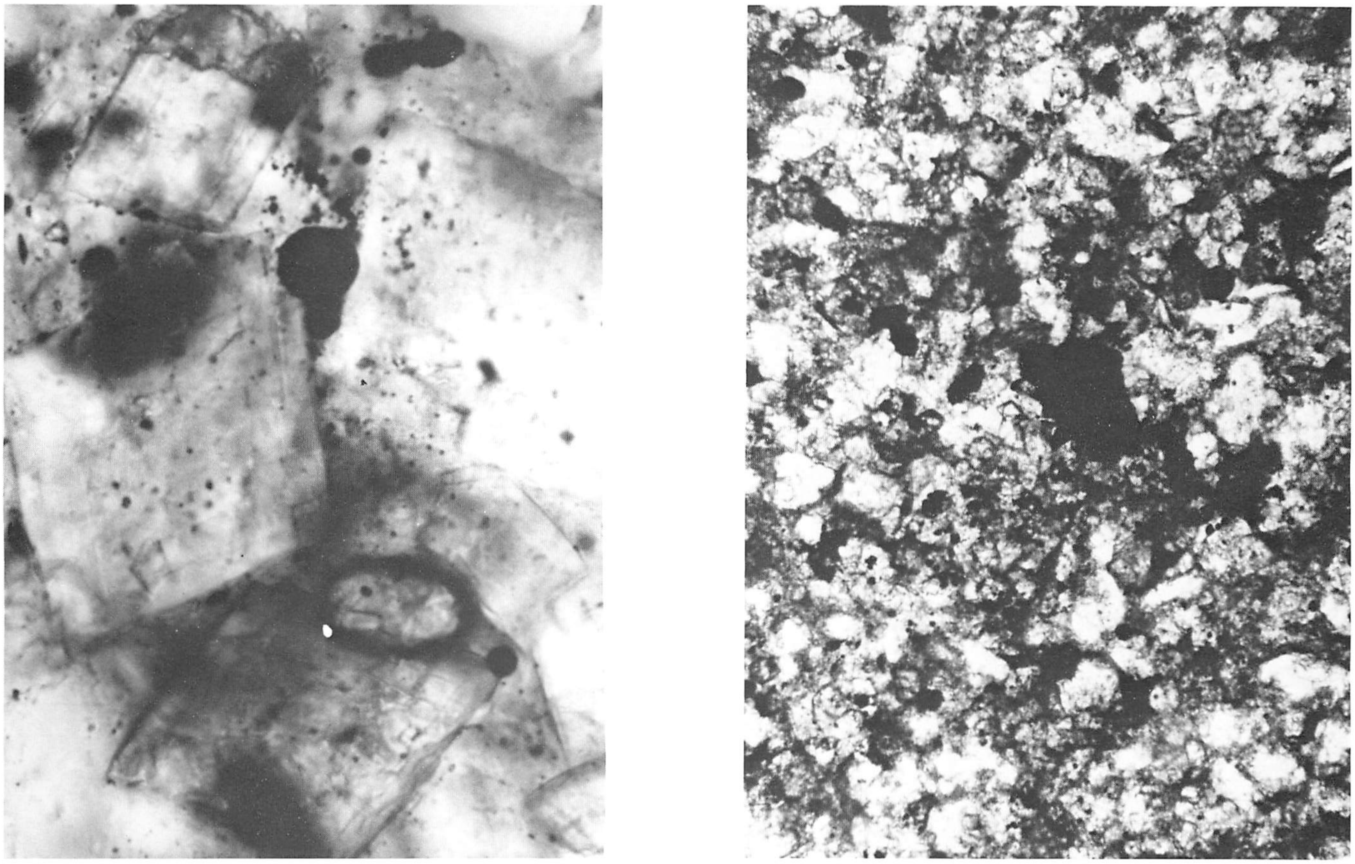


Figure 5 - Photomicrographs of calcareous packstone from the Silurian Decatur Limestone (T.V.A. core 51-C-3 at 315 feet depth) located in the NE/4, NE/4, NW/4, Sec. 35, T.1S., R.10E. Herein referred to as Sample no. 10.

A. Dolomite rhombohedrons typical of the replacement cement in this sample (400X magnification).

B. Field illustrating the large scale replacement by dolomite and minor sparry calcite (darker colored areas). The sample also contains numerous detrital grains of silt-sized and very fine-grained quartz (light colored area) (63X magnification).

plagioclase. There is some evidence of etching of some grains prior to cementation, perhaps by secondary carbonate cement that was subsequently dissolved. The good sorting and poorer rounding suggest a textural inversion and multiple source areas. The presence of metamorphic rock fragments (phyllite and metaquartzite) plus the presence of "metamorphic" (strained) quartz suggests at least one of these sources was metamorphic. Sample no. 11 additionally contains a small amount of what appears to be interstitial organic debris. A proposed depositional environment is highly problematic with the small amount of data available at this time, but perhaps a marine beach or lagoon might be appropriate. The quartz overgrowths additionally suggest recycling events in the history of the sediment.

DIAGENESIS (SANDSTONES)

Nos. 6 and 11 - Hartselle and Pride Mountain Formations (Mississippian)

The diagenetic modification of the two sandstone samples (no. 6 - Hartselle Formation - DC 204; no. 11 - Pride Mountain Formation, Tanyard Branch Member) were similar (see Figures 6 and 7). In each sample authigenic kaolinitic clay occupies some of the available pore space. The clay is clear to dark brown (the dark color is probably due to the presence of organic material). It occurs in the pores as interstitial fillings and rarely as rims surrounding detrital quartz grains. Quartz overgrowth cement is abundant, frequently showing well-developed crystal faces. The silica appears to be the earliest cement, as suggested by partial replacement and rimming of the quartz overgrowths by the kaolinite. Some of the softer rock fragments have also been compressed by adjacent quartz and/or feldspar grains. There is also some minor grain interpenetration, presumably due to sediment compaction.

ORIGIN OF MINERALS

The mineral assemblages herein investigated and described are based on only a few samples, but are probably reasonably representative of the outcrops from which they were collected. Two of the minerals identified in these samples, specifically kaolinite and the "tripoli" quartz, are of eco-

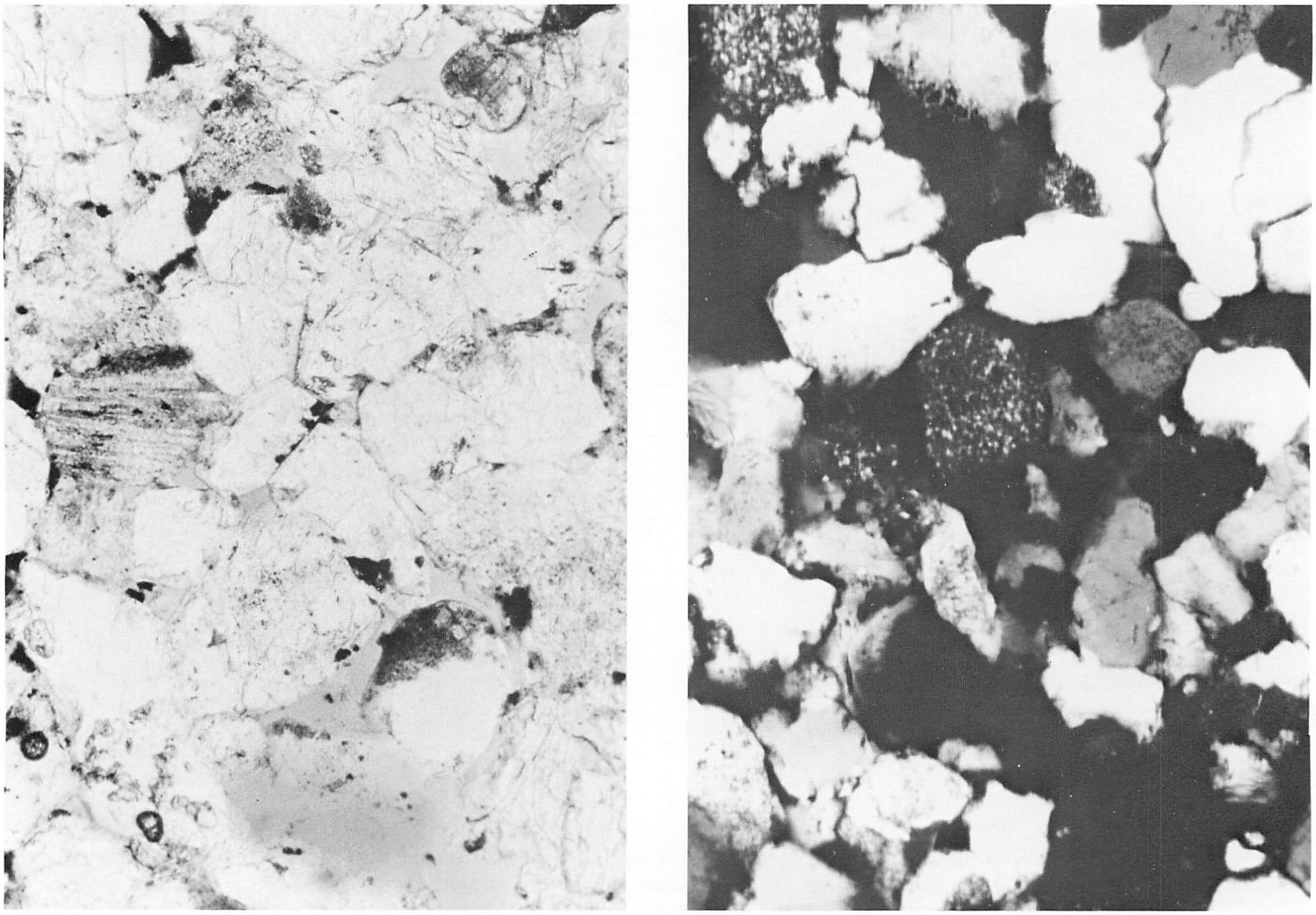


Figure 6 - Photomicrographs of the Mississippian Hartselle Formation (Core DC 204 at 74 feet depth). The sample is a very fine-grained sublitharenite. Herein referred to as Sample no. 6.

A. Numerous quartz, minor feldspar, and minor rock fragments. The smooth, featureless areas between grains represent open pore space. Several of the quartz grains have well-developed crystal faces indicative of quartz overgrowths. The fractures in the quartz grains are due to grinding during sample preparation (63X magnification).

B. Another field of the same sample taken in cross polarized light. At least two chert rock fragments (one in the center, another in the upper left corner) are recognizable due to their pin-point extinction characteristic (63X magnification).

nomic interest and as such a brief consideration of their probable origin will be of interest.

Kaolinite

The clay samples (nos. 1-5) were found to consist of an average kaolinite content of about 78% by weight (Table 2). Although the samples are of varying age (Table 1), their mode of origin appears to be similar. Mellen (1937) used the term "Little Bear residuum" for similar deposits in Alabama and Mississippi. Mellen suggested that these clay materials originated in place due to the decomposition of Paleozoic strata, although there is evidence that some of the clays have been reworked. Kaolinite is often found at other locations around the world, on weathered horizons above igneous and metamorphic rocks; as detrital and authigenic particles in sedimentary rocks; it is known to crystallize as a product of hydrothermal alteration of previously existing minerals; and in some instances it is a known by-product of in situ rock weathering under tropical climatic conditions. This latter explanation seems the most reasonable for the clay samples investigated for this report. The underlying Paleozoic, and perhaps even the Mesozoic, strata would have been subjected to tropical climatic conditions in the geologic past. These conditions were apparently present in parts of Arkansas during the early to late Cenozoic time periods, which helped to form bauxite and kaolinite deposits at the expense of Cretaceous age nepheline syenites. The silica content of the Tishomingo County formations, under these tropical conditions, would have been produced under favorable alkaline conditions associated with these tropical climatic conditions. Minerals of the feldspar group are particularly suitable and vulnerable to chemical decomposition and subsequent depletion of silica under the hot humid conditions afforded by this climate. In this way, the feldspars in the Paleozoic and/or

Figure 7 - Photomicrograph of the Tanyard Branch Member (Lewis Sand equivalent) of the Mississippian Pride Mountain Formation. This is a surface location in the SE/4, SE/4, SE/4, Sec. 5, T.5S., R.15W. The sample is a very fine-grained sublitharenite. Herein referred to as Sample no. 11. Numerous well-developed crystal faces on existing detrital quartz boundaries are indicative of quartz overgrowths. A few feldspar grains and rock fragments are also present near the top margin of the field (darker grains). Most of the smooth, featureless areas between quartz grains represent open pore space.

Mesozoic rocks, as well as other mineral constituents, would likely be decomposed, and the kaolinite would form along with the selective removal of some silica. It was not ascertained whether the quartz mixed with this kaolinite is detrital quartz, chert, or in situ quartz or chert from the previously existing weathered formations.

Tripoli

Tripoli is the name normally given to a friable, light-colored, porous, weathered material formed from the decomposition of chert or of siliceous limestone. It occurs as a very fine-grained, often powdery material consisting almost entirely of microcrystalline quartz, typically chalcedony.

Samples nos. 12-15 are "tripoli" material collected from an abandoned underground mine (described elsewhere in this bulletin) in northeastern Tishomingo County, near the Eastport community, in a local area referred to as Chalk Mine Hollow. The Alabama Flint Company operated the mine until 1899, when approximately 1600 short tons of tripoli were removed (Knox, 1985). Spain et al. (1938) suggested that these tripoli deposits formed as a residual product of solution of the Mississippian Fort Payne Formation either from decomposition or alteration of chert; or alternatively, as a weathering product of siliceous limestone. In a more recent publication, Rheams and Richter (1988), in their investigation of similar Mississippian Fort Payne Formation tripoli deposits in northwestern Alabama, postulate a relationship between lineaments and dissolution. They suggest that intersecting fractures became host areas allowing dissolution by ground water. The ground water is proposed to have been alkaline, which is more conducive to silica dissolution. Carbonate material would have been removed by dissolution of the overlying Tuscumbia limestone by carbonic acid, formed as ground waters came in contact with carbonaceous clays. As the circulating waters became less alkaline, the precipitation of microcrystalline quartz (tripoli) might then have occurred. In areas where previously existing chert deposits were more abundant in the Fort Payne Formation underlying the Tuscumbia Formation, alkaline ground water percolating downward through fractures dissolved the silica in chert nodules and, to a lesser degree, the bedded chert as well. This silica was then re-precipitated probably as in situ, microcrystalline quartz (tripoli), especially along fracture zones and intersections. These proposed conditions also appear likely to explain similar tripoli deposits in northeastern Mississippi.

A portion of our sample no. 12 was examined with the aid of the scanning electron microscope. This investigation revealed a well-developed, euhedral crystalline character for the grains comprising the grab samples collected from the abandoned mine. The grain sizes of the particles range from less than 1/2 μm to nearly 6 μm in length (see Figure 8). The euhedral forms are manifested as 6-sided, singly or doubly terminated crystals and more rarely as 6-sided, twinned forms. Even the 1/2 μm or less crystals are euhedral. These data suggest that the host rock, either siliceous limestone or chert, was at least partially dissolved, and then subsequently re-precipitated as cryptocrystalline and microcrystalline euhedra of quartz (see Figure 8). Judging from the S. E. M. examination of sample no. 12, it appears that nearly 80% of the sample is composed of grains with hexagonal quartz morphology or at least of grains with several well-developed crystal faces.

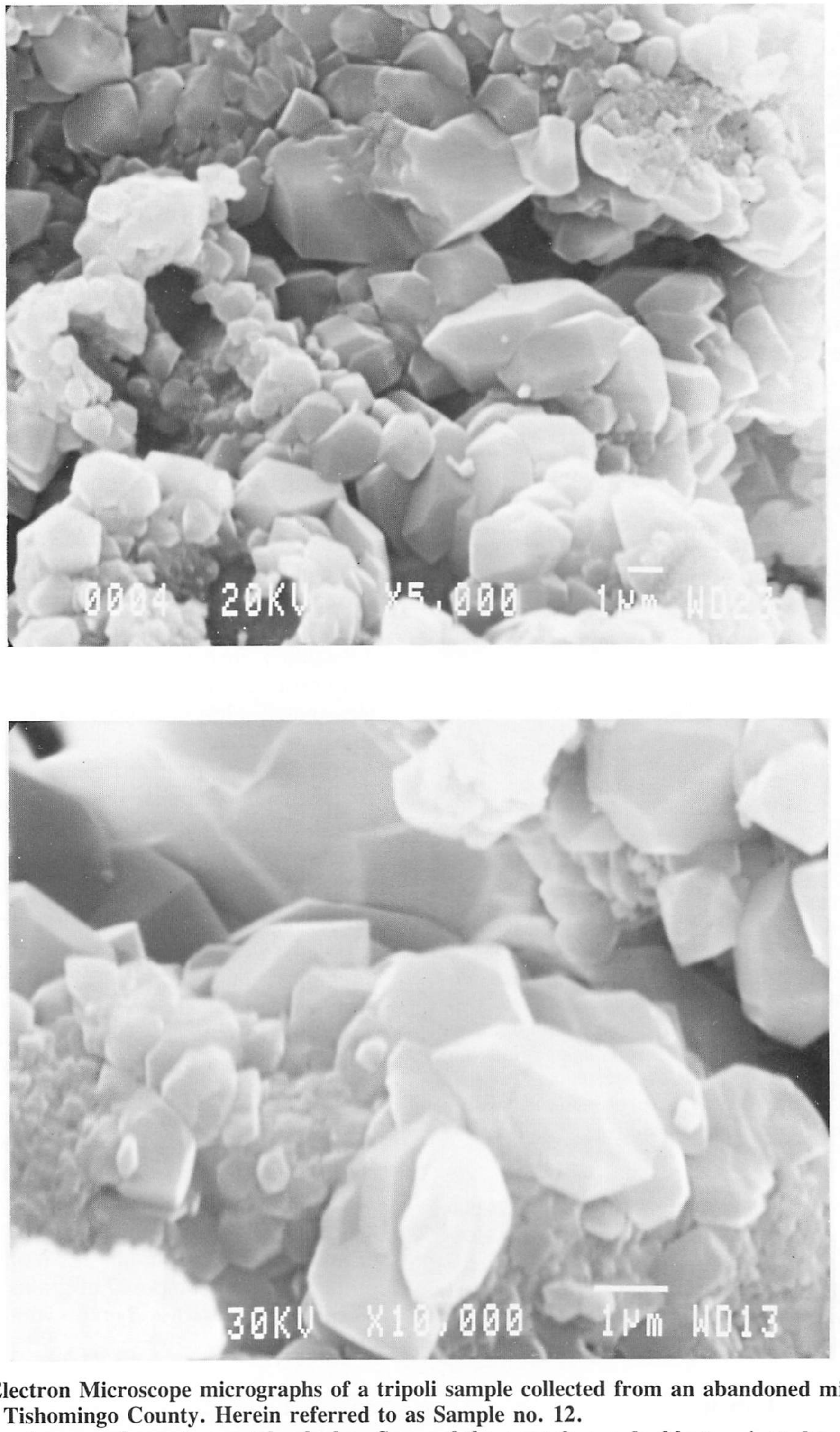


Figure 8 - Scanning Electron Microscope micrographs of a tripoli sample collected from an abandoned mine in the SW/4, Sec. 26, T.2S., R.11E., in Tishomingo County. Herein referred to as Sample no. 12.
A. Numerous hexagonal quartz crystal euhedra. Some of the crystals are doubly terminated and a few appear to be twins. Those crystals that are not obviously hexagonal also display two or more crystal faces (5000X magnification).
B. Euhedral quartz crystals from another field of the same sample but at larger magnification, suggesting that even the smallest grains tend to show crystal faces (10,000X magnification).

REFERENCES CITED

Choquette, P. W., and L. C. Pray, 1970, Geologic nomenclature and classification of porosity in sedimentary carbonates: American Association of Petroleum Geologists Bulletin, v. 54, p. 207-250.

Dunham, R. J., 1962, Classification of carbonate rocks according to depositional texture, *in* W. E. Ham, ed., Classification of Carbonate Rocks: American Association of Petroleum Geologists, Memoir 1, p. 108-121.

Folk, R. L., 1962, Spectral subdivision of limestone types, *in* W. E. Ham, ed., Classification of Carbonate Rocks: American Association of Petroleum Geologists, Memoir 1, p. 62-84.

Folk, R. L., 1974, Petrology of Sedimentary Rocks: Hemphills, Austin, Texas.

Knox, S. Cragin, 1985, An abandoned silica mine in Tishomingo County, Mississippi (abstract): Journal of the Mississippi Academy of Sciences, 1985 abstracts, p. 40.

Knox, S. Cragin, 1988, Mississippi Bureau of Geology, Jackson, Miss., personal communication.

Mellen, Frederic F., 1937, The Little Bear Residuum: Mississippi State Geological Survey, Bulletin 34.

Pettijohn, F. J., P. E. Potter, and R. Siever, 1973, Sand and Sandstone: Springer, Berlin.

Powers, M. C., 1953, A new roundness scale for sedimentary particles: Journal of Sedimentary Petrology, v. 34, p. 830-847.

Rheams, Karen F., and Karen E. Richter, 1988, Tripoli deposits in northern Alabama - A preliminary investigation: Geological Survey of Alabama, Circular 135.

Spain, Ernest L., F. E. Vestal, F. A. W. Davis, and Martin Johnson, 1938, Tripoli deposits of western Tennessee and Mississippi: Tennessee Valley Authority, Knoxville, Tenn., Geologic Bulletin No. 8.

WATER RESOURCES OF TISHOMINGO COUNTY

by
Stephen P. Jennings

ABSTRACT

Abundant supplies of good quality fresh water are available in Tishomingo County, Mississippi. Ground water currently supplies nearly all of the water consumed for domestic, commercial, and industrial purposes. Average daily water use by the 18 public water supply systems operating in the county is approximately 1.9 million gallons. Most wells in the county are less than 500 feet deep. Large supplies of surface water also exist in the county. Surface water is currently used primarily for transportation, recreation, watering livestock, and as a means of removing sewage lagoon waste. Located in the northeast corner of the state, Tishomingo County is bordered on the northeast by Pickwick Lake (Tennessee River) and contains the Divide Section of the Tennessee-Tombigbee Waterway, including Bay Springs Lake.

The principal aquifers in the county are sands and gravels of the Upper Cretaceous Tuscaloosa and Eutaw groups and Paleozoic carbonate rocks with lesser amounts of sandstone and shale. The Paleozoic and Tuscaloosa aquifers are utilized by the public water-supply systems. The Eutaw Group, which crops out across the county, is a significant source of water for many shallow, domestic wells. Minor aquifers include the Coffee Formation and Tertiary and Quaternary terrace deposits and alluvium. The Paleozoic and Tuscaloosa aquifers have highly variable but generally more favorable hydraulic characteristics than the Eutaw aquifer. Yields of Paleozoic and Tuscaloosa wells average several times greater than yields from Eutaw wells.

Ground-water quality is generally good and problems are limited. However, excessive iron concentrations and corrosiveness due to low pH are common problems from all the aquifers. Though generally soft, ground water locally reaches moderately hard levels, especially in water from the carbonate-rich Paleozoic rocks. Mineralization levels are generally well below the recommended maximum levels and are typically below 100 mg/l. Water treatment commonly consists of aeration, filtration, lime addition, and chlorination.

Surface drainage in Tishomingo County is divided between the Tennessee River Basin in the northern and eastern parts of the county and the Tombigbee River Basin in the southwestern part of the county. The Tenn-Tom Waterway and the associated Pickwick Lake and Bay Springs Lake are the dominant surface-water features of the area. Important streams include Bear Creek, Cripple Deer Creek, Indian Creek, Yellow Creek, and Mackeys Creek.

Surface-water quality is generally good. The water is soft and average total dissolved solids levels are below 100 mg/l. Iron contents are somewhat high, however. Low stream flows are commonly experienced in the late summer and fall; flood stages are commonly reached in the late winter and spring months. Severe floods have been limited, however, and much of the area's runoff is controlled by drainage canals and dams.

INTRODUCTION

Purpose and Scope of Investigation

Many natural processes as well as human activities are greatly influenced by the quantity and quality of fresh-water resources. The development and proper use of the water resources directly affect the economic growth of an area. Because of the importance of having abundant and suitable supplies of fresh water, this report is included as an integral part of the bulletin on Tishomingo County geology and mineral resources. The information summarized in this section of the bulletin serves as a supplement to the preceding sections and provides additional data to that previously published about the water resources of Tishomingo County. Data concerning availability, quantity, quality, and use of water resources as well as hydrogeologic information on the various aquifers are presented in this report. It is hoped that the data are presented in a manner to be of use to anyone interested in the development and proper utilization of the water resources of the county.

This report is divided into two major headings: ground-water resources and surface-water resources. Tishomingo County contains adequate supplies of fresh ground water (water containing less than 1,000 parts per million total dissolved minerals) and surface water for current domestic, municipal, agricultural, industrial, and recreational demands. The county is uniquely positioned to benefit from the water resources of Pickwick Lake (Tennessee River) and the Tennessee - Tombigbee Waterway.

Methods of Investigation

Basic data collected and shown for water wells includes information on ownership, location, year drilled, surface elevation, depth, screen depth, casing diameter, static water level, water-bearing stratigraphic unit, use, and yield. In addition to data collected by Bureau of Geology personnel, information was also provided by various Federal and state agencies, municipal and industrial personnel, well drillers, and private well owners. The locations of 132 domestic, industrial, and municipal wells were verified by field reconnaissance. Data on these wells along with data on Corps of Engineers wells are summarized in Table 1 and shown in Figure 1.

Physical and chemical characteristics of ground-water and surface-water samples of Tishomingo County are also included in this report (Tables 5 and 9). Specific conduc-

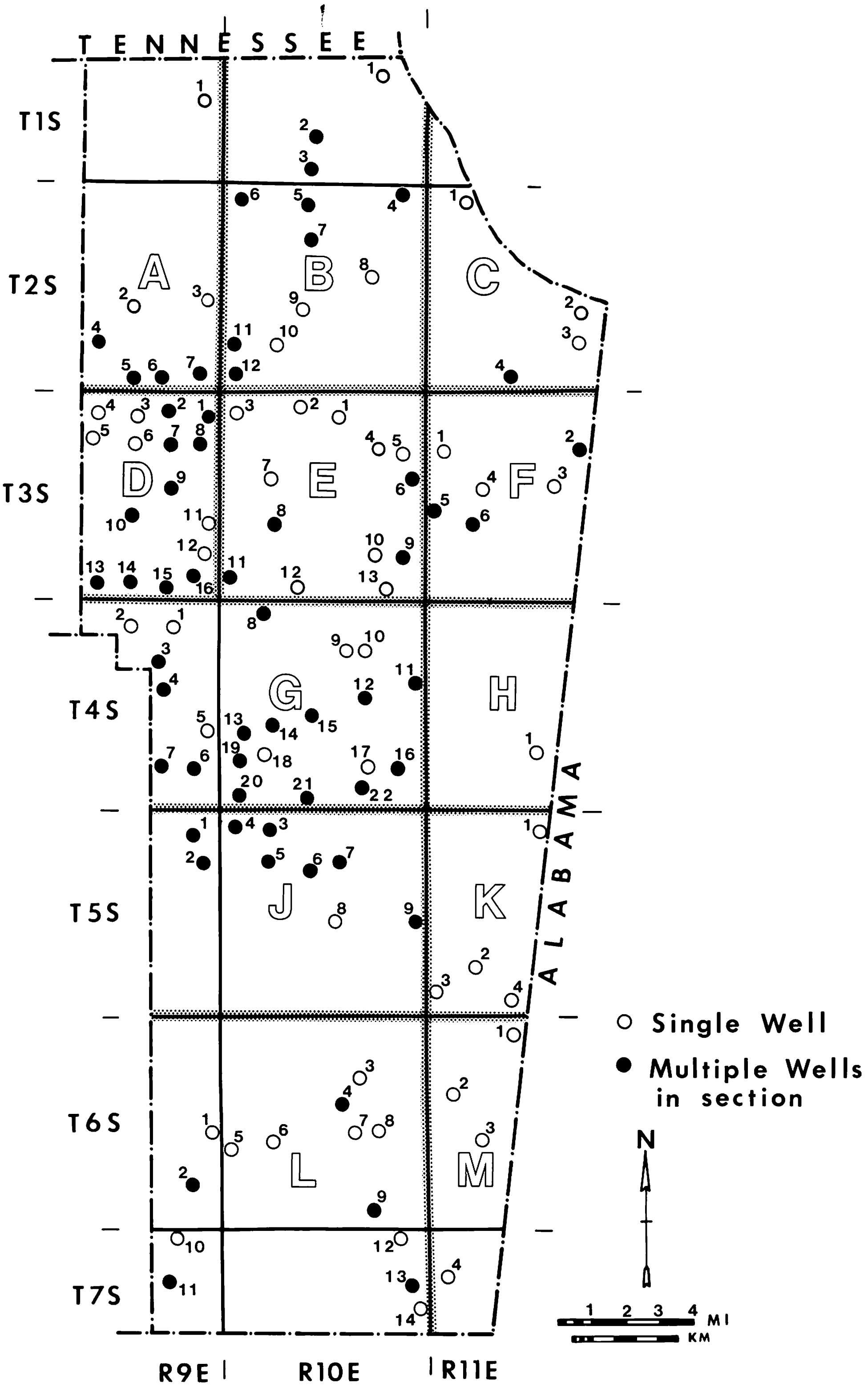


Figure 1 - Index map: Locations of wells in Tishomingo County.

TABLE 1

RECORDS OF SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NUMBER: Numbers correspond to location on Figure 1

USE OF WELL: D, Domestic; P, Public Supply; I, Industrial; U, Unused

SURFACE ELEVATION: Elevations of ground surface determined from topographic maps

REMARKS: C, Chemical Analysis; E, Electric Log

INDEX MAP NO.	USGS NO.	OWNER AND	LOCATION	YEAR DRILLED	SURFACE ELEV.	WELL DEPTH	TOP OF SCREEN	CASING DIAMETER	WATER LEVEL	DATE	AQUIFER	USE	YIELD (GPM)	DATE	REMARKS
A1		J. McMEANS	SEC. 24-1S- 9E	1965	660	35		24.0			TERR	D			C
A2	A13	D. PERRY	SEC. 22-2S- 9E	1974	480	125	120	4.0	80	1974	EUTAW	D	5	1974	C
A3	A14	USCE BDP-169	SEC. 24-2S- 9E	1973	425	48	39	3.0	19	1985	EUTAW	U			
A4	A1	G. A. HALL	SEC. 28-2S- 9E	1954	505	165		4.0	17	1954	EUTAW	D			STAINS
A4	A11	J. A. TUCKER	SEC. 28-2S- 9E	1972	490	110		4.0	40	1972	EUTAW	D	8	1972	C
A4		L. A. ADAMS	SEC. 28-2S- 92		495	35		24.0			COFFEE	D			C
A5	A2	H. JOHNSON	SEC. 34-2S- 9E	1954	460	124		4.0			EUTAW	D			IRON COLOR
A5	A9	D. CHILDS	SEC. 34-2S- 9E	1970	490	80	75	4.0	35	1970	EUTAW	U	3	1970	
A6	A4	O. JONES	SEC. 35-2S- 9E	1969	520	75	70	4.0	30	1969	EUTAW	U			C
A6	A7	D. GARRETT	SEC. 35-2S- 9E	1969	500	125	120	6.0	60	1969	EUTAW	U			
A7	A10	N. COOPER	SEC. 36-2S- 9E	1971	450	71	46	4.0	16	1971	EUTAW	U			C
A7	E44	USCE 2MW13	SEC. 36-2S- 9E	1981	445	88	86	1.5	40	1985	EUTAW	U			
A7	E46	USCE 2MW15	SEC. 36-2S- 9E	1981	445	128	126	1.5	51	1985	TUSC	U			
B1	B11	R. GIBBONS	SEC. 14-1S-10E	1969	600	188	120	6.0	40	1969	EUTAW	U			
B2	B18	YELLOW CREEK PORT	SEC. 28-1S-10E	1973	560	378	147	6.0	104	1985	PLZC	U			C, E
B2	B35	SHORT-COLEMAN PK	SEC. 28-1S-10E	1981	440	226	201	16.0	-6	1982	TUSC	P	500	1981	C
B3	B21	YELLOW CREEK PORT	SEC. 33-1S-10E	1973	455	349	76	6.0	3	1985	PLZC	U	247	1973	C
B3	B22	YELLOW CREEK PORT	SEC. 33-1S-10E	1973	442	247	77	6.0	14	1973	TUSC+PLZC	U	80	1973	C
B3	B31	SHORT-COLEMAN PK	SEC. 33-1S-10E	1979	520	98	68	10.0	12	1979	TUSC	P	160	1979	C
B4	B5	SHORT CRK W.A.	SEC. 1-2S-10E	1968	620	234	210	8.0	146	1973	PLZC	P	275	1973	C, E
B4	B16	SHORT CRK W.A.	SEC. 1-2S-10E	1970	530	133	46	8.0	47	1973	PLZC	P	150	1970	C
B5	B20	YELLOW CREEK PORT	SEC. 4-2S-10E	1973	514	266	90	6.0	76	1973	PLZC				
B5	B9	W. PRATHER	SEC. 4-2S-10E	1969	515	150	140	6.0	60	1969	PLZC	U			
B6	B19	YELLOW CREEK PORT	SEC. 6-2S-10E	1973	467	228	123	6.0	11	1985	PLZC	U	7	1973	C, E
B6	B8	J. McDUFFY	SEC. 6-2S-10E	1968	480	103	93	6.0	40	1968	EUTAW	U			
B7	B7	C. DAVIS	SEC. 9-2S-10E	1968	480	143	93	6.0	20	1968	TUSC	U			
B7	B6	CROSSROADS W. A.	SEC. 9-2S-10E	1968	490	781	46	6.0	44	1968	PLZC	U			TEST WELL - UNUSED
B8	B12	B. DOVE	SEC. 14-2S-10E	1969	575	188	80	6.0	40	1969	PLZC	U			
B9	B13	P. ADAMS	SEC. 21-2S-10E	1969	520	60	50	6.0	20	1969	EUTAW	D			C
B10	B24	J. HUBBARD	SEC. 29-2S-10E	1973	565	120		4.0	35	1973	EUTAW	U			

TABLE 1 (Continued)

RECORDS OF SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	OWNER AND	LOCATION	YEAR DRILLED	SURFACE ELEV.	WELL DEPTH	TOP OF SCREEN	CASING DIAMETER	WATER LEVEL	DATE	AQUIFER	USE	YIELD (GPM)	DATE	REMARKS
B11	B14	F. BRAG	SEC. 30-2S-10E	1971	475	63	26	4.0	26	1971	EUTAW	D			
B11	B10	C. CUMMINGS	SEC. 30-2S-10E	1969	475	75	70	4.0			EUTAW	U			
B11	B36	T. DAVIS	SEC. 30-2S-10E	1970	490	50		4.0			EUTAW?	D			C
B12	B29	E. EMBRY	SEC. 31-2S-10E	1974	490	58	56	4.0	24	1974	EUTAW	U	10	1974	
B12	B34	USCE	SEC. 31-2S-10E	1980	500	100		4.0			EUTAW?	U			
C1	C1	COLEMAN PK	SEC. 5-2S-11E	1959	460	260		6.0			PLZC	U			C
C2	C5	S. WARD	SEC. 23-2S-11E	1968	450	103	78	6.0	75	1968	EUTAW	U			
C3	C7	L. DAVIDSON	SEC. 26-2S-11E	1969	500	75	37	6.0	20	1969	EUTAW	U			
C4	C2	C. HUGHES	SEC. 33-2S-11E	1968	615	558		6.0	50	1968	EUTAW?	U	10	1968	
C4	C3	T. HUGHES	SEC. 33-2S-11E	1968	600	200	140	6.0	130	1968	EUTAW	D	10	1968	C
D1	D59	USCE 7DP167	SEC. 1-3S- 9E	1973	435	88	68	3.0	29	1985	TUSC	U			
D1	D66	USCE 2MW5	SEC. 1-3S- 9E	1980	455	60	50	1.5	23	1985	EUTAW	U			
D2	D4	BURNSVILLE	SEC. 2-3S- 9E	1914	460	127	96	4.0	4	1919	TUSC	U			C
D2	D12	J. TUCKER	SEC. 2-3S- 9E	1955	540	145	17	4.0			EUTAW	U			OPEN HOLE, IRON TASTE
D2	D52	BURNSVILLE	SEC. 2-3S -9E	1977	520	280	230	10.0	91	1987	PLZC?	P	350	1977	C, E
D3	D32	J. LAMBERT	SEC. 3-3S- 9E	1971	500	195	21	4.0	60	1971	EUTAW	U			OPEN HOLE
D4	D21	J. LIGON	SEC. 4-3S- 9E	1966	560	170	21	4.0			EUTAW	U			
D5	D19	C. HENDERSON	SEC. 9-3S- 9E	1967	580	126	71	4.0	35	1967	EUTAW	U	5	1967	
D6	D23	L. WHIRLEY	SEC. 10-3S- 9E	1969	600	135	125	4.0	90	1969	EUTAW	D	5	1969	C
D7	D3	P. TROTTER	SEC. 11-3S- 9E	1954	500	102		4.0			EUTAW?	U			
D7	D8	L. ELLEDGE	SEC. 11-3S- 9E	1951	465	63	58	2.0			EUTAW	D			IRON TASTE, STAINS
D7	D13	O. NIXON	SEC. 11-3S- 9E	1955	460	65		2.0			EUTAW?	D			
D7	D24	BURNSVILLE	SEC. 11-3S- 9E	1966	465	246	214	8.0	47	1982	PLZC	U	126	1978	C
D8	D7	J.SPENCER	SEC. 12-3S- 9E	1951	460	74	64	4.0			EUTAW	U			IRON COLOR
D8	D20	G. NEWCOMB	SEC. 12-3S- 9E	1967	490	100	95	4.0	60	1967	EUTAW	U	5	1967	
D9	D54	USCE 3DP150	SEC. 14-3S- 9E	1972	450	220	200	3.0	30	1985	TUSC	U			
D9	D56	USCE 3P152	SEC. 14-3S- 9E	1972	450	100	90	3.2	34	1985	EUTAW	U			
D10	D5	W. ELLIOT	SEC. 22-3S- 9E	1954	540	186	20	4.0			EUTAW	U			OPEN HOLE
D10	D6	M. HATCHER	SEC. 22-3S- 9E	1955	520	134		4.0	41	1955	EUTAW?	U			IRON STAIN
D10	D16	HATCHER	SEC. 22-3S- 9E	1965	520	113	93	4.0	60	1965	EUTAW	U			
D10	D17	M. VANDERFORD	SEC. 22-3S- 9E	1965	500	136	20	4.0	40	1965	EUTAW	U			
D10	D18	J. VANDERFORD	SEC. 22-3S- 9E	1965	500	135	20	4.0	50	1965	EUTAW	U			
D11	D38	R. CHILDS	SEC. 24-3S- 9E	1971	560	90	85	4.0	60	1971	EUTAW	U			
D12	D39	J. HARDWICK	SEC. 25-3S- 9E	1972	510	155	150	4.0	100	1972	EUTAW	U			
D13	D29	USCE 11A	SEC. 33-3S- 9E	1971	520	414	400	2.0	113	1971	TUSC?	U			
D13	D30	USCE 11B	SEC. 33-3S- 9E	1971	520	176	171	4.0	77	1971	EUTAW	U	23	1971	

TABLE 1 (Continued)

RECORDS OF SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	OWNER AND	LOCATION	YEAR DRILLED	SURFACE ELEV.	WELL DEPTH	TOP OF SCREEN	CASING DIAMETER	WATER LEVEL	DATE	AQUIFER	USE	YIELD (GPM)	DATE	REMARKS
D13	D50	USCE 11C	SEC. 33-3S- 9E	1975	505	404	394	6.0	67	1987	TUSC	U			E
D13	D51	USCE 11D	SEC. 33-3S- 9E	1976	505	210	200	6.0	92	1987	EUTAW				C
D14	D9	N. POTTS	SEC. 34-3S- 9E	1953	505	123	98	4.0	75	1958	EUTAW	U			
D14	D15	ROLAND MILLS	SEC. 34-3S- 9E		510		55				EUTAW?	P			STAINS
D14	D35	USCE 12	SEC. 34-3S- 9E	1972	485	334					PLZC	U			E
D14	D40	USCE 12A	SEC. 34-3S- 9E	1972	485	192	162	6.0	67	1985	TUSC	U			C
D14	D41	USCE 12B	SEC. 34-3S- 9E	1972	485	150	100	8.0	63	1985	EUTAW	U	60	1972	C
D14	D42	USCE 12C	SEC. 34-3S- 9E	1972	485	88	78	6.0	56	1985	EUTAW	U	58	1972	C
D15	D36	USCE 13A	SEC. 35-3S- 9E	1972	462	378	366	12.0	38	1985	PLZC	U			E
D15	D45	USCE 13B	SEC. 35-3S- 9E	1972	462	288	266	3.0	47	1985	TUSC	U			
D15	D46	USCE 13C	SEC. 35-3S- 9E	1972	462	220	198	12.0	35	1985	TUSC	U			
D15	D47	USCE 13D	SEC. 35-3S- 9E	1972	462	134	118	3.0	2	1972	EUTAW	U			
D15	D48	USCE 13E	SEC. 35-3S- 9E	1972	462	75	40	3.0	2	1972	EUTAW	U			
D16	D34	USCE 14	SEC. 36-3S- 9E	1972	545	390					PLZC	U			E
D16	D37	USCE 14A	SEC. 36-3S- 9E	1972	545	184	174	2.0	79	1981	TUSC	U			C, E
D16	D43	USCE 14B	SEC. 36-3S- 9E	1972	545	154	144	2.0	86	1985	EUTAW	U			C
D16	D44	USCE 14C	SEC. 36-3S- 9E	1972	545	106	100	2.0	80	1983	EUTAW	U			C
E1	E10	R. KERS	SEC. 3-3S-10E	1969	580	130	120	6.0	80	1969	TUSC	U			
E2	E20	J. WORKS	SEC. 4-3S-10E	1973	530	70		4.0	27	1973	EUTAW	U	10	1973	
E3	E42	USCE 2MW9	SEC. 6-3S-10E	1981	445	36	34	1.5	1	1985	EUTAW	U			
E4	E9	C. SANDERS	SEC. 11-3S-10E	1969	550	130	90	6.0	80	1969	TUSC	U	30	1969	
E5	E4	MASSEY	SEC. 12-3S-10E	1954	610	126	120	2.0			EUTAW	D			STAINS
E6	E5	IUKA	SEC. 13-3S-10E	1962	565	378	367	6.0	90	1962	PLZC	P	175		C
E6	E6	IUKA	SEC. 13-3S-10E	1965	570	360	285	12.0	73	1965	PLZC	P	776		C
E6	E19	IUKA	SEC. 13-3S-10E	1973	590	386	306	12.0	86	1982	PLZC	P	800		
E7	E11	SKINNER	SEC. 17-3S-10E	1969	480	60		6.0	20	1969	EUTAW	U			
E8	E40	USCE E2-1	SEC. 20-3S-10E	1983	560	156	146	1.5	83	1985	TUSC	U			
E8	E41	USCE E2-2	SEC. 20-3S-10E	1983	560	107	97	1.5	83	1985	EUTAW				
E9	E35	MIDWAY-PLEASANT HILL	SEC. 25-3S-10E	1982	680	620	600	4.0	191	1982	PLZC	P	25		
E9	E39	MIDWAY-PLEASANT HILL	SEC. 25-3S-10E	1984	680	400	347	10.0	126	1984	TUSC	P	495		
E10	E8	TISH. CO. FAIR ASSN.	SEC. 26-3S-10E	1965	590	87	67	4.0	27	1965	TUSC	D			
E11	E14	USCE 15A	SEC. 31-3S-10E	1972	540	340	320	2.0	99	1985	TUSC	U	20	1972	C, E
E11	E15	USCE 15B	SEC. 31-3S-10E	1972	540	204	184	4.0	66	1985	TUSC	U	3	1972	C
E11	E16	USCE 15C	SEC. 31-3S-10E	1972	540	130	120	4.0	57	1985	EUTAW	U	3	1972	C
E12	E22	USCE NE2	SEC. 33-3S-10E	1977	580	440	420	1.5		1985	PLZC	U			
E13	E3	H. EMLOW	SEC. 35-3S-10E	1957	460	22			18	1957	EUTAW?	D			TILE WELL

TABLE 1 (Continued)

RECORDS OF SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	OWNER AND	LOCATION	YEAR DRILLED	SURFACE ELEV.	WELL DEPTH	TOP OF SCREEN	CASING DIAMETER	WATER LEVEL	DATE	AQUIFER	USE	YIELD (GPM)	DATE	REMARKS
F1	F14	D. MEDLEY	SEC. 7-3S-11E	1969	540	120		6.0	70	1969	TUSC?	D			C
F2	F5?	IUKA	SEC. 11-3S-11E	1965	530	366	286	12.0	75	1965	PLZC	P			C
F2	F12	E. McDOUGLE	SEC. 11-3S-11E	1969	600	70	65	6.0	20	1969	PLZC	U			
F2	F13	E. GREGORY	SEC. 11-3S-11E	1969	440	50	40	6.0	6	1969	PLZC	U			
F3	F11	FISK	SEC. 15-3S-11E	1968	500	200	175	6.0	170	1968	PLZC	U	6	1968	
F4	F4	V. LEDBETTER	SEC. 17-3S-11E	1954	600	154		6.0	90	1954	TUSC?	U			STAINS, IRON TASTE
F5	F1	H. BIGGS	SEC. 19-3S-11E	1955	545	113	105	8.0	46	1982	TUSC	U			C
F5	F2	IUKA	SEC. 19-3S-11E	1927	530	128	118	10.0	45	1955	TUSC	U	100		C
F5	F3	IUKA	SEC. 19-3S-11E	1955	530	130					TUSC?	U			C
F6	F7	F. MARTIN	SEC. 20-3S-11E	1968	580	90	87	6.0	50	1968	TUSC	U			
F6	F8	R. WOODRUFF	SEC. 20-3S-11E	1968	580	95	90	6.0	60	1968	TUSC	U			
F6	F9	E. MARTIN	SEC. 20-3S-11E	1968	580	75	69	6.0	40	1968	TUSC	U			
G1	G45	USCE	SEC. 2-4S- 9E	1974	482	118	90	10.0	2	1974	EUTAW	U	201	1974	C, H2S ODOR
G2	G3	L. MILLER	SEC. 3-4S- 9E	1958	465	102					EUTAW?	U			
G3	G110	USCE 2DP143	SEC. 11-4S- 9E	1983	500	647	627	3.2	103	1985	PLZC	U			
G3	G111	USCE 2P144A	SEC. 11-4S- 9E	1972	500	270	250	3.2	89	1985	TUSC	U			
G3	G113	USCE 2P148	SEC. 11-4S- 9E	1972	500	130	120	3.0	91	1985	EUTAW	U			
G4	G43	USCE DP171	SEC. 14-4S- 9E	1973	552	380	360	3.5	129	1985	TUSC	U			E
G4	G120	USCE 9P172	SEC. 14-4S- 9E	1973	560	255	240	4.0	125	1985	TUSC	U			
G4	G123	USCE 9P175	SEC. 14-4S- 9E	1973	560	113	101	4.0	89	1985	EUTAW	U			
G5	G78	USCE 6DP162A	SEC. 24-4S- 9E	1973	590	332	322	4.0	142	1985	TUSC	U			
G6	G38	USCE 22A	SEC. 25-4S- 9E	1972	625	360	320	4.0	183	1985	TUSC	U			C,E
G6	G40	USCE 22B	SEC. 25-4S- 9E	1972	625	240	230	4.0	174	1985	EUTAW	U			C
G7	G4	USCE 21A	SEC. 36-4S- 9E	1971	585	278	268	4.0	106	1985	TUSC	U	3	1971	C, E
G7	G5	USCE 21B	SEC. 36-4S- 9E	1971	585	235	225	4.0	109	1985	EUTAW	U	11	1971	
G8	G83	USCE NE1-1	SEC. 5-4S-10E	1977	495	190		1.5	3	1985	TUSC	U			
G8	G84	USCE NE1-2	SEC. 5-4S-10E	1977	495	100	98	1.5	4	1985	EUTAW	U			
G9	G107	MIDWAY-PLEASANT HILL	SEC. 10-4S-10E	1982	550	220	200	4.0	58	1982	TUSC	P	40		
G10	G69	MIDWAY-PLEASANT HILL	SEC. 11-4S-10E	1981	590	200	160	6.0	44	1981	TUSC	P	100		
G11	G94	USCE ME3-1	SEC. 13-4S-10E	1979	517	466	457	1.5	6	1985	PLZC	U			
G11	G95	USCE ME3-2	SEC. 13-4S-10E	1979	517	93	82	1.5	15	1985	TUSC?	U			
G12	G92	USCE ME2-1	SEC. 14-4S-10E	1979	560	162	160	1.5	29	1985	TUSC	U			
G12	G93	USCE ME2-2	SEC. 14-4S-10E	1979	560	67	65	1.5	10	1985	EUTAW	U			
G13	G28	USCE 24D	SEC. 19-4S-10E	1971	594	255	215	4.0	86	1972	TUSC	U	7	1971	C, E
G13	G36	USCE 24B	SEC. 19-4S-10E	1971	594	173	163	4.0	85	1972	EUTAW	U	22	1971	C
G13	G37	USCE 24C	SEC. 19-4S-10E	1971	594	112	107	4.0	80	1972	EUTAW	U			C
G14	G15	USCE 25A	SEC. 20-4S-10E	1971	610	235	230	4.0	116	1985	TUSC	U			C

TABLE 1 (Continued)

RECORDS OF SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	OWNER AND LOCATION		YEAR DRILLED	SURFACE ELEV.	WELL DEPTH	TOP OF SCREEN	CASING DIAMETER	WATER LEVEL	DATE	AQUIFER	USE	YIELD (GPM)	DATE	REMARKS
G14	G16	USCE 25B	SEC. 20-4S-10E	1971	610	200	190	4.0	104	1985	EUTAW	U	30	1971	C
G14	G17	USCE 26A	SEC. 20-4S-10E	1971	565	250	210	2.0	53	1985	TUSC	U			
G14	G18	USCE 26B	SEC. 20-4S-10E	1971	565	127	122	4.0	44	1985	EUTAW	U			
G14	G19	USCE 26C	SEC. 20-4S-10E	1971	565	72	67	2.0	44	1985	EUTAW	U	5	1971	
G15	G86	USCE ME1-1	SEC. 21-4S-10E	1979	560	204	202	1.5	50	1985	TUSC	U			
G15	G87	USCE ME1-2	SEC. 21-4S-10E	1979	560	129	127	1.5	41	1985	EUTAW	U			
G16	G103	USCE SE2-1	SEC. 25-4S-10E	1979	580	341	321	1.5	105	1985	PLZC	U			
G16	G104	USCE SE2-2	SEC. 25-4S-10E	1979	580	183	172	1.5	62	1985	TUSC	U			
G16	G105	USCE SE2-3	SEC. 25-4S-10E	1979	580	137	134	1.5	67	1985	EUTAW	U			
G16	G106	USCE SE2-4	SEC. 25-4S-10E	1979	580	103	101	1.5	48	1985	EUTAW	U			
G17	G2	O. HARRIS	SEC. 26-4S-10E		620	13					EUTAW?	U			
G18	G44	W. LONG	SEC. 29-4S-10E	1973	610	130		4.0	46	1973	EUTAW?	D	10	1973	C
G19	G41	USCE 23N	SEC. 30-4S-10E	1972	600	200	180	4.0	162	1985	EUTAW	U	20	1972	C
G19	G42	USCE 23O	SEC. 30-4S-10E	1972	561	60	50	6.0	DRY	1985	EUTAW	U	9	1972	C
G19	G6	USCE 23A	SEC. 30-4S-10E	1971	569	202	99	4.0	55	1972	EUTAW	U			E
G19	G7	USCE 23B	SEC. 30-4S-10E	1971	569	85	82	4.0	63	1972	EUTAW	U			
G19	G20	USCE 23C	SEC. 30-4S-10E	1971	588	330	230	2.0	85	972	TUSC	U			E
G19	G23	USCE 23G	SEC. 30-4S-10E	1971	601	260	240	2.0	170	1987	TUSC	U			E
G19	G27	USCE 23I	SEC. 30-4S-10E	1971	587	492	452	2.0	179		PLZC	U			C, E
G19	G30	USCE 23K	SEC. 30-4S-10E	1971	559	300	200	8.0	54	1972	TUSC	U	325	1971	C, E
G19	G31	USCE 23J	SEC. 30-4S-10E	1971	587	380	360	4.0	83	1972	TUSC	U	60	1971	C, E
G19	G32	USCE 23L	SEC. 30-4S-10E	1971	563	126	86	8.0	120	1980	EUTAW	U	60	1971	C, E
G19	G33	USCE 23D	SEC. 30-4S-10E	1971	590	145	135	4.0	DRY	1985	EUTAW	U	20	1971	
G19	G34	USCE 23E	SEC. 30-4S-10E	1971	585	92	87	2.0	69	1972	EUTAW	U			
G19	G35	USCE 23F	SEC. 30-4S-10E	1971	588	148	138	4.0	86	1972	EUTAW	U			E
G20	G50	USCE W13	SEC. 31-4S-10E	1975	473	103	25	10.0	10	1975	EUTAW	U	135	1975	C
G20	G51	USCE W14	SEC. 31-4S-10E	1975	489	149	38	10.0	25	1975	EUTAW	U	210	1975	C
G20	G52	USCE W15	SEC. 31-4S-10E	1975	497	132	44	10.0	37	1975	EUTAW	U	195	1975	C
G20	G53	USCE W16	SEC. 31-4S-10E	1975	478	110	23	10.0	5	1975	EUTAW	U	109	1975	C
G20	G54	USCE W17	SEC. 31-4S-10E	1975	509	139	50	10.0	35	1975	EUTAW	U	180	1975	C
G20	G55	USCE W18	SEC. 31-4S-10E	1975	499	137	56	10.0	23	1975	EUTAW	U	140	1975	C
G20	G56	USCE W19	SEC. 31-4S-10E	1975	469	110	28	10.0			EUTAW	U	100	1975	C
G20	G57	USCE W20	SEC. 31-4S-10E	1975	512	169	126	10.0	37	1976	EUTAW	U	160	1975	C
G20	G58	USCE W21	SEC. 31-4S-10E	1975	495	150	42	10.0	17	1976	EUTAW	U	140	1975	C
G20	G59	USCE E12	SEC. 31-4S-10E	1975	463	98	28	10.0			EUTAW	U	116	1975	C
G20	G60	USCE E13	SEC. 31-4S-10E	1975	462	81	39	10.0			EUTAW	U	49	1975	C
G20	G61	USCE E14	SEC. 31-4S-10E	1975	470	112	58	10.0			EUTAW	U	80	1975	C
G20	G62	USCE E15	SEC. 31-4S-10E	1975	473	120	75	10.0	11	1976	EUTAW	U	55	1975	C

TABLE 1 (Continued)

RECORDS OF SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	OWNER AND	LOCATION	YEAR DRILLED	SURFACE ELEV.	WELL DEPTH	TOP OF SCREEN	CASING DIAMETER	WATER LEVEL	DATE	AQUIFER	USE	YIELD (GPM)	DATE	REMARKS
G20	G63	USCE E16	SEC. 31-4S-10E	1975	463	94	67	10.0			EUTAW	U	45	1975	C
G20	G64	USCE E17A	SEC. 31-4S-10E	1976	464	110	70	10.0			EUTAW	U	24	1976	C
G20	G65	USCE E18	SEC. 31-4S-10E	1975	533	169	72	10.0	28	1975	EUTAW	U	130	1975	C
G20	G66	USCE E19	SEC. 31-4S-10E	1976	506	146	46	10.0			EUTAW	U	160	1976	C
G20	G67	USCE E20	SEC. 31-4S-10E	1976	480	133	27	10.0			EUTAW	U	120	1976	C
G20	G68	USCE E21	SEC. 31-4S-10E	1976	513	162	50	10.0			EUTAW	U	176	1976	C
G21	G13	USCE 35A	SEC. 33-4S-10E	1971	600	300	260	4.0	119	1985	TUSC	U	6	1971	C, E
G21	G14	USCE 35B	SEC. 33-4S-10E	1971	600	203	198	4.0	102	1985	EUTAW	U	5	1971	C
G22	G99	USCE SE1-1	SEC. 35-4S-10E	1979	560	344	330	1.5	51	1985	PLZC	U			
G22	G100	USCE SE1-2	SEC. 35-4S-10E	1979	560	218	208	1.5	56	1985	TUSC	U			
G22	G101	USCE SE1-3	SEC. 35-4S-10E	1979	560	130	127	1.5	44	1985	EUTAW	U			
G22	G102	USCE SE1-4	SEC. 35-4S-10E	1979	560	73	73	1.5	45	1985	EUTAW	U			
H1	H1	MAGNOLIA PROD.	SEC. 27-4S-11E	1971	450	200					PLZC	I			C, E
J1	J18	USCE 31A	SEC. 1-5S- 9E	1972	473	178	158	4.0			TUSC	U	1		C
J1	J19	USCE 31B	SEC. 1-5S- 9E	1972	473	74	64	4.0			EUTAW	U			C
J2	J66	USCE SW1-2	SEC. 12-5S- 9E	1977	550	150	148	1.5	88	1985	EUTAW	U			
J2	J67	USCE SW1-3	SEC. 12-5S- 9E	1977	550	75	73	1.5	69	1985	EUTAW	U			
J2	J75	USCE SW1-1	SEC. 12-5S- 9E	1977	550	271	262	1.5	103	1985	TUSC	U			
J3	J9	USCE 34	SEC. 5-5S-10E	1971	560	380					PLZC	U			E
J3	J13	USCE 34A	SEC. 5-5S-10E	1971	560	266	256	4.0	101	1985	TUSC	U	8		C
J3	J14	USCE 34B	SEC. 5-5S-10E	1971	560	134	129	4.0	74	1985	EUTAW	U	8		C
J3	J15	USCE 34C	SEC. 5-5S-10E	1971	560	100	95	4.0	73	1972	EUTAW	U			
J4	J8	USCE 33A	SEC. 6-5S-10E	1971	515	172	162	4.0	51	1972	EUTAW	U			E
J4	J16	USCE 33B	SEC. 6-5S-10E	1971	515	90	90	4.0	59	1985	EUTAW	U			C
J4	J17	USCE 33C	SEC. 6-5S-10E	1971	515	212	212	2.0	64	1985	TUSC	U			E
J4	J20	USCE 32A	SEC. 6-5S-10E	1972	530	240	240	4.0	85	1985	TUSC	U	10		C
J4	J21	USCE 32B	SEC. 6-5S-10E	1972	530	112	102	4.0	75	1985	EUTAW	U	8		C
J4	J27	USCE W1	SEC. 6-5S-10E	1975	445	74	25	10.0	9	1975	EUTAW	U			C, TWO SCREEN INTERVALS
J4	J28	USCE W2	SEC. 6-5S-10E	1975	443	71	17	10.0	5	1975	EUTAW	U			TWO SCREEN INTERVALS
J4	J29	USCE W3	SEC. 6-5S-10E	1975	444	65	29	10.0	10	1975	EUTAW	U			C
J4	J30	USCE W4	SEC. 6-5S-10E	1975	445	86	32	10.0			EUTAW	U	31	1975	TWO SCREEN INTERVALS
J4	J31	USCE W5	SEC. 6-5S-10E	1975	446	86	19	10.0	2	1975	EUTAW	U	40	1975	C, TWO SCREEN INTERVALS
J4	J32	USCE W6A	SEC. 6-5S-10E	1975	449	82	30	10.0	4	1976	EUTAW	U			C, TWO SCREEN INTERVALS
J4	J33	USCE W7	SEC. 6-5S-10E	1975	448	62	17	10.0	2	1975	EUTAW	U	40	1975	C, TWO SCREEN INTERVALS
J4	J34	USCE W8	SEC. 6-5S-10E	1975	450	77	29	10.0	2	1975	EUTAW	U	100	1975	C, TWO SCREEN INTERVALS
J4	J35	USCE W9	SEC. 6-5S-10E	1975	453	76	22	10.0	4	1976	EUTAW	U	50	1975	C, TWO SCREEN INTERVALS

TABLE 1 (Continued)

RECORDS OF SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	OWNER AND	LOCATION	YEAR DRILLED	SURFACE ELEV.	WELL DEPTH	TOP OF SCREEN	CASING DIAMETER	WATER LEVEL	DATE	AQUIFER	USE	YIELD (GPM)	DATE	REMARKS
J4	J36	USCE W10	SEC. 6-5S-10E	1975	454	75	34	10.0	5	1976	EUTAW	U	50	1975	C
J4	J37	USCE W11	SEC. 6-5S-10E	1975	456	82	21	10.0	2	1976	EUTAW	U	80	1975	C
J4	J38	USCE W12	SEC. 6-5S-10E	1975	472	102	24	10.0	13	1975	EUTAW	U	115	1975	C, TWO SCREEN INTERVALS
J4	J39	USCE E1	SEC. 6-5S-10E	1975	441	62	22	10.0			EUTAW	U	8	1975	E, TWO SCREEN INTERVALS
J4	J40	USCE E2	SEC. 6-5S-10E	1975	443	67	25	10.0	4	1976	EUTAW	U	24	1975	C, E, TWO SCREEN INT.
J4	J41	USCE E3	SEC. 6-5S-10E	1975	443	63	26	10.0	4	1976	EUTAW	U	24	1975	C, E
J4	J42	USCE E4	SEC. 6-5S-10E	1975	452	77	36	10.0			EUTAW	U	68	1975	C
J4	J43	USCE E5	SEC. 6-5S-10E	1975	458	88	31	10.0	8	1976	EUTAW	U	84	1975	C, E
J4	J44	USCE E6	SEC. 6-5S-10E	1975	453	80	24	10.0	4	1976	EUTAW	U	36	1975	C, E, TWO SCREEN INT.
J4	J45	USCE E7	SEC. 6-5S-10E	1975	451	76	25	10.0	4	1976	EUTAW	U	74	1975	C, E
J4	J46	USCE E8	SEC. 6-5S-10E	1975	471	96	39	10.0	19	1976	EUTAW	U	160	1975	C, TWO SCREEN INTERVALS
J4	J47	USCE E9	SEC. 6-5S-10E	1975	476	96	35	10.0	19	1976	EUTAW	U	112	1975	C
J4	J48	USCE E10	SEC. 6-5S-10E	1975	478	104	43	10.0	20	1976	EUTAW	U	96	1975	C
J4	J49	USCE E11	SEC. 6-5S-10E	1975	460	98	25	10.0	20	1976	EUTAW	U	92	1975	C, TWO SCREEN INTERVALS
J5	J3	S. SHACKLEFORD	SEC. 8-5S-10E	1951	450	28		30.0	23	1961	EUTAW?	U			
J5	J10	USCE	SEC. 8-5S-10E	1968	420	181	165	6.0	47	1987	TUSC	U	20		
J6	J79	USCE 8DP-170	SEC. 9-5S-10E	1981	520	348	343	1.5	15	1985	PLZC	U			
J6	J80	USCE E1-2	SEC. 9-5S-10E	1981	520	131	109	1.5	58	1985	TUSC	U			
J6	J81	USCE E1-3	SEC. 9-5S-10E	1981	520	102	90	1.5	63	1985	EUTAW	U			
J7	J1	W. GREEN	SEC. 10-5S-10E		540	50			46	1957	EUTAW?	U			
J7	J2	CARTER SCHOOL	SEC. 10-5S-10E	1959	560	125	85	4.0			TUSC	U			
J8	J4	W. WHITENER	SEC. 22-5S-10E	1946	520	570	500	8.0	100	1961	PLZC	U			
J9	J62	TISHOMINGO	SEC. 24-5S-10E	1977	625	120	100	10.0	72	1978	TUSC	P	102	1978	C
J9	J64	TISHOMINGO	SEC. 24-5S-10E	1978	600	91	81	10.0	51	1978	TUSC	P	60	1978	
J9	J65	TISHOMINGO	SEC. 24-5S-10E	1978	605	89	69	10.0	54	1978	TUSC	P	55	1978	
K1	K2	A. CAMPBELL	SEC. 1-5S-11E	1968	560	85	65	6.0	50	1968	TUSC	U			
K2	K4	C. GRAY	SEC. 29-5S-11E	1969	600	105	55	6.0	40	1969	TUSC	U			
K3	K1	TISHOMINGO ST.PK.	SEC. 31-5S-11E	1957	465	150	21	6.0	16	1961	PLZC	P	60	1961	C
K4	K3	VALLEY GROVE W. A.	SEC. 33-5S-11E	1969	540	270	220	6.0	89	1983	PLZC	P			C
L1	L4	L. HAWKINS	SEC. 24-6S- 9E		505	85					EUTAW?	D			C
L2	L31	USCE 45A	SEC. 25-6S- 9E	1972	485	92	82	4.0	80	1972	TUSC	U			
L2	L32	USCE 45B	SEC. 25-6S- 9E	1972	485	76	66	4.0	56	1987	TUSC	U			
L3	L1	I. BURLESON	SEC. 11-6S-10E	1948	630	55			51	1957	EUTAW	U			
L4	L14	DENNIS W. A.	SEC. 15-6S-10E	1967	600	172	102	10.0	88	1976	TUSC	P	70		E, TWO SCREEN INTERVALS
L4	L15	DENNIS W. A.	SEC. 15-6S-10E	1968	600	160	110	10.0	80	1968	TUSC	U	55		E
L4	L19	DENNIS W. A.	SEC. 15-6S-10E	1969	580	131	81	10.0	57	1976	TUSC	P	75	1969	C

TABLE 1 (Continued)

RECORDS OF SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	OWNER AND	LOCATION	YEAR DRILLED	SURFACE ELEV.	WELL DEPTH	TOP OF SCREEN	CASING DIAMETER	WATER LEVEL	DATE	AQUIFER	USE	YIELD (GPM)	DATE	REMARKS
L4	L25	DENNIS W. A.	SEC. 15-6S-10E	1971	600	160	120	10.0	93	1978	TUSC	P	75	1971	C, E
L4	L45	DENNIS W. A.	SEC. 15-6S-10E	1980	600	161	131	10.0	103	1980	TUSC	P	60	1980	E
L4	L46	DENNIS W. A.	SEC. 15-6S-10E	1980	575	145	83	10.0	65	1980	TUSC	P	95	1980	E
L4	L49	DENNIS W. A.	SEC. 15-6S-10E	1983	600	150	125	12.0	68	1983	TUSC	P	100	1983	
L5	L35	L. TENNISON	SEC. 19-6S-10E	1973	520	120		4.0	60	1973	EUTAW?	D	5	1973	C
L6	L24	J. GOGA	SEC. 20-6S-10E	1969	500	160	150	6.0	60	1969	TUSC	U			
L7	L5	F. SARTAIN	SEC. 22-6S-10E		620	115					EUTAW?	U			
L8	L6	B. MOORE	SEC. 23-6S-10E		640	150					TUSC?	U			
L9	L2	BELMONT	SEC. 35-6S-10E	1953	580	221	158	8.0	85	1953	TUSC	P	150		C
L9	L11	BELMONT	SEC. 35-6S-10E	1962	570	173	120	6.0	79	1976	TUSC	P	50		C
L9	L18	BELMONT	SEC. 35-6S-10E	1969	570	200	110	10.0	45	1969	TUSC	P	70		C, E
L9	L37	BELMONT	SEC. 35-6S-10E	1975	573	120	80	10.0	80	1976	TUSC	P	100	1976	C, E
L9	L38	BELMONT	SEC. 35-6S-10E	1975	580	185	155	10.0	78	1976	TUSC	P	100	1976	E
L9	L39	BELMONT	SEC. 35-6S-10E	1976	575	180	150	10.0	79	1976	TUSC	P	100	1976	
L9	L40	BELMONT	SEC. 35-6S-10E	1976	565	185	155	10.0	80	1976	TUSC	P	100	1976	E
L9	L16	W. HOLCOMB	SEC. 35-6S-10E	1966	560	127		4.0			TUSC?	U			
L10	L51	USCE GW125	SEC. 2-7S- 9E	1975	367	17	12	2.0	11	1985	ALLUV	U			
L11	L29	USCE 54A	SEC. 11-7S- 9E	1972	332	27	22	4.0	3	1987	TUSC	U			E
L11	L30	USCE 55A	SEC. 11-7S- 9E	1972	380	50	45	4.0	23	1987	TUSC	U	18	1972	C, E
L11	L33	USCE 54B	SEC. 11-7S- 9E	1972	332	12	7	4.0	3	1987	ALLUV	U	1	1972	C
L11	L34	USCE 54C	SEC. 11-7S- 9E	1972	333	13	8	2.0	3	1987	ALLUV	U			
L12	L10	BELMONT	SEC. 1-7S-10E	1936	575	150	100	8.0	110	1969	TUSC	P	30		C
L13	L12	GOLDEN W. A.	SEC. 12-7S-10E	1965	556	115	95	10.0			TUSC	P	80		E
L13	L27	GOLDEN W. A.	SEC. 12-7S-10E	1965	556	115	95	10.0	28	1978	TUSC	P	80		C
L13	L36	GOLDEN W. A.	SEC. 12-7S-10E	1970	557	110	60	10.0	27	1973	TUSC	P	90	1973	
L13	L47	GOLDEN W. A.	SEC. 12-7S-10E	1980	560	107	82	16.0	33	1980	TUSC	P	150	1980	
L13	L23	C. BOSTICK	SEC. 12-7S-10E	1969	550	125	100	6.0	56	1969	TUSC	U			
L14	L8	J. SOUTH	SEC. 13-7S-10E		605	50					TUSC	U			
M1	M22	VALLEY GROVE W. A.	SEC. 4-6S-11E	1983	640	90	80	4.0			TUSC	P			C
M2	M21	L. THORN	SEC. 18-6S-11E	1969	575	106	66	6.0	30	1969	TUSC	U			
M3	M20	R. BYRAM	SEC. 20-6S-11E	1969	570	128	85	6.0	77	1983	TUSC	D			
M4	M3	GOLDEN W. A.	SEC. 7-7S-11E	1980	538	117	92	10.0	40	1980	TUSC	P	150		C

tance, pH, temperature, and color were measured for some samples in the field. Chemical characteristics of the water samples were determined by Hach Company analytical procedures and with a Sequoia-Turner Spectrophotometer. Fourteen ground-water and ten surface-water samples were collected and analyzed for silica, iron, sulfate, chloride, fluoride, total dissolved solids, and hardness. Laboratory analyses of some ground-water samples completed by the Mississippi State Department of Health and the U. S. Geological Survey are included in the compilation of data presented here. Laboratory analyses by the U. S. Geological Survey of some surface-water samples are also included.

Discharge measurements conducted by the U. S. Geological Survey and U. S. Army Corps of Engineers are summarized in Table 8.

Acknowledgments

The author wishes to thank the many individuals and agencies who assisted and cooperated in writing this report. Various water well owners, drillers, local officials, personnel from the United States Geological Survey, Mississippi Bureau of Land and Water Resources, Mississippi Board of Health, and Mississippi Research and Development Center provided data. W. T. Oakley and E. J. Tharpe of the U. S. Geological Survey were very helpful in providing data and assistance. Special acknowledgment is made to Darrel Schmitz and Lamar Russell, former Bureau of Geology employees, who conducted the field work and preliminary compilation of data.

GROUND-WATER RESOURCES

Ground-Water Availability

Ground water is contained in the void spaces (pores) of the loosely consolidated sediments and in rocks. Although fresh water may be held within the pores of nearly any earth material, for it to be a usable resource it must exist in sufficient quantity to flow freely to well bores or springs. Deposits with such quantities of water are termed aquifers and in Tishomingo County are generally the loosely consolidated sands and gravels of Cretaceous age or the ancient weathered zone of the underlying Paleozoic rocks. In Tishomingo County fresh water is everywhere available from one or more aquifers. In practicality the base of the weathered zone of the Paleozoic rocks marks the limit of fresh-water supplies.

The primary aquifers in Tishomingo County are rocks of Paleozoic age and sands and gravels of the Upper Cretaceous Tuscaloosa and Eutaw groups (Figure 2). The municipal and certificated water service organizations utilize two aquifers, the Paleozoics and the Tuscaloosa Formation. Sands of the Eutaw Group provide water to many shallow domestic wells. The Coffee Sand is a minor aquifer, used as a water source in some shallow wells in the northwestern part of the county. Tertiary and Quaternary terrace sands and gravels are also used as minor water sources, primarily in the northern part of the county. Quaternary alluvial deposits supply water to some shallow wells in valleys in the western part of the county. As will be discussed in greater detail in a following section, these aquifers vary significantly in hydraulic characteristics and contain water of variable chemical and physical properties. Variability in the water-bearing characteristics of the aquifers is common due to several factors: aquifer thickness, grain size and shape, sorting, and presence of clay or silt.

Precipitation on the outcrops of the permeable strata and its downward filtration through overlying sediments is the ultimate primary source of recharge to the aquifers. Average annual precipitation in the area is approximately 56 inches (National Oceanic and Atmospheric Administration) but is heaviest in the winter and spring months and lightest in late summer and early autumn. Water that enters the sediments moves in a general west-southwest direction, coincident with the general dip of the strata.

Present Ground-Water Use

Ground water presently provides virtually all of the residential, commercial, and industrial water supplies in Tishomingo County. Industrial usage is provided by public water systems within the county. Municipal water systems presently supply the following areas: Belmont, Burnsville, Iuka, and Tishomingo. In addition there are 14 water service areas operating in the county serving areas outside the municipalities (Table 2 and Figure 3). The town of Iuka provides water to Walker Switch, Midway-Pleasant Hill, Eastport-Snowdown, and Harmony Central water associations and provides a small portion to the Short Creek-Coleman Park Water Association. The municipal and certificated water service areas provide water to over 6,000 customers, of which over 300 are commercial and 20 are industrial.

The average daily total ground-water use by the public-supply systems in Tishomingo County is approximately 1.9 million gallons. Elevated storage capacity for the county is approximately 1.5 million gallons, and there is an additional ground storage capacity of approximately 0.75 million gallons. Total self-supplied domestic water use is approximately 150,000 gallons, the majority of which is from rural wells. The wells range in depth from 30 feet to 558 feet.

Ground-Water Quality

When considering the use of water, quality is of critical importance. By water quality is meant the constituent chemistry and physical properties coupled with the intended use of the water. There are three main classes of water use: domestic (household), agricultural, and industrial. Although water used for domestic purposes generally must meet very high standards (Table 3), water for use in particular industrial or agricultural applications may need to be of special quality. Table 4 lists water quality tolerances for some industrial applications. Ground water is commonly selected for use over surface water because of several quality factors: (1) very minor or no suspended matter in ground water, (2) small

ERA	SYSTEM	SERIES	GROUP	STRATIGRAPHIC UNIT	Thickness (feet)	WATER RESOURCES DATA
CENOZOIC	QUATERNARY	HOLOCENE		ALLUVIUM	5-30	Minor, generally poor source of water in flood plain areas. Calcium bicarbonate water, low in total dissolved solids.
		PLEISTOCENE		TERRACE DEPOSITS (LOW ELEVATION)	5-35	Minor, poor source of water. Sands discontinuous and of limited extent. Calcium bicarbonate water, low in total dissolved solids.
				TERRACE DEPOSITS (HIGH ELEVATION)	35-56 +	
MESOZOIC	CRETACEOUS	UPPER CRETACEOUS	SELMA	COFFEE FORMATION	150	Minor source of water for shallow domestic wells in northwest part of county. Quality generally good.
			EUTAW	EUTAW FORMATION: TOMBIGBEE SAND MEMBER	70-100	Major source of water in fine- to medium-grained, glauconitic sands interbedded with clay. Aquifer in many shallow domestic wells. Quality generally good but may contain moderate to high iron content.
				EUTAW FORMATION: LOWER EUTAW	70-125	
				McSHAN FORMATION	20-70	
			TUSCALOOSA	TUSCALOOSA GROUP (UNDIFFERENTIATED)	0-350 +	Major source of water in sands and gravels. Outcrops in eastern part of county. Quality generally good but may have moderate to high iron content. Maximum thickness in central part of county.
PALEOZOIC	MISSISSIPPIAN	CHESTER		HARTSELLE FORMATION	25-64	Not differentiated as individual aquifers. Hartselle and Pride Mountain predominantly clastic units. Tuscumbia, Fort Payne, and Ross predominantly carbonates and chert. Paleozoic rocks generally only an aquifer where fractured and weathered (upper 200'). Water quality generally good but hardness somewhat higher than other aquifers. High yield well at Iuka.
				PRIDE MOUNTAIN FORMATION	300-349	
		MEREMEC	IOWA	TUSCUMBIA FORMATION	0-240	
		KINDERHOOK-OSAGE		FORT PAYNE FORMATION	150-250	
	DEVONIAN	BRADFORDIAN		CHATTANOOGA FORMATION	0-35	
		ULSTERIAN	LINDEN	ROSS FORMATION	105	

Figure 2 - Stratigraphic column and general aquifer characteristics, Tishomingo County, Mississippi.

TABLE 2

PUBLIC WATER SERVICE AREAS

I. Municipal Water Service Areas

A Burnsville
B Iuka
C Tishomingo
D Belmont

II. Certificated Water Service Areas

1 Alcorn Water Association
2 Dennis Water Association
3 Eastport-Snowdown Water Association
4 Golden Water Association
5 Harmony-Central Water Association
6 Holcutt-Cairo Water Association
7 Midway-Pleasant Hill Water Association
8 Northeast Itawamba Water Association
9 Short-Coleman Park Water Association
10 Smith & Smith Utility Corporation
11 The First Utility District - Hardin County, Tennessee
12 Valley Grove Water Association
13 Walker Switch Water Association
14 New Site Water Association

numbers of bacteria, generally harmless types, in ground water, (3) generally clear and colorless ground water, (4) relatively constant temperature, and (5) generally, a decreased likelihood of contamination. Although filtration and diffusion of suspended and dissolved matter by soil and rock are significant factors in reducing contamination, the fact that we enjoy good quality ground water is largely due to tapping supplies that accumulated in aquifers long before human activities in the area.

However, even unpolluted ground water is not pure due to dissolved minerals derived from the sediments and rocks through which the water moves. In addition, water quality may vary significantly from well to well, even within a small geographic area, due to variations in such natural factors as mineralogy of the enclosing sediments, temperature, pH, rate of ground-water movement, and distance of movement. For a well at a particular geographic location, water in more permeable beds may contain lower mineral concentrations than water in less permeable beds (other factors held constant) due to the greater rate of migration of water in the more permeable strata. Thus, water generally contains more dissolved minerals the longer it is underground and the farther it travels through a particular type of sediment. The mineralogy and textural parameters of the sediment are important; relatively "clean," well-sorted quartz sands will generally contribute less mineralization than argillaceous, immature, "dirty" sediments. Mineralization is reflected in the "total dissolved solids" (TDS in mg/l or parts per million) measurement. In general, water containing less than 1,000 mg/l TDS is considered fresh water, water with 1,000 to 10,000 mg/l is brackish, water with 10,000 to 100,000 mg/l is saline, and water with over 100,000 mg/l TDS is considered a brine. In Tishomingo County, water with TDS concentrations exceeding the fresh water limit are considerably deeper within the Paleozoic stratigraphic section than is generally drilled or, with regard to the Cretaceous and Tertiary aquifers, lies many miles to the west of the county (Gandl, 1982). Note that the recommended drinking water standards limit total dissolved solids to 500 mg/l, but in Tishomingo County ground water rarely exceeds 100 mg/l.

Table 5 shows chemical analyses of water from selected wells in Tishomingo County. Although ground water in

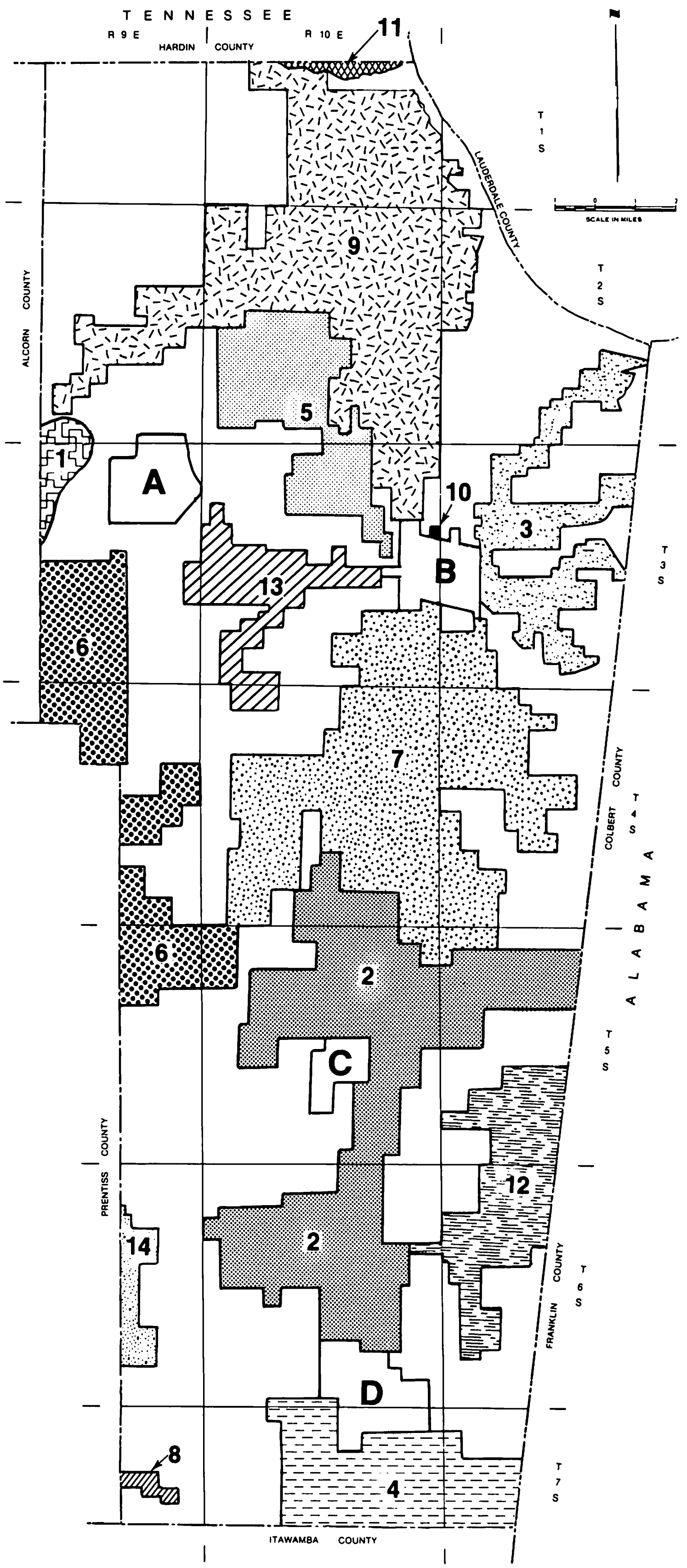


Figure 3 - Municipal and certificated water service areas.

TABLE 3

U.S. ENVIRONMENTAL PROTECTION AGENCY DRINKING WATER STANDARDS
(all values in milligrams per liter unless noted otherwise)

PARAMETERS	U.S. EPA PRIMARY MCL*	U.S. EPA SECONDARY MCL*
PHYSICAL FACTORS		
COLOR (PLATINUM STD)	-	15
ODOR, THRESHOLD NUMBER	-	3
TURBIDITY, JTU	1	-
pH	-	6.5-8.5
CHEMICAL FACTORS		
ARSENIC	0.1	-
BARIUM	1	-
CADMIUM	0.01	-
CHLORIDE	-	250
CHROMIUM	0.05	-
COPPER	-	1.0
FLUORIDE	1.4-2.4	-
IRON	-	0.3
LEAD	0.05	-
MANGANESE	-	0.05
MBAS	-	0.6
MERCURY	0.002	-
NITRATE (AS N)	10	-
SELENIUM	0.01	-
SILVER	0.05	-
SULFATE	-	250
TOTAL DISSOLVED SOLIDS	-	500
ZINC	-	5
CORROSION AND SCALING FACTORS		
HARDNESS	-	NON-CORROSIVE
SODIUM	-	NON-CORROSIVE
BACTERIOLOGICAL FACTORS		
COLIFORM (MEMBRANE FILTER)	1/100 ml	-
RADIOLOGICAL FACTORS		
GROSS ALPHA ACTIVITY	15 pCi/l	-
GROSS BETA ACTIVITY	-	-
RADIUM 226 AND 228	5 pCi/l	-
STRONTIUM 90	-	-
ORGANIC CHEMICALS		
CHLORINATED HYDROCARBONS		
ENDRIN	0.0005	-
LINDANE	0.005	-
METHOXYCHLOR	1	-
TOXAPHENE	0.005	-
CHLOROPHENOXY HERBICIDES		
2,4-D	0.02	-
2,4,5-TP (SILVEX)	0.03	-
TOTAL TRIHALOMETHANE	0.1	-

* MCL = Maximum Containment Level

TABLE 4

WATER QUALITY TOLERANCES FOR INDUSTRIAL APPLICATIONS
(concentrations in milligrams per liter)

INDUSTRIAL USE	TURBIDITY	COLOR	ALKALINITY	HARDNESS	pH	Fe	Mn	SiO2	Cl	HCO3	TOTAL DISS. SOLIDS	REMARKS
* Air Conditioning	-	-	-	-	-	0.5	0.5	-	-	-	-	A, B
* Baking	10	10	-	-	-	0.2	0.2	-	-	-	-	C, D
* Boiler Feed:												
0-150 psi	20	70	-	80	8.0+	-	-	40	-	50	1000-3000	
150-250 psi	10	40	-	40	8.5+	-	-	20	-	30	500-2500	
250-400 psi	5	5	-	10	9.0+	-	-	5	-	5	100-1500	
400 and greater psi	1	2	-	2	9.6+	-	-	1	-	0	50	
**Canning - fruits and vegetables	-	5	250	250	6.5-8.5	0.2	0.2	50	250	-	500	C
* Carbonated Beverages	2	10	125	250	-	0.2	0.2	-	-	-	850	C
**Cement	-	-	400	-	6.5-8.5	25.0	0.5	35	250	-	600	
**Chemicals:												
Organic	-	5	125	170	6.5-8.7	0.1	0.1	-	-	128	250	
Inorganic	-	5	70	250	6.5-7.5	0.1	0.1	-	-	210	425	
Plastic and Resin	-	2	1	0	7.5-8.5	0.005	0.005	0.02	0	0.1	1.0	
Pharmaceuticals	-	2	2	0	7.5-8.5	0.005	0.005	0.02	0	0.5	2.0	
Soaps and Detergents												
Paints	-	5	100	150	6.5	0.1	0.1	-	30	125	270	
Fertilizer	-	10	175	250	6.5-8.0	0.2	0.2	25	50	210	300	
* Cooling	50	-	-	50	-	0.5	0.5	-	-	-	-	A, B
* Food (general)	10	5-10	30-250	10-250	-	0.2	0.2	-	-	-	850	C
* Ice (raw water)	1-5	5	30-50	-	-	0.2	0.2	10	-	-	300	C, F
* Paper and Pulp:												
Groundwood	50	30	150	200	-	0.3	0.1	50	75	-	500	E
Kraft, bleached	40	25	75	100	-	0.2	0.1	50	200	-	300	E
Soda and Sulfite Pulps	25	5	75	100	-	0.01	0.05	20	75	-	250	E
Fine Paper	10	5	75	100	-	0.01	0.05	20	-	-	200	E
* Tanning	20	10-100	135	50-135	6.0-8.0	0.2	0.2	-	-	-	-	
* Textiles:												
General	5	20	-	20	-	0.25	0.25	-	100	-	-	
Dyeing	5	5-20	-	20	-	0.25	0.25	-	-	-	-	G
Wool Scouring	-	70	-	20	-	1.0	1.0	-	-	-	-	H
Cotton Bandage	5	5	-	20	-	0.2	0.2	-	-	-	-	H

* Todd (1970)
** Nemerow (1978)

REMARKS:
A - No corrosiveness
B - No slime formation
C - Meets Federal drinking water standards
D - Some hardness desirable
E - Free CO_2 less than 10 mg/l
F - $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$ troublesome; sulphates and chlorides of Ca, Mg, and Na each less than 300 mg/l
G - Constant composition; residual alumina less than 0.5 mg/l
H - Calcium, magnesium, iron, manganese, suspended matter and soluble organic matter may be objectionable

TABLE 5

CHEMICAL ANALYSES OF WATER FROM SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

SiO2 = Silica
Fe = Iron
Ca = Calcium
Mg = Magnesium
Na = Sodium
K = Potassium

HCO3 = Bicarbonate
SO4 = Sulfate
Cl = Chloride
F = Fluoride
NO3 = Nitrate
TDS = Total Dissolved Solids

HARDNESS (as CaCO3)
COND. = Specific Conductance (micromhos at 25 deg. Centigrade)
TEMP. = Temperature (deg. Fahrenheit)
COLOR = Color in Platinum Units

Note* All dissolved constituents and hardness given in milligrams per liter

INDEX MAP NO.	USGS NO.	AQUIFER	SiO2	Fe	Ca	Mg	Na	K	HCO3	SO4	Cl	F	NO3	TDS	HARDNESS	COND.	pH	TEMP.	COLOR
A7	A10	EUTAW	26.00							1.40	1.80	0.10			9.8	58	5.6	68.0	5
A4	A11	EUTAW	20.70							0.30	7.90	0.10			15.2	51	5.0	66.0	5
A2	A13	EUTAW	35.90							0.80	1.20	0.30				81	5.9	64.0	5
B9	B13	EUTAW	9.10							3.70	1.50	0.02			16.7	52	5.1	66.0	5
B12	B34	EUTAW	26.00	0.04	0.90	0.80	1.90	1.40	8.00	2.50	1.10	0.10		40	6.0	30	5.3		
B11	B36	EUTAW	14.30							0.00	1.50	0.02			5.2	35	4.6	64.0	10
C4	C3	EUTAW	9.50							0.07	1.50				2.7	15	4.9	64.0	12
D6	D23	EUTAW	42.20							2.40	1.30	0.10			46.5	115	6.4	64.0	12
D14	D41	EUTAW	40.00	17.00	16.00	2.80	4.20	2.80		56.00	2.70	0.20		170	51.0	131	6.5	63.5	20
D14	D42	EUTAW	31.00	0.91	12.00	2.50	6.40	2.40		5.00	2.40	0.30		91	47.0	120	6.4		10
D16	D43	EUTAW			9.50	2.00	4.30	2.40	44.00	3.20	1.40	0.20			32.0	82	6.3		
D16	D44	EUTAW	43.00	1.40	4.10	1.60	3.50	2.70	24.00	6.00	1.20	0.10			17.0	58	6.0		
D13	D51	EUTAW	7.60	25.00	14.00	2.70	4.10	4.40		3.40	2.00	0.20		74	46.0	126	6.9		20
E11	E16	EUTAW	28.00		6.40	2.00	3.30	2.70	28.00	8.00	1.40	0.20			24.0	70	6.9		43
G21	G14	EUTAW									1.60				24.0	61	6.1		
G14	G16	EUTAW	20.00	0.61	1.90	1.00	1.90	1.10		8.00	1.00	0.10		47	9.0	36	5.8		1
G14	G18	EUTAW							13.00		1.20				14.0	25	5.7		
G19	G32	EUTAW	28.00	1.10	2.40	0.90	13.00	1.40	26.00	4.20	1.40	4.80	0.50	71	10.0	71	6.8		
G13	G36	EUTAW	30.00		3.80	1.20	3.40	1.80	19.00	8.80	1.20	0.10			14.0	53	6.0		
G13	G37	EUTAW	14.00		1.80	0.60	1.00	1.20	12.00	0.20	1.20	0.10			7.0	26	6.0		
G6	G40	EUTAW	30.00	1.30	9.40	1.60	3.50	1.50	50.00	13.00	1.40	0.10		78	30.0	92	6.1	62.6	5
G19	G41	EUTAW	29.00	0.05	3.10	1.10	3.10	1.90		6.40	1.50	0.10		50	12.0	36	5.1		1
G19	G42	EUTAW	34.00	0.05	2.00	0.70	3.50	2.60	13.00	6.20	2.40	0.10			8.0	46	6.0		
G18	G44	EUTAW	15.20							2.20	2.30	0.06			29.7	52	6.0	64.0	2
G1	G45	EUTAW	39.00	14.00	9.70	2.10	4.80	3.40	35.00	11.00	1.80	0.30		97	33.0	103	6.0		8
G20	G50	EUTAW	28.00	4.80	4.30	1.30	2.70	1.80	20.00	7.90	1.10	0.30		55	16.0	72	5.6		5
G20	G51	EUTAW	16.00	2.20	7.80	1.50	3.20	2.10	38.00	6.80	1.50	0.10			26.0	92	5.5		
G20	G52	EUTAW		2.40	4.40	1.50	3.10	1.80	21.00	7.30	1.30	0.10		60	17.0	8	5.4		
G20	G53	EUTAW	24.00	0.25	5.70	1.20	2.70	1.80	26.00	6.90	0.60	0.10			19.0	69	5.3		
G20	G54	EUTAW	19.00	1.70	4.30	1.00	1.90	1.60	16.00	7.30	0.40	0.10			15.0	55	5.3		
G20	G55	EUTAW	18.00	2.10	4.30	0.80	1.80	1.50	24.00	2.10	0.40	0.10		44	14.0	52	5.2		

TABLE 5 (Continued)

CHEMICAL ANALYSES OF WATER FROM SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	AQUIFER	SiO2	Fe	Ca	Mg	Na	K	HCO3	SO4	Cl	F	NO3	TDS	HARDNESS	COND.	pH	TEMP.	COLOR
G20	G56	EUTAW	23.00	2.00	7.50	1.50	2.60	1.90	28.00	6.30	1.30	0.10		58	25.0	86	5.1		5
G20	G57	EUTAW	21.00	0.07	3.80	1.00	1.40	1.60	24.00	0.30	0.40	0.20			14.0	44	4.9		
G20	G58	EUTAW	28.00	6.50	8.00	1.60	3.40	2.00	35.00	4.10	0.90	0.20			27.0	97	5.9		
G20	G59	EUTAW	21.00	2.70	4.00	1.00	2.10	1.30	20.00	2.90	0.70	0.20			14.0	44	5.7		
G20	G60	EUTAW	29.00	0.01	5.70	1.10	2.60	1.80	31.00	5.20	0.50	0.10			19.0	76	5.2		
G20	G61	EUTAW	31.00	0.04	8.30	1.60	3.20	2.20	41.00	6.30	1.00	0.20		85	27.0	100	5.3		
G20	G62	EUTAW	26.00	7.00	7.20	1.00	2.90	2.00	32.00	4.20	1.10	0.20		60	22.0	84	6.5		
G20	G63	EUTAW	26.00	6.00	8.60	1.40	3.00	2.10	36.00	5.20	0.60	0.10			27.0	99	5.3		
G20	G64	EUTAW	28.00	12.00	11.00	1.80	3.40	2.20	45.00	5.70	1.10	0.20		62	35.0	120	5.7		5
G20	G65	EUTAW	25.00	1.50	7.20	1.30	2.80	2.00	30.00	5.90	1.40	0.20		55	23.0	88	5.5		
G20	G66	EUTAW	21.00	7.50	8.00	1.80	3.10	1.90	47.00	5.30	1.30	0.10			27.0	100	5.2		
G20	G67	EUTAW	24.00	3.40	6.60	1.40	2.90	1.80	30.00	5.40	0.80	0.10		53	22.0	85	5.1		
G20	G68	EUTAW	23.00	2.20	4.40	1.10	2.50	1.40	23.00	4.80	1.50	0.10		52	16.0	57	5.0		5
J3	J14	EUTAW	20.00	0.01	1.80	0.90	1.50	1.10		4.00	0.90	0.10		35	8.0	32	5.8	60.8	5
J4	J16	EUTAW	21.00		2.60	1.00	1.70	1.30	13.00	4.00	0.40	0.10			11.0	38	6.0		2
J1	J19	EUTAW	29.00	2.40	3.60	1.40	2.60	1.40		7.20	1.20	0.10		57	15.0	49	5.8	65.3	1
J4	J21	EUTAW	20.00		14.00	1.00	1.50	2.10	48.00	7.20	0.80	0.20			39.0	89	6.7		
J4	J27	EUTAW	26.00	5.90	4.10	1.80	2.70	1.60	25.00	6.00	1.60	0.10		60	18.0	72	5.6		
J4	J29	EUTAW	29.00	1.30	8.20	2.60	3.00	2.00	30.00	12.00	2.60	0.10		90	31.0	115	5.9		
J4	J31	EUTAW	26.00	0.84	7.20	1.40	2.60	1.60	22.00	6.10	1.40	0.10			24.0	74	5.6		
J4	J32	EUTAW	29.00	4.20	5.60	1.10	2.60	1.70	24.00	5.60	1.40	0.10			19.0	77	5.6		
J4	J33	EUTAW	29.00	8.60	8.90	2.00	2.90	2.20	33.00	7.00	1.40	0.20		56	30.0	90	6.5		10
J4	J34	EUTAW	26.00	7.50	5.90	1.80	2.60	2.10	26.00	8.30	1.40	0.10			22.0	88	5.7		
J4	J35	EUTAW	27.00	5.80	6.00	1.90	2.50	1.90	28.00	7.30	1.30	0.10			23.0	86	5.7		
J4	J36	EUTAW	27.00	6.60	5.50	1.50	2.10	1.80	23.00	6.00	1.30	0.30		61	20.0	81	5.7		
J4	J37	EUTAW	27.00	7.90	6.90	1.40	2.70	2.00	24.00	6.70	1.20	0.10		66	23.0	84	5.8		
J4	J38	EUTAW	30.00	6.80	5.00	1.30	2.60	2.00	23.00	8.90	1.10	0.20		70	18.0	85	5.7		
J4	J40	EUTAW	26.00	8.20	7.00	1.70	2.70	2.00	35.00	5.20	1.40	0.10			24.0	98	5.8		
J4	J41	EUTAW	23.00	7.80	7.80	2.50	2.60	2.10	43.00	4.90	0.70	0.10			30.0	108	5.8		
J4	J42	EUTAW	27.00	5.50	5.10	1.30	3.30	1.70	22.00	7.90	0.40	0.10			18.0	82	5.7		
J4	J43	EUTAW	29.00	4.00	4.30	1.20	2.40	1.50	20.00	7.40	1.30	0.10			16.0	59	5.6		
J4	J44	EUTAW	28.00	5.70	6.20	1.40	3.00	1.60	26.00	5.10	1.50	0.10			21.0	72	5.6		
J4	J45	EUTAW	27.00	5.40	4.50	1.00	2.70	1.60	22.00	4.10	0.90	0.10			15.0	68	5.4		
J4	J46	EUTAW	23.00	3.30	4.00	1.00	2.00	1.60	20.00	5.20	0.50	0.10			14.0	58	5.6		
J4	J47	EUTAW	23.00	1.30	3.20	1.20	1.80	1.60	20.00	4.60	1.00	0.10		56	13.0	42	5.3		
J4	J48	EUTAW	24.00	4.80	4.00	1.10	2.50	1.50	25.00	4.40	0.90	0.10			15.0	64	5.6		
J4	J49	EUTAW	21.00	4.20	5.00	1.30	1.80	1.60	16.00	3.90	0.60	0.10			18.0	56	5.6		5
L1	L4	EUTAW	13.50								2.20	0.04			9.0	20	5.1	68.0	5
L5	L35	EUTAW	10.90								5.18	0.05			9.0	24	4.6	61.0	5

TABLE 5 (Continued)

CHEMICAL ANALYSES OF WATER FROM SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	AQUIFER	SiO2	Fe	Ca	Mg	Na	K	HCO3	SO4	Cl	F	NO3	TDS	HARDNESS	COND.	pH	TEMP.	COLOR
B3	B31	TUSC		0.10	2.40	5.60	0.10	0.10		15.30	19.00	0.10		57	29.0		5.3		
B2	B35	TUSC		0.10	3.20	4.10	3.00	0.10		4.10	21.00	0.10		45	25.0		5.6		
D2	D4	TUSC	8.30	15.00	8.40	2.70	1.30	1.70	36.00	7.40	1.10	0.30		78	32.0	75	7.4		5
D16	D37	TUSC	18.00	1.40	12.00	2.30	4.10	2.90	44.00	11.00	1.00	0.30		74	39.0	104	6.4		
D14	D40	TUSC	0.90	0.02	14.00	0.10	6.40	2.40	30.00	19.00	2.60	0.10		70	35.0	110	6.8		20
E11	E14	TUSC	8.60	0.28	14.00	2.10	3.70	2.80	58.00	7.20	1.40	0.40		69	44.0	108	7.3		45
E11	E15	TUSC		13.00	10.00	1.80	4.50	3.30	45.00	8.40	1.00	0.40			32.0	94	6.9		17
E9	E39	TUSC	8.60	17.00	2.60	1.30	1.50	1.20		5.60	1.20	0.10		49	12.0	56	6.3	63.5	10
A7	E46	TUSC	8.80	0.10	1.52	1.02					7.00			35	8.0		5.4		
F5	F1	TUSC	8.30	9.60	5.10	1.20	1.30	1.40		5.30	1.40	0.10		45	18.0	89	6.6		5
F5	F2	TUSC	7.20	0.06	2.20	1.30	1.20	0.70	10.00	1.20	1.80	0.10	3.00	35	11.0	36	6.2		4
F5	F3	TUSC	8.00	0.80	2.30	4.40				2.50	10.00			33	25.2		5.5		
F1	F14	TUSC	9.60							1.60	2.40	0.03			8.2	31	4.6	64.0	5
G7	G4	TUSC							102.00		2.00				104.0	216	6.9		
G21	G13	TUSC							51.00		0.40				42.0	93	6.5		
G14	G15	TUSC	34.00	13.00	3.00	0.90	3.00	1.70		4.30	1.70	0.10		71	11.0	74	5.3		5
G13	G28	TUSC	16.00		9.40	1.70	4.10	2.20	44.00	7.60	1.60	0.20			30.0	84	6.4		4
G19	G30	TUSC	12.00	1.50	6.00	1.70	3.90	2.60	34.00	4.00	1.60	0.40		49	22.0	68	6.8		
G19	G31	TUSC	8.40	1.90	13.00	3.00	3.60	2.60	56.00	7.20	1.40	0.30		68	45.0	106	7.0		6
G6	G38	TUSC	8.20		10.00	2.30	4.90	2.90	50.00	6.80	1.40	0.30			34.0	96	7.4		17
G10	G69	TUSC		0.40	2.40	0.90	5.00	5.00			13.00				15.0		5.9		
J3	J13	TUSC							62.00		0.80				48.0	114	7.0		
J1	J18	TUSC	18.00	0.02	3.70	0.23	17.00	3.00		11.00	1.60	0.10		79	10.0	130	9.3	65.3	10
J4	J20	TUSC	11.00		26.00	2.50	3.30	1.10	90.00	9.00	1.60	0.40			75.0	164	7.8		4
J9	J62	TUSC	10.00	0.02	1.60	0.60	1.40	0.60	10.00	0.70	1.60	0.10			6.0	50	5.4		
L9	L2	TUSC	5.30	0.04	1.20	0.70	2.20	0.30	9.00	1.60	1.80	0.10	0.20	27	6.0	31	8.0		5
L12	L10	TUSC			2.20						4.00			17	5.6		5.2	60.0	
L9	L11	TUSC	11.00	0.12	0.90	0.50	1.40	1.00	4.00		0.50		2.90	32	4.0	25	5.4		5
L4	L14	TUSC	1.60	0.10	2.00	0.48	1.20				2.00			12	7.0		5.3		
L9	L18	TUSC	12.00	0.01	1.20	0.50	4.00	0.40	10.00	1.20	2.60	0.10	2.00	39	5.0	23	6.8		10
L4	L19	TUSC	10.00	0.06	2.10	0.20	1.50	1.00	6.00		2.00		2.80	26	6.0	26	5.0		
L4	L25	TUSC		0.25	3.20	3.30	10.00	0.60		3.50	13.00	0.10		31	21.6		5.3	67.0	
L13	L27	TUSC	9.90	0.05	2.20	1.30	4.20	0.50	2.00	0.20	5.90		14.00	51	11.0	56	5.1	5.0	
L11	L30	TUSC		1.50					16.00		0.80				22.0	35	6.0		
L13	L36	TUSC			1.36	0.39	35.19				8.00	0.10		87	5.0		5.3		
L9	L37	TUSC		0.25							8.00				24.2		5.4		
L9	L40	TUSC		0.25							8.00				24.2		5.4		

TABLE 5 (Continued)
CHEMICAL ANALYSES OF WATER FROM SELECTED WELLS IN TISHOMINGO COUNTY, MISSISSIPPI

INDEX MAP NO.	USGS NO.	AQUIFER	SiO2	Fe	Ca	Mg	Na	K	HCO3	SO4	Cl	F	NO3	TDS	HARDNESS	COND.	pH	TEMP.	COLOR
L4	L45	TUSC		0.20	1.60	1.00		0.80		3.00	11.00			34	8.0		5.6		
L4	L46	TUSC		0.10	1.60	1.50		0.60		4.00	18.00			43	8.0		5.6		
L13	L47	TUSC			2.40	1.50		0.40		10.00	16.00			48	12.0		5.5		
M4	M3	TUSC				1.50		0.50		5.50	24.00			53	7.0		5.3		
M3	M20	TUSC		0.25							8.00				18.0		6.8	58.0	
M1	M22	TUSC		0.70	1.60		4.00	0.40			11.00	0.20		27	8.0		5.3		
B4	B5	PLZ	1.20	0.10	1.60	1.00					8.00	0.20		23	8.0		5.4	65.0	5
B4	B16	PLZ		0.10							3.00				10.0		5.8		
B2	B18	PLZ	9.40	15.00	4.00	1.50	1.00	1.50	16.00	6.00	1.50			32	16.0	41	6.0		15
B6	B19	PLZ		15.00							1.20	0.20				60	6.5		
B5	B20	PLZ		3.70							0.90	0.10				308	7.6		
B3	B21	PLZ	12.00	0.10	2.40	1.00	1.00	0.90	8.00	1.00	1.40		2.50	44	10.0	32	5.6		10
B3	B22	PLZ	9.40	0.46	4.40	2.20	1.00	1.30	16.00	7.20	3.20			43	20.0	39	6.5		10
C1	C1	PLZ	7.20		35.00	5.20	4.60	0.60	123.00	9.60	3.50	0.30	0.60	138	109.0	214	7.7		2
D7	D24	PLZ	9.00	17.00	9.60	2.00	1.70	1.60		6.00	1.20	0.20		68	32.0	89	6.5	61.7	10
D2	D52	PLZ	9.50	16.00	5.80	1.70	1.90	1.10		6.60	2.50	0.20		39	23.0	61	6.5	62.6	25
E6	E5	PLZ	8.10	0.05	3.10	0.90	1.20	0.80		2.50	1.00	0.10		26	11.0	32	5.7		1
E6	E6	PLZ	8.40	0.03	1.70	0.70	1.20	0.50		1.00	1.30	0.10		21	7.0	26	5.6	62.6	1
E6	E19	PLZ			2.80	4.60		0.10		11.00	15.00	0.10		48	26.0		5.5		
E9	E35	PLZ		12.00	10.40	3.40	3.00	1.80		6.70	15.00	0.10		82	40.0		6.2		
F2	F5	PLZ	8.80	0.10	1.50	1.00					7.00			35	8.0		5.4	62.0	5
G19	G27	PLZ	9.30	0.09	26.00	8.40	5.80	3.70	132.00	6.80	1.60	0.20		127	100.0	215	7.7		3
H1	H1	PLZ	8.60							3.50	1.25	0.07			159.0	182	7.2	63.0	5
K3	K1	PLZ	8.70	0.01	36.00	4.00	16.00	1.10		4.70	14.00	0.20		157	110.0	291	7.2	61.7	17
K4	K3	PLZ		0.30							8.00				26.0		6.8	62.0	
A4		COFF	31.80							1.40	1.90	0.10			17.7	50	5.2	68.0	10
A1		TERR	11.00							0.30	4.10	0.06			9.3	26	5.0	63.0	10
L11	L33	ALLUV	8.70	0.09	2.00	0.50	2.00	1.30		4.50	2.90	0.10		26	7.0	36	6.8	61.0	10

SUMMARY OF CHEMICAL DATA FOR ALL AQUIFERS	SiO2	Fe	Ca	Mg	Na	K	HCO3	SO4	Cl	F	NO3	TDS	HARDNESS	COND.	pH	TEMP.	COLOR
MEAN	19.33	4.01	6.29	1.66	3.54	1.69	31.68	5.95	3.26	0.19	3.17	57	23.6	77	5.9	61.8	9
STD. DEVIATION	9.82	5.37	5.99	1.19	4.10	0.86	23.12	5.77	4.49	0.45	3.97	29	22.3	50	0.8	10.5	8
MAXIMUM	43.00	25.00	36.00	8.40	35.19	5.00	132.00	56.00	24.00	4.80	14.00	170	159.0	308	9.3	68.0	45
MINIMUM	0.90	0.01	0.90	0.10	0.10	0.10	2.00	0.07	0.40	0.02	0.20	12	2.7	8	4.6	5.0	1

the county generally is of good quality and requires little treatment, there are some problems, including hardness, iron, and acidity (relatively low pH). Hardness is the property of water affecting the amount of soap required to produce suds; "hard" water causes difficulty in producing soap suds because the minerals in the water causing hardness, chiefly calcium and magnesium, must first be combined with the soap. Hardness is usually shown as calcium carbonate hardness because calcium carbonate is less soluble than magnesium carbonate and thus is the first to precipitate out as "scale." Water with a hardness less than 50 mg/l is considered "soft" whereas hardness in excess of 150 mg/l can cause significant problems due to relatively rapid and extensive scale buildups in boilers, pipes, well casings, and cooling towers. Temperature and pressure are important factors in hardness problems. A drop in pressure (and/or an increase in temperature), as commonly occurs near a well screen, causes the release of carbon dioxide, which results in bicarbonate changing to carbonate. Carbonate then reacts with calcium and magnesium to form scale. Scale buildup can cause a serious decrease in well efficiency. In Tishomingo County, hardness values measured from ground water range from 2.7 to 159 mg/l, with an average of about 24 mg/l.

The pH of water is the logarithm of the inverse of the hydrogen ion concentration and is thus a measure of its acidity or alkalinity. The pH scale ranges from 0 to 14, with measurements less than 7 indicating acidic solutions and pH values greater than 7 indicating alkaline conditions. The U. S. Environmental Protection Agency (1976) recommended pH level for drinking water is 6.5 to 8.5. The pH is largely dependent on the amount of dissolved carbon dioxide versus the dissolved carbonates and bicarbonates derived from carbonate-rich rocks and sediments. Low pH water can result in corrosion of metals such as well casings, screens, and water pipes. As with hardness, the effects of decreased pressure (and/or increased temperature) of the water in the vicinity of the well bore during pumping can affect the carbon dioxide content and thus the pH of the water. As noted from Table 5, the average pH for Tishomingo County ground water is 6, indicating slightly acidic conditions for most samples taken. Shallow wells commonly have more problems resulting from low pH than do deeper wells in the county, reflecting the higher carbon dioxide levels typical of rainwater and shallow ground water.

Iron is another common problem in ground-water supplies, causing rust deposits in plumbing, encrustation of well screens, staining of laundry, sinks, and tubs, and unpleasant taste. As indicated in Table 4, most industrial plant processes can tolerate only minor iron concentrations; 0.3 mg/l is the recommended limit for drinking water (Table 3). High iron concentrations also promote the growth of iron bacteria, which can form a gelatinous mat and clog the openings in well screens. Although dissolved ferrous iron ions (Fe^{+2}) can occur in relatively high concentrations in ground water where low oxygen and neutral pH conditions exist, the change to insoluble ferric iron (Fe^{+3}) occurs when ground water is exposed to air, forming a reddish-brown precipitate. Although ferrous iron most commonly combines with oxygen to form ferric oxides and oxyhydroxides, it may also combine with carbonate to form iron bicarbonate, which can also contribute to plugging of screens and plumbing. Iron is commonly removed by aeration, sedimentation, and fine filtration. Iron concentrations in samples of Tishomingo County ground water are commonly high. However, the extreme range in iron contents from the reported analyses (0.01 to 25 mg/l) suggests that sampling procedures may have failed in some cases to obtain representative formation water samples. Water standing in a well that has been little used will commonly have a higher iron concentration than the true formation water concentration. Coupled with the low pH water common in the shallow aquifers, which promotes corrosiveness, it is not surprising to find high iron concentrations in the county.

Bicarbonate ion levels are generally moderately high relative to other dissolved ions in Tishomingo County ground water, averaging about 31 mg/l but ranging up to 132 mg/l. However, these amounts cause few serious problems. The principal effect of elevated bicarbonate ion content is a contribution to the alkalinity of the water. Excessive bicarbonate results in corrosiveness and affects taste.

As will be discussed later, water from the various aquifers exhibits somewhat different chemical characteristics. The variations in water quality can be significant in choosing well locations and aquifers, depending on the intended use of the ground water.

Treatment of ground water in Tishomingo County by the municipalities and water associations commonly includes chlorination, aeration, and pH adjustment (addition of lime). In addition, filtration, coagulation, and fluoridation are utilized locally. Though chlorine, a strong oxidizing agent, is used primarily to control coliform bacteria, it is also helpful in reducing taste and odor problems and in oxidizing iron and manganese. Although high pH can reduce the bacteriocidal effectiveness of chlorine, in Tishomingo County, where pH values are relatively low, chlorination is the most widespread and cost-effective method of disinfection. Aeration is also effective in oxidation and in removal of organic chemicals. Aeration and filtration, aided by chlorination, are used to reduce iron contents. Locally, the Burnsville water system is treated with alum, which acts as a coagulant in the filtration of colloidal material, and Iuka is currently fluoridating their water.

AQUIFERS

Paleozoic Rocks

The Paleozoic rocks, the oldest aquifer system in Tishomingo County, lie unconformably below the Cretaceous and younger sediments. As discussed and illustrated previously in this bulletin by Merrill, various Paleozoic formations are exposed in the eastern and northern parts of the county (Figure 4) but are covered to the west-northwest by progressively younger sediments. The stratigraphic section consists of Devonian and Mississippian limestone, chert, shale, and sandstone (Figure 2). Because the Paleozoic rocks

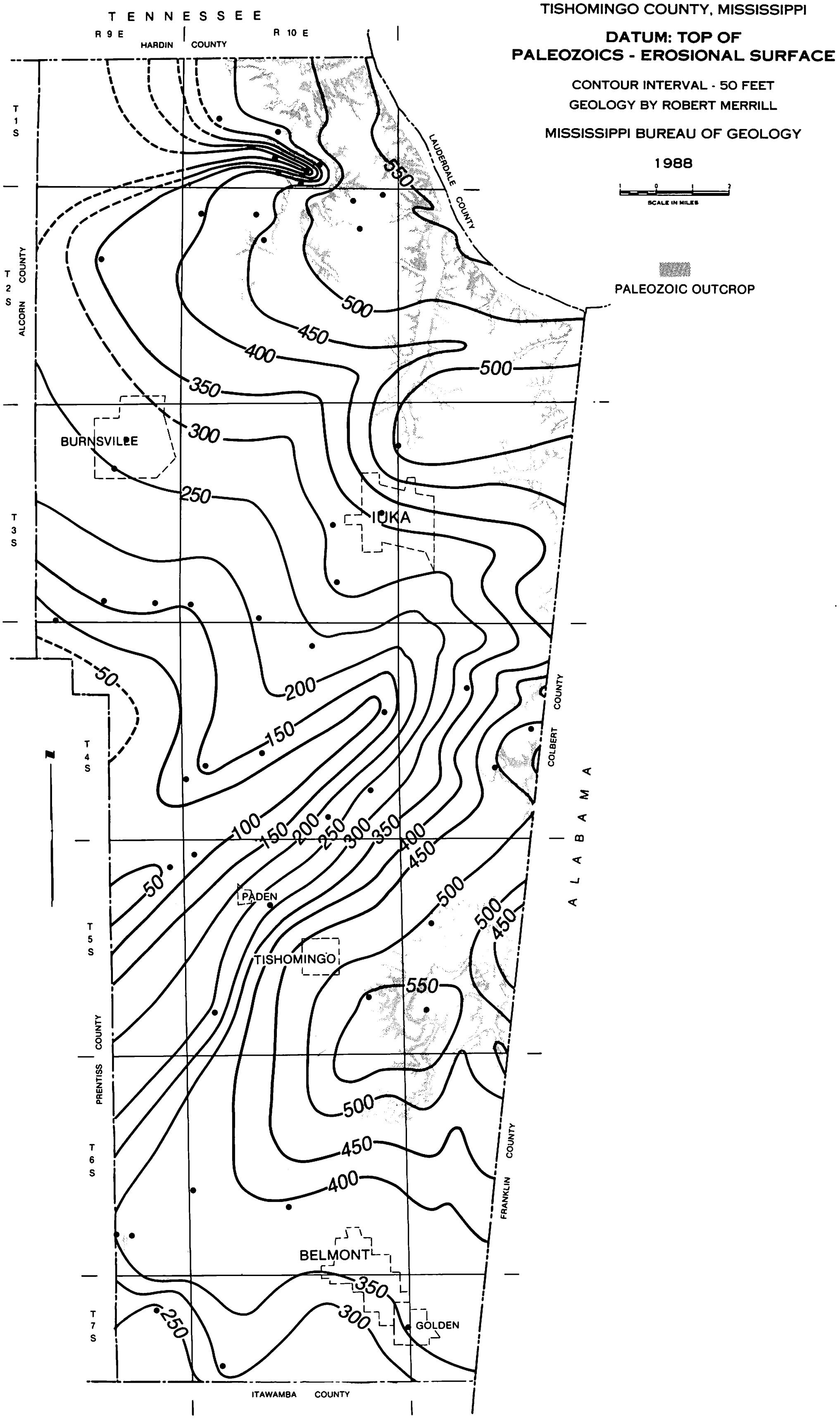


Figure 4 - Outcrop of Paleozoic rocks and structural configuration of the top of the Paleozoic surface; contour interval is 50 feet (from Merrill, this report, Plate 5).

generally dip to the south at a greater rate than the slope of the eroded Paleozoic surface, progressively younger Paleozoic formations occur beneath the Cretaceous section from north to south (see cross section A-A' of Merrill).

Limestone and cherty limestone of the Fort Payne, Tuscumbia, Pride Mountain, and possibly the Bangor Formation in the subsurface of the southeastern part of the county constitute the dominant lithologies of the Paleozoic aquifer system. Sandstones of the Hartselle Formation and minor sandstones of the Pride Mountain Formation also occur, especially in the southern part of the county. However, because the Paleozoic formations were probably exposed across the county for millions of years prior to deposition of the Upper Cretaceous sediments, significant weathering and erosion of these units occurred. Although no definitive work has been done to determine the nature and extent of porosity and permeability of the Paleozoic rocks with regard to the aquifer's hydraulic characteristics, it is generally believed (Wasson and Tharpe, 1975, and Simmons, 1985) that the upper 100 to 200 feet of the Paleozoic section, the ancient weathered zone or regolith, comprises the aquifer. However, in some wells, screens (or open holes) have been set to depths considerably greater than 200 feet below the top of the Paleozoic surface. In addition to any remnant primary porosity and permeability, the water storage and transmission capacities of the Paleozoic rocks have been enhanced by dissolution features, fractures, and joints.

Although the Paleozoic aquifer is not as widely used as the Tuscaloosa and Eutaw aquifers, several important public-supply wells at Iuka, Burnsville, Tishomingo State Park, Coleman State Park, and Short Creek Water Association withdraw significant amounts of water from the Paleozoics. In some wells water is withdrawn from screened intervals which include the uppermost Paleozoics and extend upward into the Tuscaloosa or younger sediments.

As might be anticipated from an aquifer system with such highly varied geologic parameters as the Paleozoic rocks, the hydraulic characteristics of the aquifer show considerable variability (Table 6). Transmissivity values range from 800 to 52,000 gpd/ft. The data shown in Table 6 also support the interpretation by Wasson (1986) that the transmissivity of the Paleozoic aquifer is good in a belt extending from Iuka to Corinth in Alcorn County but is generally poor in southern Tishomingo County. A yield of over 800 gpm has been reported from a Paleozoic well at Iuka. It should be noted that in many localities water in the upper Paleozoic aquifer is probably hydraulically connected with water in the overlying formations. This is exemplified where sand and gravel beds of the Tuscaloosa Group directly overlie permeable Paleozoic rocks without significant intervening clay beds to act as aquicludes or aquitards.

Water from the Paleozoic aquifer is generally soft, averaging less than 50 mg/l, though hardness values are commonly higher than those of the other aquifers (Table 7). Sparse data indicate that hardness exceeds 100 mg/l in the southern half of the county. Total dissolved solids levels are all well below the recommended maximum of 500 mg/l. Mineralization generally increases to the southwest, with TDS levels exceeding 150 mg/l in the southwestern part of the county. Iron content is locally high and requires treatment for removal. Measurements of pH are moderately to slightly acidic but average slightly higher than pH of waters of the Tuscaloosa or Eutaw aquifers. The abundance of limestone in the Paleozoic aquifer is responsible for the higher pH and somewhat harder water than found in the other aquifers.

Tuscaloosa Group

The upper part of the Tuscaloosa Group, termed the Gordo Formation by some previous workers, is the primary aquifer in Tishomingo County, providing water to most of the large public-supply and industrial users and to many domestic wells. The Tuscaloosa sediments are exposed in the eastern part of the county but dip to the west at the rate of 25-30 feet per mile (Figure 5). Because the Tuscaloosa was deposited on the very irregular Paleozoic unconformity, thicknesses of the unit vary greatly, ranging from 0 to over 400 feet (Figure 6).

The Tuscaloosa Group is composed primarily of fine to coarse gravel beds interbedded with fine- to coarse-grained sands and white, gray, or red-brown clay beds. Gravel, sand, and clay lenses occur discontinuously throughout the unit, and bedding is irregular, reflecting a variety of depositional environments of limited geographic extent. Locally, thick clay beds separate the gravel and sand beds, resulting in more than one aquifer within the unit and perched water tables. The abundance of multi-colored chert gravel results locally in difficulty in distinguishing the Tuscaloosa from the underlying cherty Mississippian and Devonian rocks.

The heterogeneity of sands, gravels, and clays in the Tuscaloosa Group coupled with the unit's variable thickness results in a wide range of hydraulic characteristics. Transmissivities range from 2,600 to 29,000 gpd/ft and hydraulic conductivities from 75 to 380 gpd/ft^2. These values are similar to those reported for the upper part of the Tuscaloosa by Simmons (1985) in his report on the Corps of Engineers' study of the Tennessee-Tombigbee Waterway Divide Cut; transmissivity values ranged from 1,800 to 14,000 gpd/ft and hydraulic conductivity values from 75 to 430 gpd/ft^2. Yields from Tuscaloosa wells range up to 500 gpm for a well at Short Creek Water Association and 495 gpm reported for a well at Midway-Pleasant Hill Water Association. Recharge to the aquifer is high because of the proximity to the Tuscaloosa outcrop belt.

Water from the Tuscaloosa Group is generally of good quality. Mineralization is generally low, with the exception of some locally high iron contents and associated acidity (low pH) problems. The water is soft to moderately hard, but locally, though not a health hazard, hardness may be too high for some industrial purposes. Total dissolved solids, everywhere in the county below 100 mg/l in the Tuscaloosa, generally increase to the west with increasing depth of the aquifer (Figure 7).

TABLE 6

AQUIFER HYDRAULIC CHARACTERISTICS

No.	U.S.G.S. No.	Owner	Location	Depth (feet)	Screen Length	Duration of test(hrs)	Yield (gpm)	Transmissivity (gpd/ft)	Permeability (gpd/ft2)	Specific Capacity (gpm/ft drawdown)
				PALEOZOIC AQUIFER						
1	B21	Yellow Creek Port T. H. 4	Sec. 33-1S-10E	349	273	6	201	8,000	-	4.4
2	E19	City of Iuka	Sec. 13-3S-10E	386	80?	24	838	52,000	260?	14.0
3	G27	U.S.C.O.E. test well 23I	Sec. 30-4S-10E	492	40	-	10	800		
				TUSCALOOSA AQUIFER						
1	G13	U.S.C.O.E. test well 35A	Sec. 33-4S-10E	300	40	1.25	5.8	23,000	380	7.6
2	G15	U.S.C.O.E. test well 25A	Sec. 20-4S-10E	235	5	1	6	2,600	170	1.4
3	G30	U.S.C.O.E. test well 23K	Sec. 30-4S-10E	300	100	48	300	20,000	130	7.8
4	G31	U.S.C.O.E. test well 23J	Sec. 30-4S-10E	380	20	-	60	3,700	75	-
5	J13	U.S.C.O.E. test well 34A	Sec. 5-5S-10E	266	40	3	6.7	29,000	230	17.0
6	J17	U.S.C.O.E. test well 33C	Sec. 6-5S- 9E	212	20	-	20	3,700	120	-
				EUTAW AQUIFER						
1	D43	U.S.C.O.E. test well 14B	Sec. 36-3S- 9E	154	10	2	6.7	1,500	60	0.6
2	D44	U.S.C.O.E. test well 14C	Sec. 36-3S- 9E	106	6	2	6.7	3,500	115	1.0
3	E16	U.S.C.O.E. test well 15C	Sec. 31-3S-10E	130	10	1.4	7	5,700	190	0.2
4	G5	U.S.C.O.E. test well 21B	Sec. 36-4S- 9E	235	10	1.2	4.2	4,000	200	0.4
5	G16	U.S.C.O.E. test well 25B	Sec. 20-4S-10E	200	10	1	6	12,000	170	1.1
6	G18	U.S.C.O.E. test well 26B	Sec. 20-4S-10E	200	10	1	6	4,600	80	0.8
7	G32	U.S.C.O.E. test well 23L	Sec. 30-4S-10E	126	40	27	60	11,000	220	2.5
8	G36	U.S.C.O.E. test well 24B	Sec. 19-4S-10E	173	10	1.25	5.8	6,000	240	0.9
9	G41	U.S.C.O.E. test well 23N	Sec. 30-4S-10E	200	20	-	20	9,000	180	-
10	J14	U.S.C.O.E. test well 34B	Sec. 5-5S-10E	134	10	1	6.7	6,500	130	0.7
11	J19	U.S.C.O.E. test well 31B	Sec. 1-5S- 9E	74	10	1.25	7.5	5,500	140	0.8

TABLE 7

COMPARISON OF SELECTED WATER QUALITY PARAMETERS FOR THE MAJOR AQUIFERS

	EUTAW	TUSCALOOSA	PALEOZOIC
IRON (mg/l)			
MEAN	4.50	2.88	5.00
STD. DEV.	4.66	5.42	6.86
MAX.	25.00	17.00	17.00
MIN.	0.01	0.01	0.01
TOTAL DISSOLVED SOLIDS (mg/l)			
MEAN	66.18	47.14	63.07
STD. DEV.	24.95	19.49	43.91
MAX.	170.00	87.00	157.00
MIN.	35.00	11.60	21.00
HARDNESS (mg/l $CaCO_3$)			
MEAN	20.55	22.16	42.06
STD. DEV.	10.21	19.55	45.28
MAX.	51.00	104.00	159.00
MIN.	2.70	4.00	7.00
pH			
MEAN	5.69	6.15	6.48
STD. DEV.	0.51	0.96	0.84
MAX.	6.90	9.30	8.20
MIN.	4.60	4.60	5.40

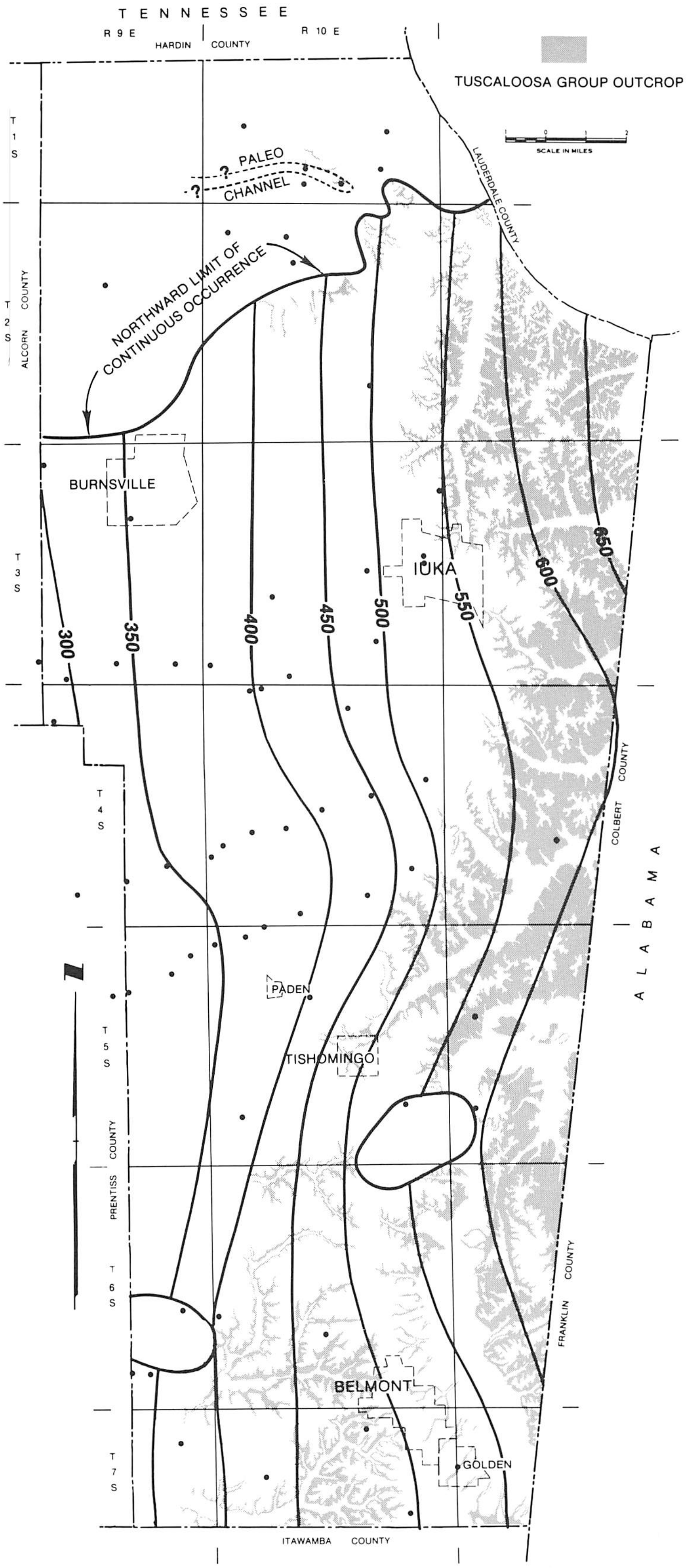


Figure 5 - Outcrop of the Tuscaloosa Group and structural configuration of the top of the Tuscaloosa Group; contour interval is 50 feet (from Merrill, this report, Figure 75).

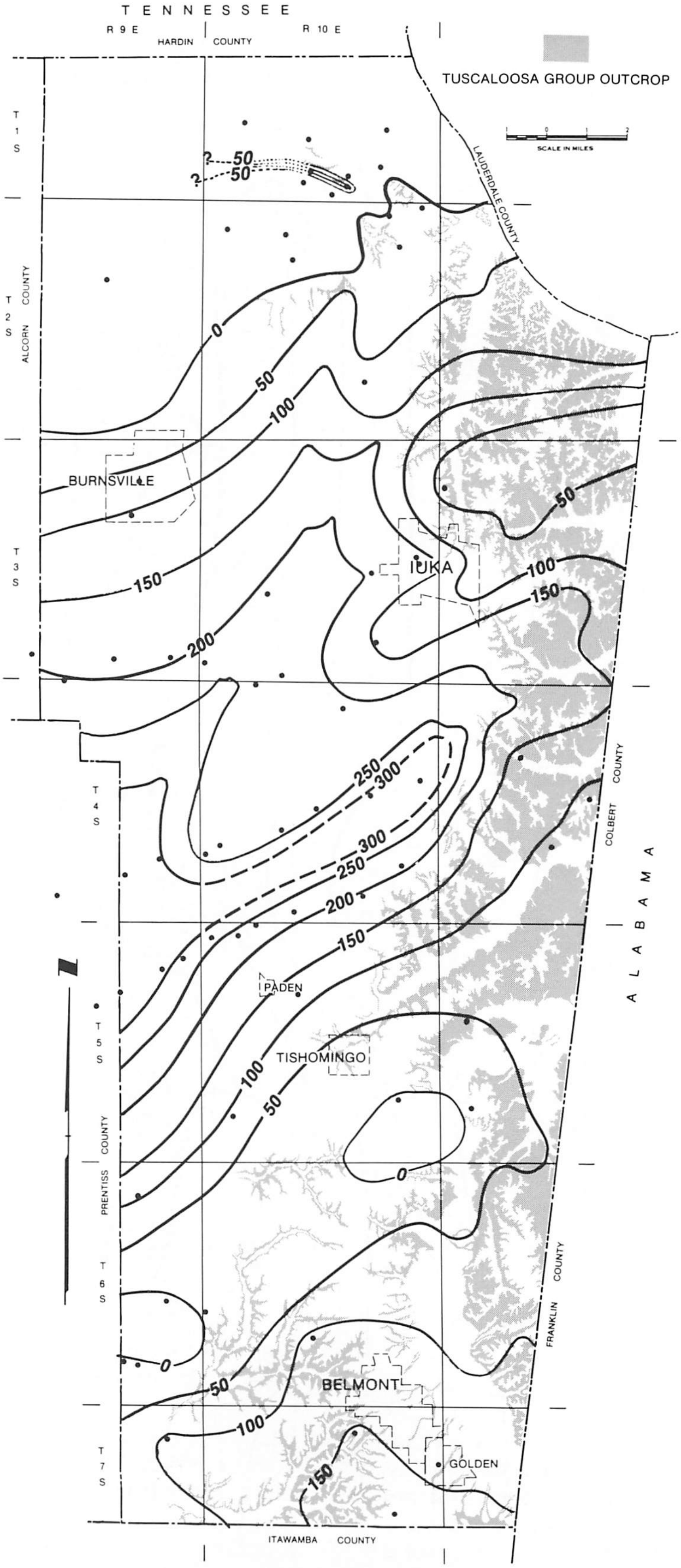


Figure 6 - Isopach map of the Tuscaloosa Group; contour interval is 50 feet (from Merrill, this report, Figure 74).

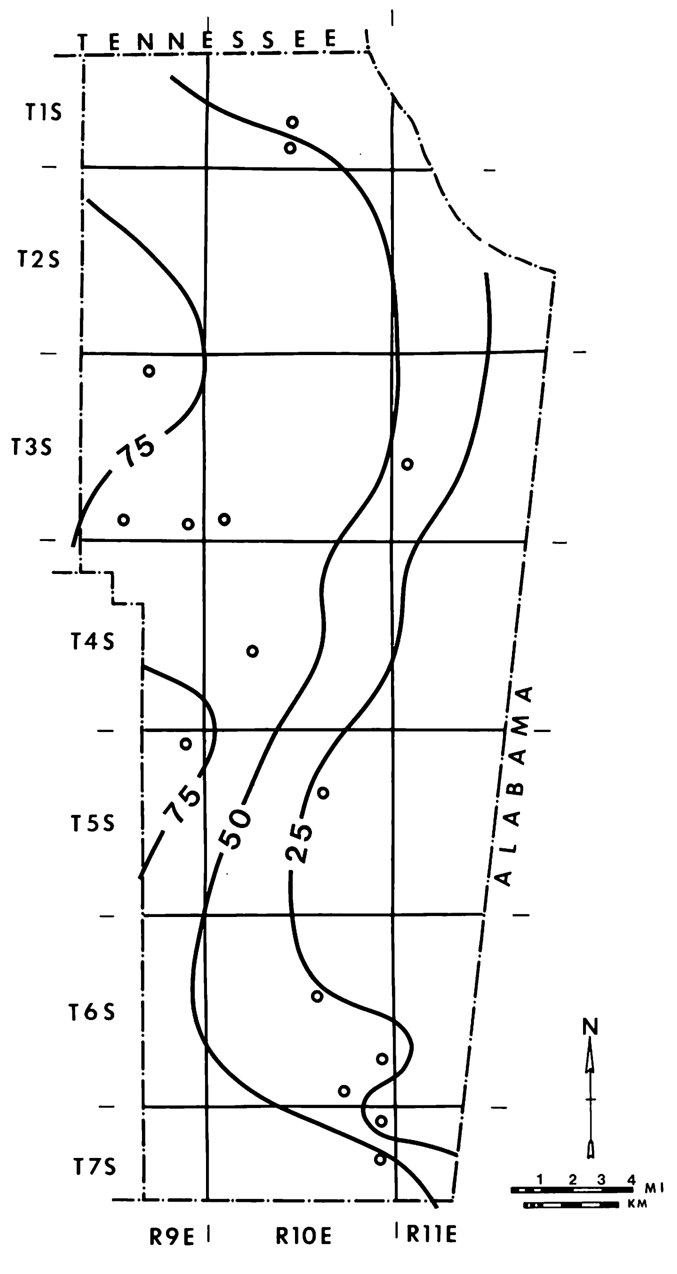


Figure 7 - Total dissolved solids in the Tuscaloosa Aquifer; contour interval is 25 mg/l.

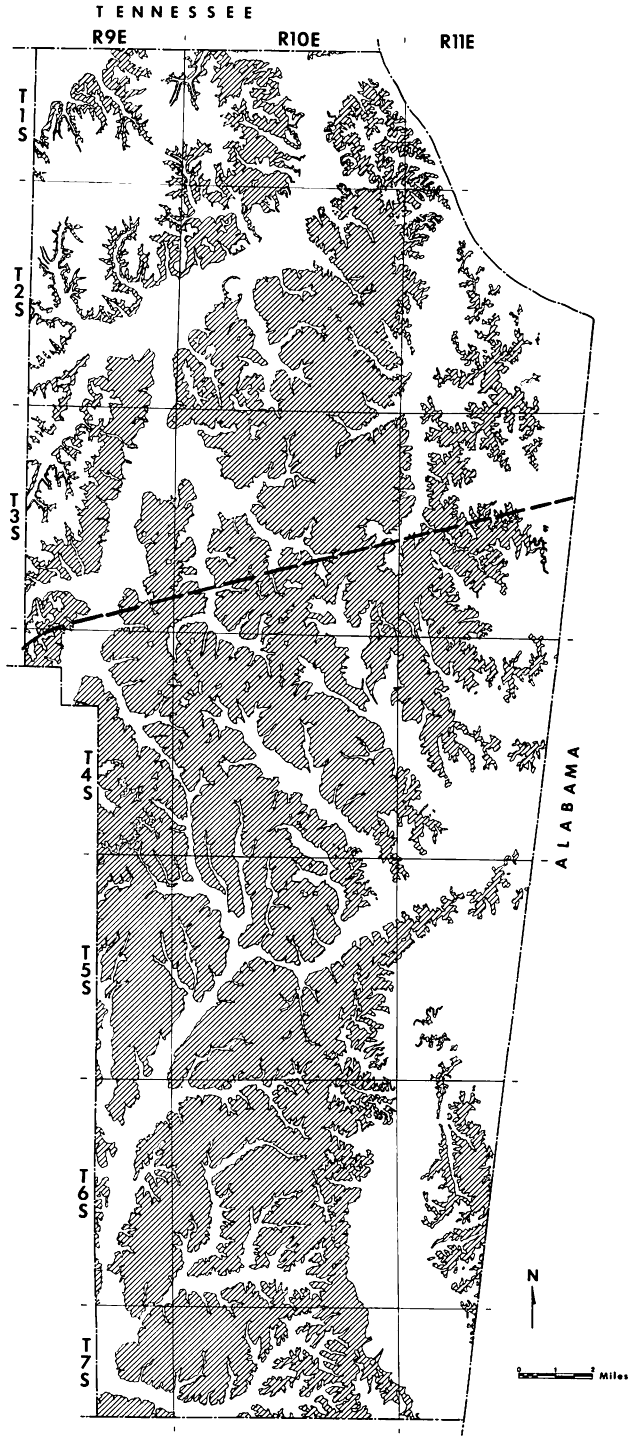


Figure 8 - Outcrop of the Eutaw Group. McShan Formation is not present north of dashed line.

Eutaw Group

The Eutaw Group, a 250-foot thick section of fine sands and clays, unconformably overlies the Tuscaloosa Group. The Eutaw includes, in ascending order as mapped by Merrill, the McShan Formation and the Eutaw Formation and crops out in a wide band across Tishomingo County (Figure 8). The McShan is composed of light colored, glauconitic, fine-grained sands interbedded with abundant silt and clay beds and lenses. Although the McShan is generally not considered a good aquifer because of its fine-grained texture, the formation locally is very sandy and probably stores and transmits significant quantities of ground water. The McShan thins northward, eventually pinching out in the northern part of the county (Figure 8). The Eutaw Formation consists of the Lower Eutaw Member and the overlying Tombigbee Sand Member. The Lower Eutaw Member is composed of fine- to medium-grained, glauconitic, micaceous sands with abundant interbeds of medium gray clay. The Tombigbee Sand

Member is a fine- to medium-grained, well-sorted, massive-bedded, glauconitic sand with minor silt and clay.

The Eutaw aquifer is not utilized by the large-yield, public-supply wells but is a significant source of water in many shallow (generally less than 200 feet depth) domestic wells. The Eutaw shows a somewhat smaller range of hydraulic characteristics than the Tuscaloosa or Paleozoic aquifers with transmissivities ranging from 1,500 to 12,000 gpd/ft and hydraulic conductivities from 60 to 240 gpd/ft^2. Yields are generally low, averaging less than 10 gpm for most domestic wells. However, some yields of over 200 gpm have been recorded by the U. S. Corps of Engineers in test wells in the Eutaw. The generally lower quantitative aquifer coefficients of the Eutaw are primarily the result of the general fine-grained nature of the sediments and the complex intertonguing and lamination of clays and sands. Simmons (1985) concluded that the Eutaw and Tuscaloosa aquifers are locally hydraulically connected.

Water from the Eutaw aquifer is soft and generally contains less than 100 mg/l total dissolved solids. However, high iron content and acidity of Eutaw water are common problems. Like the Tuscaloosa and Paleozoic aquifers, the Eutaw aquifer contains significant, though not harmful, bicarbonate ion concentrations.

Minor Aquifers

Minor sources of ground water in Tishomingo County include the Cretaceous Coffee Formation, Tertiary and Quaternary terrace deposits, and Quaternary alluvium. These deposits supply water to some shallow, domestic, low-yield wells.

The Coffee Formation unconformably overlies the Eutaw Group and is present only in the northwestern part of the county (Figure 9). The Coffee is composed primarily of very fine- to medium-grained, well-sorted, micaceous, glauconitic sand with common silty or clay-rich beds. Although no hydraulic parameters were documented for Coffee Formation wells in Tishomingo County, transmissivities are reported as averaging below 7,500 gpd/ft for the Coffee outcrop region of northeastern Mississippi (Wasson, 1986).

The Tertiary and Quaternary terraces and alluvium are commonly composed of thin deposits of sand and gravel of limited geographic extent. Although these deposits may contain water of poor quality, yields can be high due to high permeabilities and hydraulic connection to the more important underlying aquifers. Water in these very shallow aquifers should be suspect for contamination due to recharge from nearby chemically or biologically polluted streams without the beneficial effects of filtration and dispersion over long distances and time.

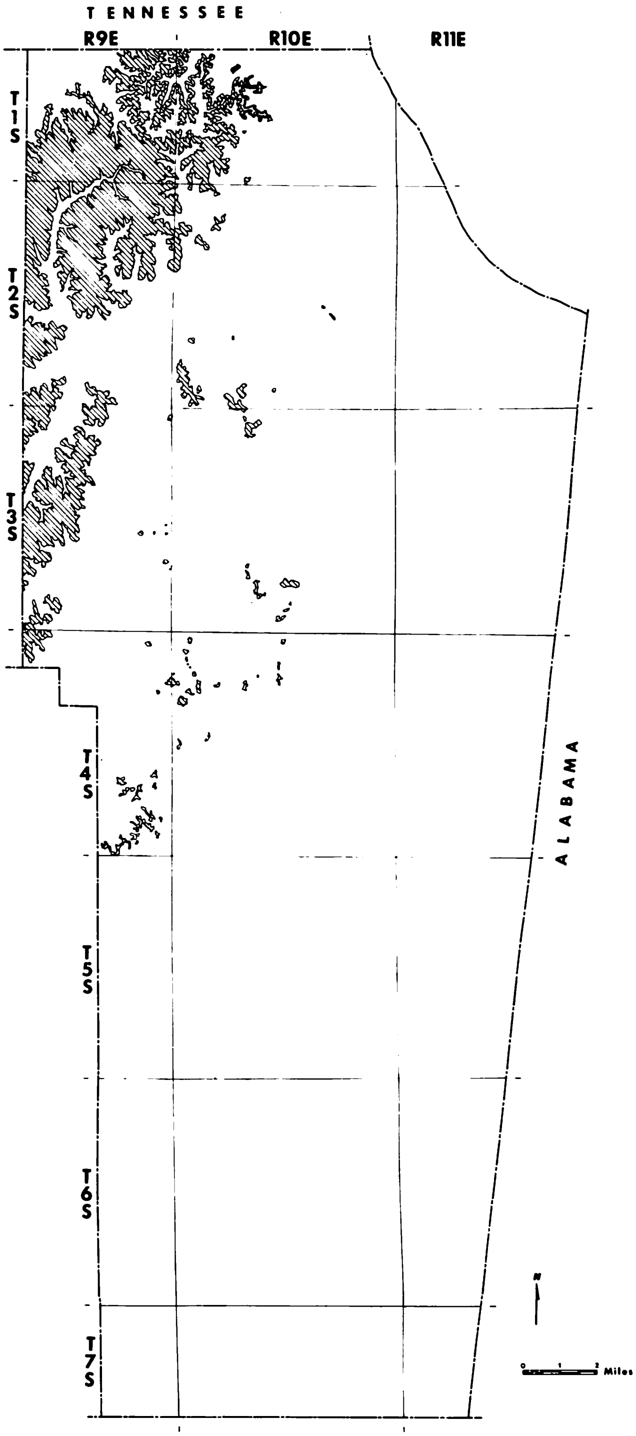


Figure 9 - Outcrop of the Coffee Formation.

Effects of the Tennessee-Tombigbee Waterway on Ground Water

The construction of the Tennessee-Tombigbee Waterway significantly affected the ground water as well as surface-water systems in Tishomingo County. The excavation of more than 150 million cubic yards of sand and clay during the construction of the Divide Cut of the waterway required the lowering of the ground-water table as much as 100 feet and averaged about 50 feet (Simmons, 1985). In the immediate vicinity of the waterway, piezometric levels are now permanently lowered to the elevation of the navigation channel (elevation 408-414 feet). The U.S. Army Corps of Engineers continues to study and monitor the impact of the waterway on the ground-water system and have thus far concluded that drawdown effects within the Eutaw and Tuscaloosa (Gordo) aquifers extend outward about 8 miles from the waterway with the most dramatic and permanent effects within the first three miles (Simmons, 1985). The drawdown is most severe in the immediate Divide Cut area, but extends from near Doskie in the northern part of the county to Bay Springs Lake in the southwestern part of the county.

Ground Water: Conclusions

Ground water currently provides virtually all of the water used in Tishomingo County. One or more aquifers are present everywhere in the county to provide water of suitable quantity and quality for most purposes. The principal aquifers are sand intervals within the Tuscaloosa and Eutaw groups and fractured and weathered zones in the upper part of the Paleozoic rocks. The Tuscaloosa and Paleozoic aquifers currently provide water to the large public water supply systems. These two aquifers, though each is variable in its hydraulic characteristics, are capable of yielding large supplies of water. The Eutaw Group, which crops out across the county and is found in the shallow subsurface, serves as an adequate aquifer for many domestic, low-yield wells. In addition, sands in the Coffee Formation and Tertiary and Quaternary terraces and alluvium are utilized and available as minor sources of ground water.

The quality of ground water in Tishomingo County is generally good but there are some problems. Excessive iron and corrosiveness due to acidity are common problems in water from all the aquifers, especially the Eutaw aquifer. Hardness locally reaches moderately hard levels, especially in water from the carbonate-rich Paleozoic rocks. Total dissolved solids are everywhere well below the E.P.A. recommended maximum levels and are typically below 100 mg/l. There are no current health hazards known due to contamination or excessive bacteria in the ground-water supplies that cannot be treated. The ground-water quality problems in the county are solved or alleviated with aeration, filtration, addition of lime, and chlorination.

SURFACE-WATER RESOURCES

Introduction

Surface water includes all running water in streams and rivers and all standing water in natural or man-made impoundments (lakes and ponds). Because surface-water supplies are subject to greater variations in quantity and quality than ground water, it is commonly used as a supplement to ground-water supplies. But surface water also has usefulness in recreation, transportation, and in the generation of electrical power. Tishomingo County has abundant supplies of fresh surface water.

Surface-Water Availability

Surface-water supplies in Tishomingo County include Pickwick Lake, Bay Springs Lake, Tennessee-Tombigbee Waterway, and numerous streams and ponds.

Surface drainage in the county constitutes parts of two major drainage basins (Figure 10); the northern three quarters of the county lies within the Tennessee River drainage basin and the southwestern part of the county is part of the headwaters of the Tombigbee River system. Major streams draining into the Tennessee River in Tishomingo County are Yellow Creek, now constituting the northern part of the Divide Cut section of the Tenn-Tom Waterway, Bear Creek, Cripple Deer Creek, and Indian Creek. Mackeys Creek, now the southern part of the Divide Cut section, and its tributaries comprise the Tombigbee drainage area in the county. As will be discussed in the following section, the Tennessee-Tombigbee Waterway was constructed to traverse the natural divide of the two major drainage basins.

Pickwick Lake, located in the northeastern part of Tishomingo County, was created by damming the Tennessee River in Hardin County, Tennessee. Bay Springs Lake, a part of the Tennessee-Tombigbee Waterway created by impounding Mackeys Creek, is located in the southwestern part of the county. These two reservoirs constitute huge potential sources of fresh water for the area. In addition, numerous ponds, created by damming small creeks and springs, are scattered across the county.

Streams in Tishomingo County experience variations in stream flow due primarily to variations in precipitation but also to varying geology, topography, vegetation, and the influences of man. Minimum stream flow commonly occurs during dry weather. In addition, because the streams in Tishomingo County comprise the headwaters of basins and thus have small drainage areas, stream flows are especially variable. Stream flow during dry periods (low flow) may consist of considerable ground water discharging into the stream, whereas during and immediately after wet periods the runoff collected in a stream or lake may recharge the aquifers. However, because runoff in humid areas such as Tishomingo County commonly far exceeds the infiltration rate, much surface water bypasses the ground-water system. In Tishomingo County, streams which flow across the highly permeable Tuscaloosa Group commonly show higher dry weather flows than streams which flow across the less permeable Eutaw Group or Coffee Formation. Although a more permeable aquifer will generally discharge ground water more readily than a less permeable unit, many other factors may influence the ultimate stream discharge. Most streams also flow across several formations or flow almost entirely on Quaternary alluvial deposits and are thus not in direct contact with the large aquifer systems. Selected stream-flow data for Tishomingo County are shown in Figure 11 and Table 8.

Demands for water during low-flow periods can be met by impoundment of streams, creating large storage of water. Important factors in the selection of a site for the creation of an impounded reservoir include geology of the area, topography, and stream flow. It is important in selecting a stream that maximum water demand does not exceed the total accumulated yield of the impounded stream. The Mississippi Bureau of Land and Water Resources administers the appropriation of water from streams by evaluating requests and issuing permits.

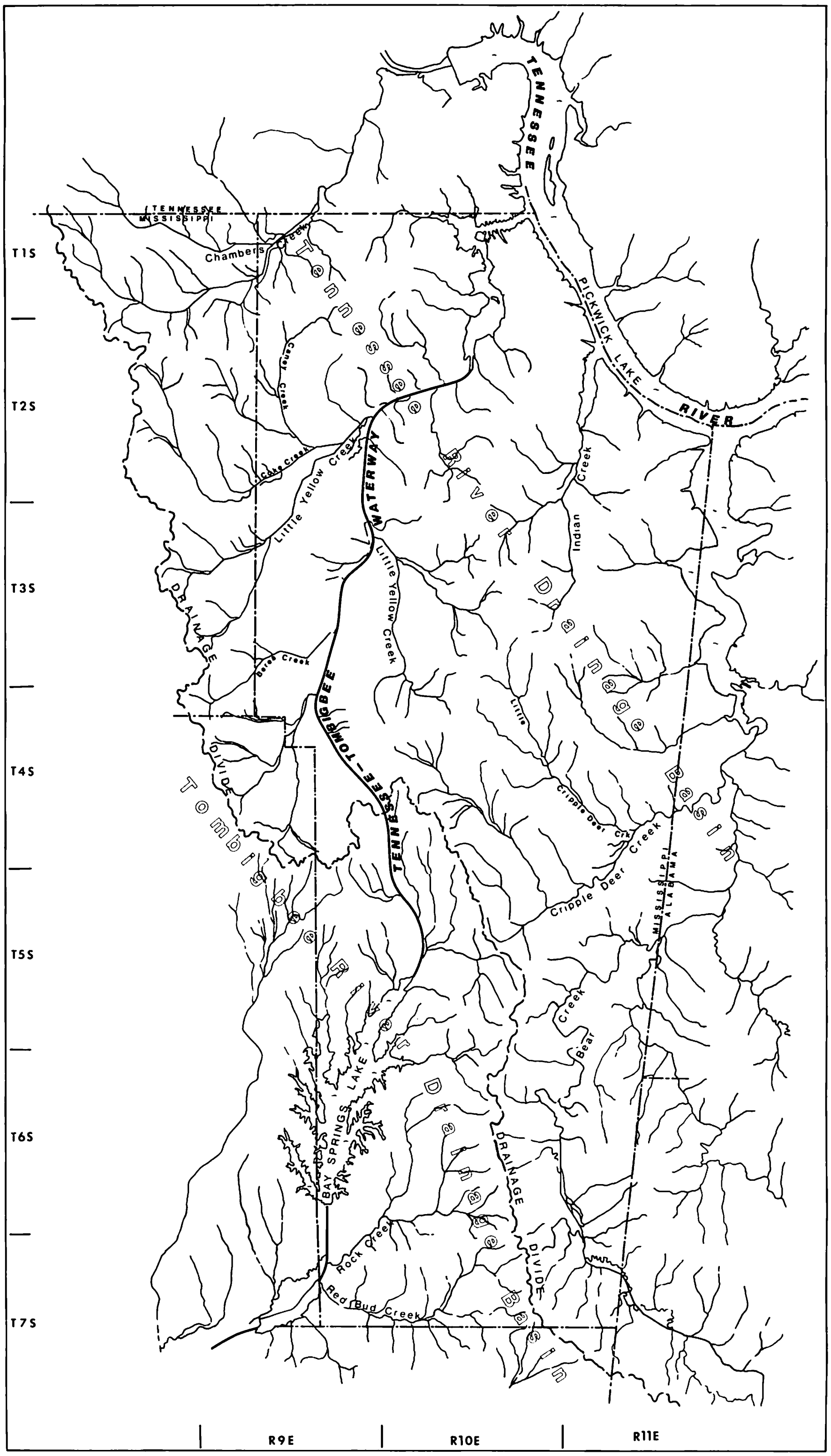


Figure 10 - Surface drainage of Tishomingo County and adjacent areas.

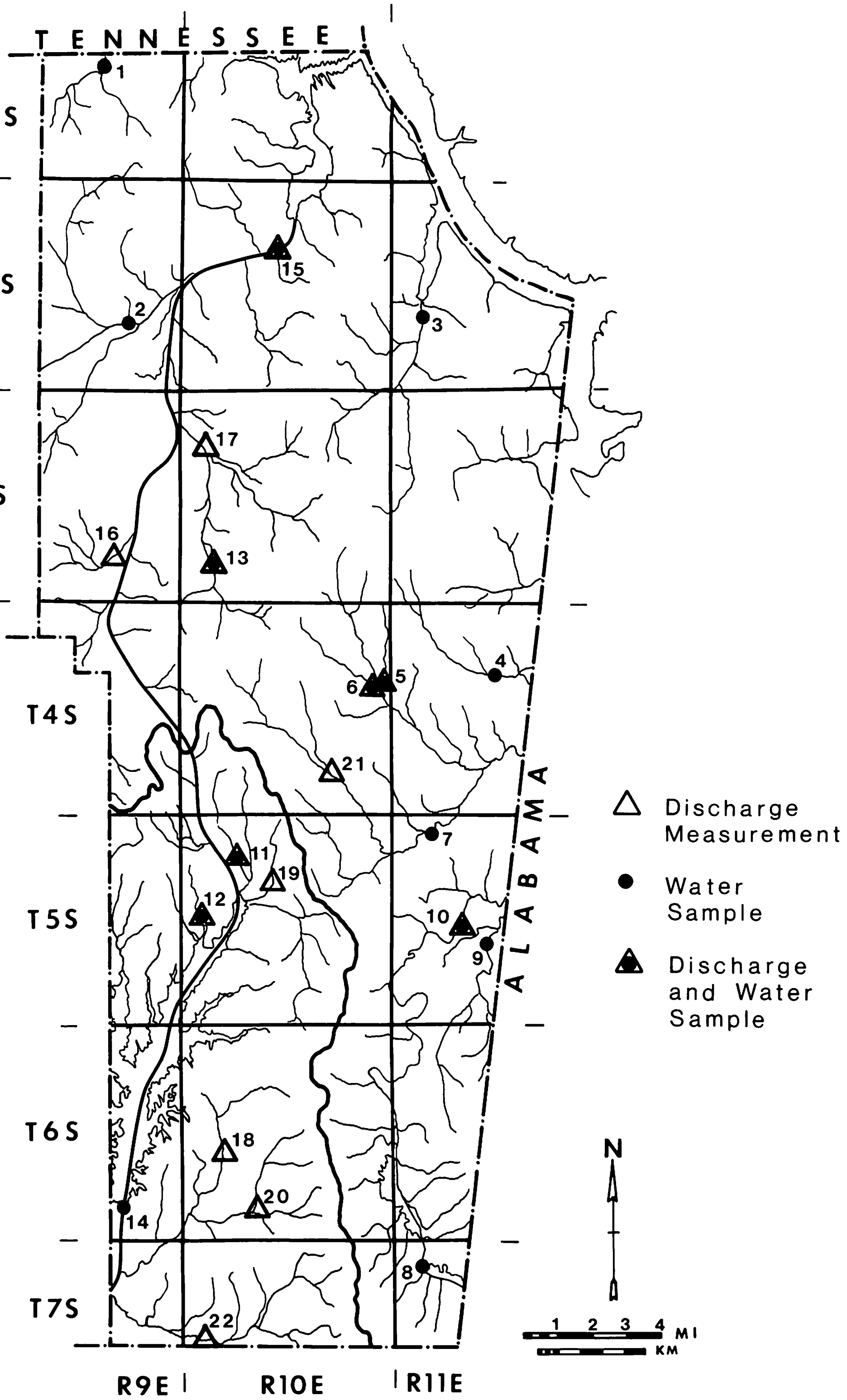


Figure 11 - Index map of surface-water discharge and sampling locations.

TABLE 8

STREAM FLOW AT SELECTED STREAMS

Stream No.	Name	U.S.G.S. Sta. No.	Drainage Area (square miles)	Date	Discharge (ft3/sec.)
5	Little Cripple Deer Creek	3592563	7.17	10/19/79	1.28
6	Moore Branch	3592565	3.51	10/19/79	1.11
10	Bear Creek	3592101	329.00	1971*	648.00
11	Black Branch		1.45	8/05/82	0.17
12	Sandy Hook Creek		1.25	8/05/82	0.38
13	Little Yellow Creek near Holts Spur		7.14	8/05/82	0.87
15	Tenn-Tom Waterway at Cross Roads	3592824		09/86*	11.19
16	Berea Creek	3592670	8.60	10/18/79	1.97
17	Little Yellow Creek East near Burnsville	3592718	24.70	1985*	28.80
18	Jourdan Creek	2430048	5.74	10/20/79	8.43
19	Pollard Mill Branch	2429980	2.01	1985*	4.72
20	Rock Creek	2430030	4.33	10/20/79	1.92
21	Cripple Deer Creek	3592550	11.10	10/19/79	1.04
22	Red Bud Creek	2430085	15.70	1985*	20.60

* Mean for year or month

Present Surface-Water Use

Surface water in Tishomingo County is primarily used for watering livestock and for recreation and transportation purposes. Streams also provide a means of disposing of wastes by carrying away effluent from sewage lagoons.

The Tennessee River and the Tennessee-Tombigbee Waterway are major transportation routes connecting mid-America to the Gulf of Mexico. Tishomingo County lies primarily in what is termed the Divide Section of the waterway. This is a 39-mile-long navigation channel and lake extending from the Tennessee River (Pickwick Lake) at the northern end of Tishomingo County to Bay Springs Lock and Dam in the southwestern part of the county (Figure 11). The Divide Cut was made by excavating a channel with a bottom width of 280 feet and a minimum water depth of 12 feet through the natural watershed divide of the Tennessee and Tombigbee basins (Simmons, 1985). The maximum cut through the divide is 175 feet deep and 1,500 feet wide and occurs near the town of Paden. The water surface elevation of the Divide Cut channel section including Bay Springs Lake is maintained at between 408 and 414 feet and is the same as that of Pickwick Lake (Underwood and Imsand, 1985). North of the divide the waterway generally follows the channel alignment of Yellow Creek; south of the divide it follows the Mackeys Creek alignment. Bay Springs Lock and Dam, at the south end of Bay Springs Lake, features a drop in surface-water elevation of the waterway of 84 feet. The dam is 2,750 feet long, 120 feet high, and is made of soil and rock.

In addition to providing a significant transportation route for barge traffic, the surface-water bodies of the Tenn-Tom Waterway provide abundant recreation sites. The scenic attractions created by the combination of lakes and the rugged topography of Tishomingo County are well known.

Although no hydroelectric power plants are located in Tishomingo County, the flow of the Tennessee River is controlled for the production of power in Tennessee and Alabama.

Surface-Water Quality

As evidenced by the water quality data presented in Table 9, Tishomingo County surface-water supplies are generally of good quality and there are few problems for current usage. Total dissolved solids average below 100 mg/l and the water is generally soft. Iron contents, though commonly lower than those of ground water, are locally high. Iron concentrations in streams are often greatest during low flow periods when there is generally a greater proportion of water supplied from ground water. Surface water also commonly shows undesirable color. Color in water is generally due to complex organic compounds resulting from the decomposition of natural organic matter and from colloidal iron and manganese. Surface water may also appear colored due to suspended matter ("apparent color" or turbidity) such as clay, silt, algae, and organic particles. High stream flow generally results in turbid water conditions, but other important factors include surface geology, soil type and thickness, topography, and rainfall distribution and intensity. The color of drinking water should not exceed 15 units on the platinum-

TABLE 9

ANALYSES OF WATER SAMPLES FROM SELECTED STREAMS IN TISHOMINGO COUNTY

SITE NO.*	DATE ANALYZED	SiO2	Fe	Ca	Mg	Na	K	SO4	Cl	F	TDS	HARDNESS	COND.	pH	TEMP.	COLOR	TURBID.	DISS. OXYGEN	COLIFORM BACTERIA	DATA SOURCE
1	12/84	8.6	-	-	-	-	-	2.0	4.5	0.03	-	19.7	27	6.1	58	90	-	9.1	-	M.B.O.G.
2	12/84	11.9	-	-	-	-	-	0	1.8	0.00	-	10.3	20	5.9	58	98	-	9.7	-	M.B.O.G.
3	12/84	9.1	-	-	-	-	-	1.7	5.1	0.06	-	18.3	60	6.3	59	62	-	10.5	-	M.B.O.G.
4	12/84	10.3	-	-	-	-	-	0.9	1.6	0.00	-	12.7	12	5.6	46	15	-	11.4	-	M.B.O.G.
5	12/84	8.7	-	-	-	-	-	1.7	2.8	0.00	-	11.7	19	6.0	41	-	-	11.6	-	M.B.O.G.
6	12/84	9.2	-	-	-	-	-	1.2	2.5	0.01	-	10.0	14	5.6	41	40	-	11.2	-	M.B.O.G.
7	12/84	8.3	-	-	-	-	-	1.1	2.0	0.00	-	15.0	10	5.6	41	52	-	10.4	-	M.B.O.G.
8	12/84	4.8	-	-	-	-	-	2.4	2.4	0.02	-	26.0	23	6.3	47	30	-	11.8	-	M.B.O.G.
9	12/84	3.9	-	-	-	-	-	1.5	2.6	0.12	-	60.0	75	6.6	50	28	-	10.9	-	M.B.O.G.
10	12/84	4.4	-	-	-	-	-	1.7	2.2	0.01	-	26.0	39	6.2	48	38	-	12.2	-	M.B.O.G.
11	8/82	-	0.45	15.0	1.2	1.2	0.7	2.0	1.3	-	58	42.0	83	7.0	72	1	1.8	9.4	-	U.S.G.S.
12	8/82	-	1.40	2.4	0.8	1.4	0.8	2.0	1.0	-	32	9.0	28	6.8	68	4	8.5	9.2	-	U.S.G.S.
13	8/82	-	1.50	2.4	0.8	1.8	1.0	2.0	1.1	-	34	9.0	32	6.0	73	15	17.0	6.8	-	U.S.G.S.
14	11/84	2.9	-	14.0	3.1	3.7	2.1	13.0	4.9	0.10	68	48.0	112	7.5	55	10	10.0	9.2	-	U.S.G.S.
14	2/85	2.2	-	14.0	2.9	3.7	2.2	10.0	4.7	0.10	64	47.0	102	7.3	43	1	2.0	13.0	< 5	U.S.G.S.
14	5/85	1.3	-	14.0	2.6	3.1	1.9	12.0	3.8	0.10	60	46.0	105	7.9	75	5	0.9	8.5	9?	U.S.G.S.
14	7/85	1.5	-	15.0	2.6	3.4	1.9	12.0	4.0	0.10	65	48.0	119	7.1	82	15	2.0	6.0	< 5	U.S.G.S.
15	11/84	6.0	2.30	-	-	2.5	-	-	-	-	-	-	91	6.5	54	75	34.0	9.4	1200	U.S.G.S.
15	2/85	7.1	1.00	-	-	1.6	-	-	-	-	-	-	94	6.7	42	30	10.0	12.3	<10	U.S.G.S.
15	6/85	2.0	0.51	-	-	5.3	-	-	-	-	-	-	146	7.3	80	5	3.1	5.7	9?	U.S.G.S.
15	7/85	3.4	0.39	-	-	12.0	-	-	-	-	-	-	153	7.8	86	15	5.1	7.4	< 5	U.S.G.S.

* See figure 11 for locations

TABLE 10

PEAK STREAM FLOWS AND SEVEN-DAY AVERAGE MINIMUM AND MAXIMUM FLOWS OF SELECTED STREAMS

LOCATION	STATION NO.	NAME AND LOCATION	DRAINAGE AREA (square miles)	DATE	PEAK DISCHARGE (cfs)	GAGE HEIGHT	MIN. FLOW (cfs) (7-DAY AVERAGE)	MAX. FLOW (cfs) (7-DAY AVERAGE)
17	3592718	LITTLE YELLOW CREEK EAST	24.7	1-10-74	3030	19.06		590
		SEC. 7-3S-10E		3-13-75	3030	19.06	6.8	600
				2-18-76	550	16.54	7.2	140
				3-04-77	2460	18.77	5.2	340
				5-08-78	3310	19.19	3.3	510
				4-12-79	2800	18.95	3.9	320
				3-17-80	2160	18.60	5.3	660
				2-01-81	583	15.79	4.5	97
				3-21-82	552	15.53	3.9	180
				4-05-83	5180	19.83	3.5	960
				4-28-84	3990	19.48	4.5	470
				4-24-85	1040	15.60	4.1	120
				6-07-86	1100	15.71	2.5	170
22	2430085	REDBUD CREEK	15.7	7-23-75	287	7.99		
		SEC. 18-7S-10E		2-18-76	524	10.39	3.2	93
				3-04-77	986	11.16	2.1	140
				5-08-78	890	10.90	2.9	190
				1-01-79	831	10.87	5.1	150
				3-20-80	749	10.67	2.6	240
				3-30-81	421	9.26	1.8	64
				1-23-82	813	10.83	2.4	120
				5-19-83	1430	11.83	3.5	280
				12-3-83	1690	12.25	2.5	310
				2-11-85	657	10.54	3.4	120
				6-11-86	669	10.58	1.7	91

cobalt scale. Water that does not exceed 75 units can be treated by coagulation, sedimentation, and filtration to reach 15 units or less (E.P.A., 1976). Aside from aesthetic reasons, the principal objection to colored or turbid water is the reduction in light penetration, which restricts the zone of photosynthetic oxygen production by phytoplankton as well as the zone of vascular plant growth. It should be noted that Pickwick Lake commonly has color values below 30 units as well as iron contents below 0.3 mg/l (Wasson and Tharpe, 1975).

Of significant concern with regard to surface-water sources are the amounts and types of bacterial, viral, protozoan, and fungal organisms present. Fecal coliform bacteria are considered primary indicators of microbiological water quality. The number of fecal coliforms present is typically used as an indication of the degree of health risk involved with using water for drinking, bathing, swimming, and shellfish harvesting. According to the U.S. E.P.A. (1976) recommended standards the fecal coliform bacteria count should not exceed the log mean of 200 per 100 ml based upon a minimum of 5 samples taken over a 30-day period, nor should more than 10 percent of the total samples during any 30-day period exceed 400 per 100 ml. High pathogenic bacteria levels are likely in streams and lakes immediately downstream of sewage lagoon discharge. Although fecal coliform bacteria counts reported for surface localities in Tishomingo County are generally low (Table 9), extreme care should be taken to avoid diseases resulting from the use of contaminated surface water.

Flood Hazard

In contrast to water supply problems created by low-flow conditions, the hazards of extreme high-flow (flood) conditions must also be considered. The design and location of roads, bridges, culverts, dams, levees, and buildings are largely dependent on the magnitude and frequency of floods. Flooding is any overflow of a stream's natural banks onto land not normally inundated, and flood stage is the elevation at which overflow occurs at a specific locality. In general a peak flow occurs some period of time after flood stage is reached, a critical period for taking steps to minimize potential damage. The flood-to-peak time period is difficult to predict, however, because of the erratic nature of rainfall amounts, soil conditions, evapotranspiration, and other variables. The effects of damage to buildings and transportation facilities, the backwater in sewers and drainage facilities, deposition of sediment in some areas and erosion in others, and the rise of ground-water levels are obvious.

The streams in Tishomingo County that experience flood conditions during or following periods of heavy rainfall include Chambers Creek, Yellow Creek and its tributaries, Indian Creek, Cripple Deer Creek and its tributaries, Bear Creek, Cedar Creek, and Mackeys Creek and its tributaries. Although flooding can occur in any month, it is most likely to occur in the winter and spring months. Maps showing the flood-prone areas can be obtained from the Federal Emergency Management Agency. The U.S. Geological Survey, Water Resources Division, maintains information concerning floods and stream gaging. As part of the Hydrologic Monitoring Network, streams in Tishomingo County are monitored by the U.S. Geological Survey and the U.S. Army Corps of Engineers for stream stage, discharge, and water quality. Data on selected streams currently monitored by the U.S.G.S. are shown in Table 10.

Surface Water: Conclusions

Surface water in Tishomingo County is currently used for transportation, recreation, watering livestock, and in the removal of sewage effluent. The county is part of the Tennessee River and Tombigbee River drainage basins. Pickwick Lake, Bay Springs Lake, and the Tennessee-Tombigbee Waterway are the dominant surface-water bodies in the county. Important streams include Bear Creek, Cripple Deer Creek, Indian Creek, Yellow Creek, and Mackeys Creek.

Stream flow is highly variable with significant low-flow periods occurring in the summer and fall and high-flow conditions generally occurring in the late winter and spring. Impoundment of small streams, springs, and local drainage areas is a common means of meeting demand for water, especially during times of low stream flow. Although flooding along the creeks and streams is commonly an annual event, damage has generally been limited because of the lack of extensive building in the relatively small flood plains and due to the implementation of flood control measures such as drainage canals and channels.

There are few water-quality problems with regard to present usage. Surface water in the county is generally soft and mineralization (TDS) levels average below 100 mg/l. High iron contents, color and turbidity, and unacceptable fecal coliform bacteria levels are localized problems that must be considered, however.

REFERENCES CITED

Gandl, L. A., 1982, Characterization of aquifers designated as potential drinking water sources in Mississippi: U.S. Geological Survey, Water Resources Investigations Open File Report 81-550, 90 p.

Nemerow, N. L., 1978, Industrial water pollution - origins, characteristics, and treatment: Addison-Wesley Publishing Company, Reading, Massachusetts, 738 p.

Simmons, M. D., 1985, Unwatering the Divide Cut of the Tennessee-Tombigbee Waterway: A major challenge to construction: Environmental Geology and and Water Sciences, vol. 7, no.1/2, p. 51-67.

Todd, D. K., 1970, The water encyclopedia: Water Information Center, Port Washington, N. Y., 559 p.

Underwood, K. D., and F. D. Imsand, 1985, Hydrology, hydraulic, and sediment considerations of the Tennessee-Tombigbee Waterway: Environmental Geology and Water Sciences, vol. 7, no.1/2, p. 69-90.

United States Environmental Protection Agency, 1976, Quality criteria for water, 256 p.

Wasson, B. E., 1986, Sources for water supplies in Mississippi: U.S. Geological Survey and Mississippi Research and Development Center, 113 p.

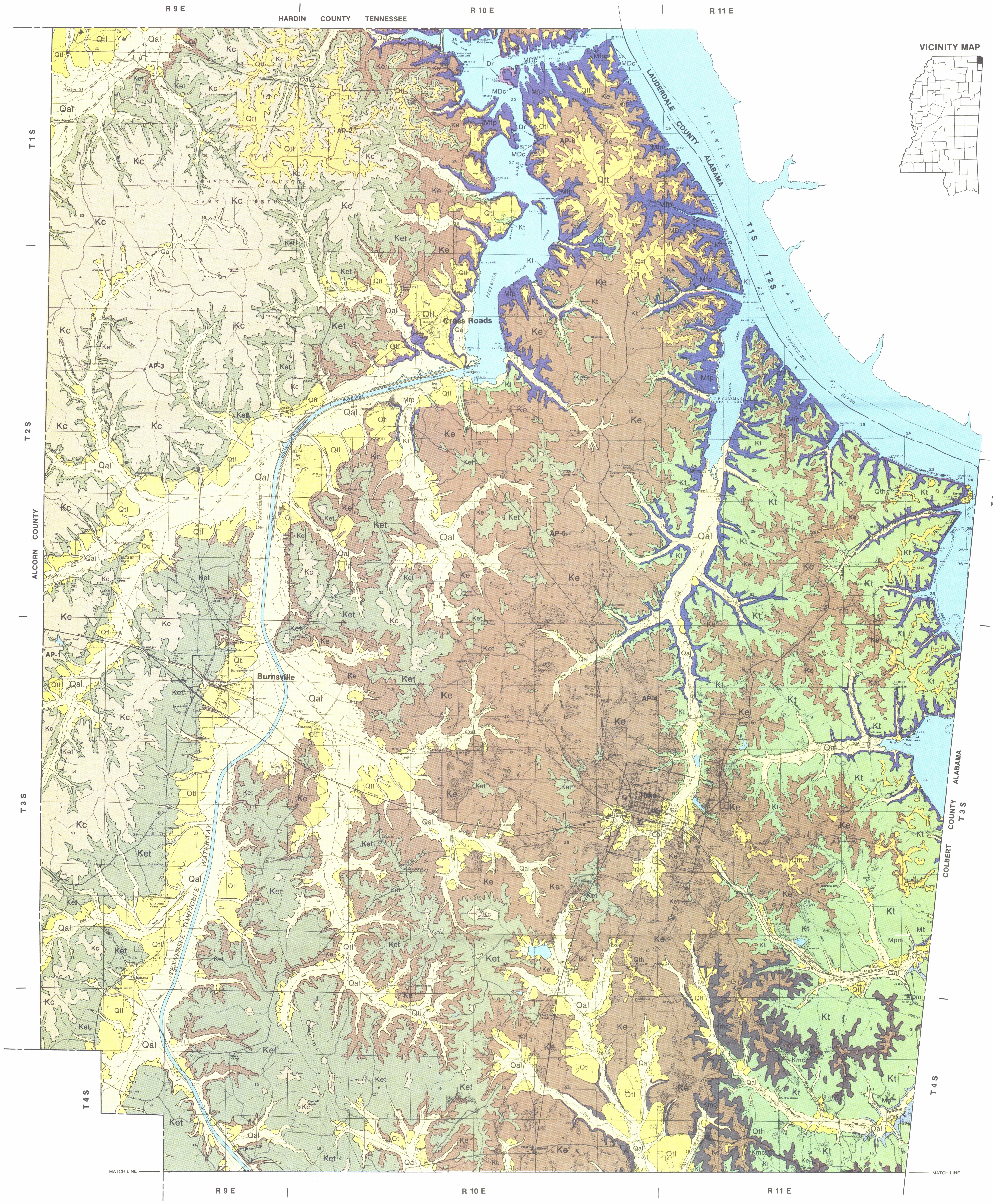
Wasson, B. E., and E. J. Tharpe, 1975, Water for industrial development in Alcorn, Itawamba, Prentiss, and Tishomingo counties, Mississippi: U.S. Geological Survey and Mississippi Research and Development Center, 60 p.

MISSISSIPPI BUREAU OF GEOLOGY
CONRAD A. GAZZIER, DIRECTOR

NORTH HALF

TISHOMINGO COUNTY, MISSISSIPPI
GEOLOGIC MAP

GEOLOGY BY ROBERT MERRILL
MISSISSIPPI BUREAU OF GEOLOGY



VICINITY MAP

SCALE

THIS MAP IS BASED ON DATA AVAILABLE TO THE DATE NOVEMBER 5, 1987.

The north and south halves overlap; see match line indicated.

Test holes indicated by AP designations.

LEGEND

Quaternary

Qal — Alluvium—sand, medium- to brownish-gray, very fine- to very coarse-grained, subangular to subrounded quartz, silty, clayey; commonly contains organic matter; chert and quartzite pebbles common at base.

Qtl — Low elevation terrace deposits—sand, light-gray to dark reddish-brown, very fine- to very coarse-grained, subangular to subrounded quartz, silty, clayey; lower portions contain layers and lenses of flattened quartzite and quartz pebbles interspersed with rounded chert pebbles; iron staining common on pebbles. Distributed adjacent to present stream courses, at and above flood plain elevation.

Qth-Qtt — High elevation terrace deposits—gravel, moderate reddish- to dark yellowish-brown, very well rounded chert and smooth, flattened quartzite pebbles; iron staining common on outer surfaces; beds and lenses of sand, silt, and clay occur frequently in upper portions. Irregular bedding, occasional cross-bedding; ironstone cementation common. Includes Tennessee River terrace deposits in northern part of study area. Mainly occur at elevations above 600 feet. Erosional contact at base.

Cretaceous

SELMA

Kc — Coffee Formation—sand, light- to medium-gray, very fine- to medium-grained, subangular quartz, glauconitic, micaceous; frequently interbedded with silt, light- to medium-gray, clayey; thinly bedded with occasional intervals of irregular- to massive-bedded sand; occasional lenses and stringers of small chert gravel at base. Frequent thin ironstone beds; weathers to shades of reddish-brown. Unconformity at base.

EUTAW

Eutaw Formation—includes in descending order:

Ket — Tombigbee Sand Member—sand, medium light- to olive-gray, very fine- to medium-grained, subangular to subrounded quartz, well sorted, massive-bedded, glauconitic, micaceous, silty, clayey; weathers to various shades of reddish-brown. Frequent occurrence of ferruginous cemented sand molds of Callianassa sp. burrows.

Ke — Lower Eutaw—sand, medium- to olive-gray, fine- to medium-grained, subangular to subrounded quartz, glauconitic, micaceous, horizontal- and cross-bedded; commonly thinly interbedded and interlaminated with clay, medium-gray, locally carbonaceous; isolated occurrences of petrified wood in lower portions. Weathers to various shades of reddish-brown. Frequent occurrence of ferruginous cemented sand molds of Callianassa sp. burrows. Unconformity at base.

Kmc — McShan Formation—sand, pale yellowish-brown to very light-gray, very fine- to fine-grained, well sorted, subangular quartz, glauconitic, micaceous, silty; thinly interbedded and interlaminated with silt, light-gray to grayish orange-pink, micaceous, clayey. Horizontal- and ripple-laminated; frequent zones of massive- to cross-bedded, fine- to coarse-grained sand; frequent chert pebble lenses and stringers. Weathers to various shades of reddish-brown to yellowish-gray; local occurrences of ferruginous cemented sand molds of Callianassa sp. burrows; common occurrence of petrified wood; occasional occurrence of carbonaceous clays, dark-gray, micaceous, containing carbonized wood fragments. Unconformity at base.

TUSCALOOSA

Kt — Tuscaloosa Group—gravel, chert, white to dark-gray, very well rounded; frequent silt and clay matrix; sand, light- to moderate reddish-brown, very fine- to very coarse-grained, subrounded to angular quartz and chert grains, poorly sorted, with frequent gravel lenses and stringers; clay, white- to medium-gray with occasional occurrences of carbonaceous dark-gray clays; zones of multi-colored chert gravel; isolated occurrences of quartzite; frequent well-cemented chert pebble conglomeratic zones. Laterally traceable silt and clay intervals occur most frequently in uppermost and lowermost intervals. Unconformity at base.

Mississippian

Mh — Hartselle Formation—sandstone, light gray to light brownish-gray, fine- to medium-grained, well cemented quartz arenite, thin- to massive-bedded; contains thin intervals of thinly bedded and laminated siltstone and shale, medium- to dark-gray; local ferruginous staining.

Mpm — Pride Mountain Formation—shale, olive- to dark-gray, calcareous, sandy; limestone, light- to brownish-gray, thin-bedded grainstones, wackestones, and mudstones, fossiliferous, occasionally oolitic, sandy, silty; sandstone, very light- to brownish-gray, thin- to massive-bedded, fine- to medium-grained, sparingly fossiliferous. Unconformity at base.

Mt — Tuscumbia Formation—limestone, light- to dark bluish-gray, fossiliferous, bioclastic grainstone, wackestone, and mudstone, thin- to thick-bedded, occasionally massive-bedded; some calcareous shale interbeds. Lowermost strata contain beds of chert, very dark-gray to black; uppermost strata contain grainstone, very light-gray, cross-bedded; local occurrences of nodular chert.

Mfp — Fort Payne Formation—includes in descending order:

Upper portion—chert, very light- to dark-gray, thin-bedded; locally weathered to clay, silty, white to very light-gray, and tripolitic silt, white to very light-gray; locally stained shades of brown.

Lower portion—limestone, medium- to dark bluish-gray, finely crystalline wackestone, and mudstone, thin- to massive-bedded, occasional shaly texture when weathered; occasionally glauconitic. Isolated occurrences of very thin interval of grayish-green shale (Maury Shale) at base. Contains isolated lenses of chert.

MDc — Chattanooga Formation—shale, brownish-gray to grayish-black, carbonaceous, silty, sandy, calcareous, very thinly bedded and laminated; isolated occurrences of thin sandstone laminae. Unconformity at base.

Devonian

Dr — Ross Formation—limestone, light- to medium bluish-gray, light brownish-gray when weathered; contains intervals of grainstone, mudstone, and shale; sparsely glauconitic; thin- to massive-bedded. Uppermost exposed portions consist of chert, light brownish-gray, granular, fractured, fossiliferous, and thin bedded.

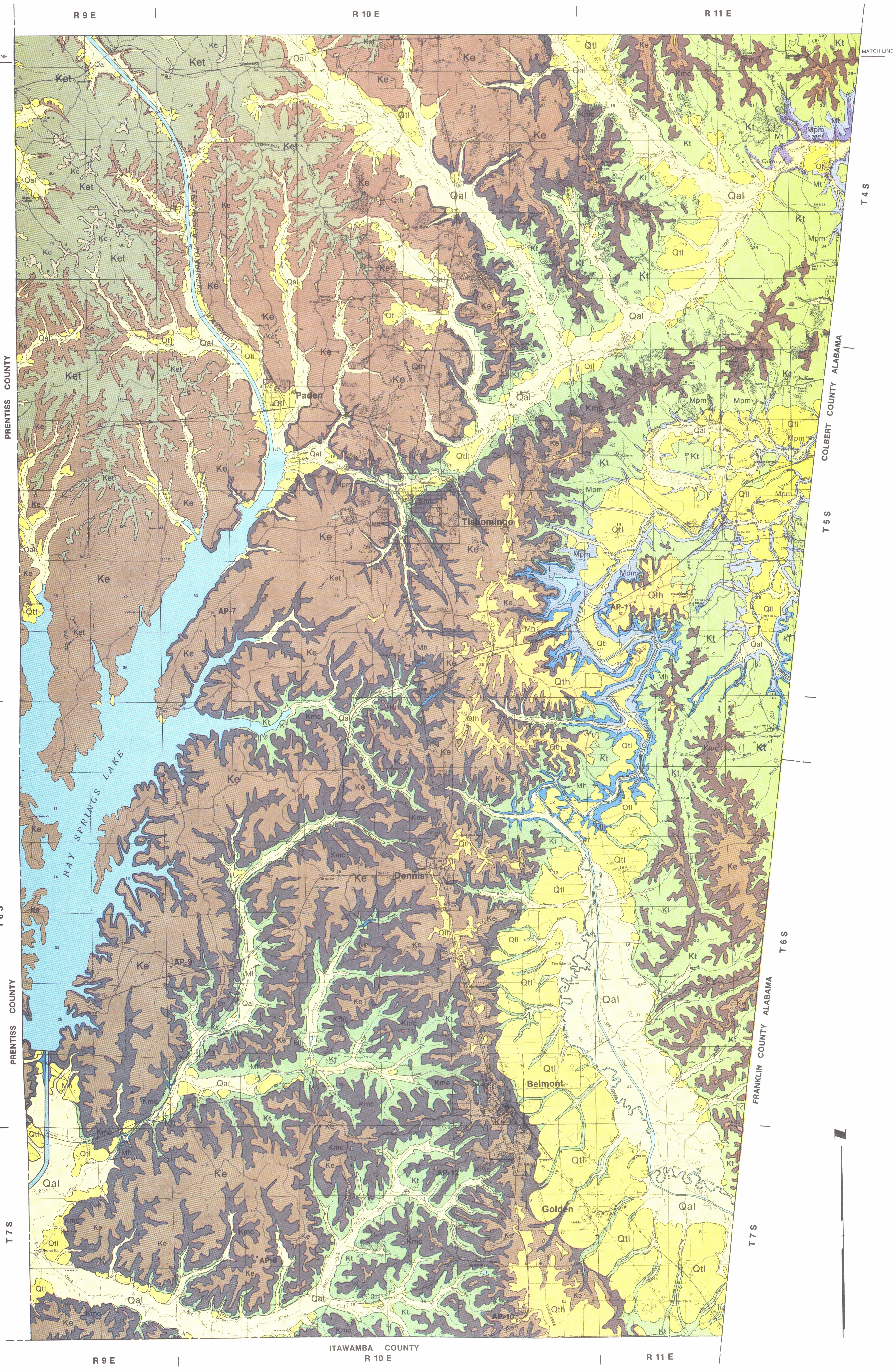
PREPARED BY MERCURY MAPS INC.

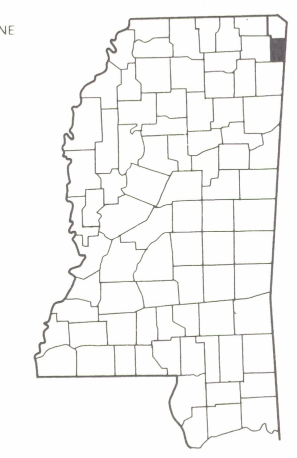
MISSISSIPPI BUREAU OF GEOLOGY
CONRAD A. GAZZIER, DIRECTOR

SOUTH HALF

TISHOMINGO COUNTY, MISSISSIPPI
GEOLOGIC MAP

GEOLOGY BY ROBERT MERRILL
MISSISSIPPI BUREAU OF GEOLOGY





SCALE

THIS MAP IS BASED ON DATA AVAILABLE TO THE DATE NOVEMBER 5, 1987.
The north and south halves overlap; see match line indicated.
Test holes indicated by AP designations.

L E G E N D

Quaternary

Qal — Alluvium—sand, medium- to brownish-gray, very fine- to very coarse-grained, subangular to subrounded quartz, silty, clayey; commonly contains organic matter; chert and quartzite pebbles common at base.

Qtl — Low elevation terrace deposits—sand, light-gray to dark reddish-brown, very fine- to very coarse-grained, subangular to subrounded quartz, silty, clayey; lower portions contain layers and lenses of flattened quartzite and quartz pebbles interspersed with rounded chert pebbles; iron staining common on pebbles. Distributed adjacent to present stream courses, at and above flood plain elevation.

Qth-Qtt — High elevation terrace deposits—gravel, moderate reddish- to dark yellowish-brown, very well rounded chert and smooth, flattened quartzite pebbles; iron staining common on outer surfaces; beds and lenses of sand, silt, and clay occur frequently in upper portions. Irregular bedding, occasional cross-bedding; ironstone cementation common. Includes Tennessee River terrace deposits in northern part of study area. Mainly occur at elevations above 600 feet. Erosional contact at base.

Cretaceous

SELMA

Kc — Coffee Formation—sand, light- to medium-gray, very fine- to medium-grained, subangular quartz, glauconitic, micaceous; frequently interbedded with silt, light- to medium-gray, clayey; thinly bedded with occasional intervals of irregular- to massive-bedded sand; occasional lenses and stringers of small chert gravel at base. Frequent thin ironstone beds; weathers to shades of reddish-brown. Unconformity at base.

EUTAW

Eutaw Formation—includes in descending order:

Ket — Tombigbee Sand Member—sand, medium light- to olive-gray, very fine- to medium-grained, subangular to subrounded quartz, well sorted, massive-bedded, glauconitic, micaceous, silty, clayey; weathers to various shades of reddish-brown. Frequent occurrence of ferruginous cemented sand molds of Callianassa sp. burrows.

Ke — Lower Eutaw—sand, medium- to olive-gray, fine- to medium-grained, subangular to subrounded quartz, glauconitic, micaceous, horizontal- and cross-bedded; commonly thinly interbedded and interlaminated with clay, medium-gray, locally carbonaceous; isolated occurrences of petrified wood in lower portions. Weathers to various shades of reddish-brown. Frequent occurrence of ferruginous cemented sand molds of Callianassa sp. burrows. Unconformity at base.

Kmc — McShan Formation—sand, pale yellowish-brown to very light-gray, very fine- to fine-grained, well sorted, subangular quartz, glauconitic, micaceous, silty; thinly interbedded and interlaminated with silt, light-gray to grayish orange-pink, micaceous, clayey. Horizontal- and ripple-laminated; frequent zones of massive- to cross-bedded, fine- to coarse-grained sand; frequent chert pebble lenses and stringers. Weathers to various shades of reddish-brown to yellowish-gray; local occurrences of ferruginous cemented sand molds of Callianassa sp. burrows; common occurrence of petrified wood; occasional occurrence of carbonaceous clays, dark-gray, micaceous, containing carbonized wood fragments. Unconformity at base.

TUSCALOOSA

Kt — Tuscaloosa Group—gravel, chert, white to dark-gray, very well rounded; frequent silt and clay matrix; sand, light- to moderate reddish-brown, very fine- to very coarse-grained, subrounded to angular quartz and chert grains, poorly sorted, with frequent gravel lenses and stringers; clay, white- to medium-gray with occasional occurrences of carbonaceous dark-gray clays; zones of multi-colored chert gravel; isolated occurrences of quartzite; frequent well-cemented chert pebble conglomeratic zones. Laterally traceable silt and clay intervals occur most frequently in uppermost and lowermost intervals. Unconformity at base.

Mississippian

Mh — Hartselle Formation—sandstone, light gray to light brownish-gray, fine- to medium-grained, well cemented quartz arenite, thin- to massive-bedded; contains thin intervals of thinly bedded and laminated siltstone and shale, medium- to dark-gray; local ferruginous staining.

Mpm — Pride Mountain Formation—shale, olive- to dark-gray, calcareous, sandy; limestone, light- to brownish-gray, thin-bedded grainstones, wackestones, and mudstones, fossiliferous, occasionally oolitic, sandy, silty; sandstone, very light- to brownish-gray, thin- to massive-bedded, fine- to medium-grained, sparingly fossiliferous. Unconformity at base.

Mt — Tuscumbia Formation—limestone, light- to dark bluish-gray, fossiliferous, bioclastic grainstone, wackestone, and mudstone, thin- to thick-bedded, occasionally massive-bedded; some calcareous shale interbeds. Lowermost strata contain beds of chert, very dark-gray to black; uppermost strata contain grainstone, very light-gray, cross-bedded; local occurrences of nodular chert.

Mfp — Fort Payne Formation—includes in descending order:

Upper portion—chert, very light- to dark-gray, thin-bedded; locally weathered to clay, silty, white to very light-gray, and tripolitic silt, white to very light-gray; locally stained shades of brown.

Lower portion—limestone, medium- to dark bluish-gray, finely crystalline wackestone, and mudstone, thin- to massive-bedded, occasional shaly texture when weathered; occasionally glauconitic. Isolated occurrences of very thin interval of grayish-green shale (Maury Shale) at base. Contains isolated lenses of chert.

Devonian

MDc — Chattanooga Formation—shale, brownish-gray to grayish-black, carbonaceous, silty, sandy, calcareous, very thinly bedded and laminated; isolated occurrences of thin sandstone laminae. Unconformity at base.

Dr — Ross Formation—limestone, light- to medium bluish-gray, light brownish-gray when weathered; contains intervals of grainstone, mudstone, and shale; sparsely glauconitic; thin- to massive-bedded. Uppermost exposed portions consist of chert, light brownish-gray, granular, fractured, fossiliferous, and thin bedded.

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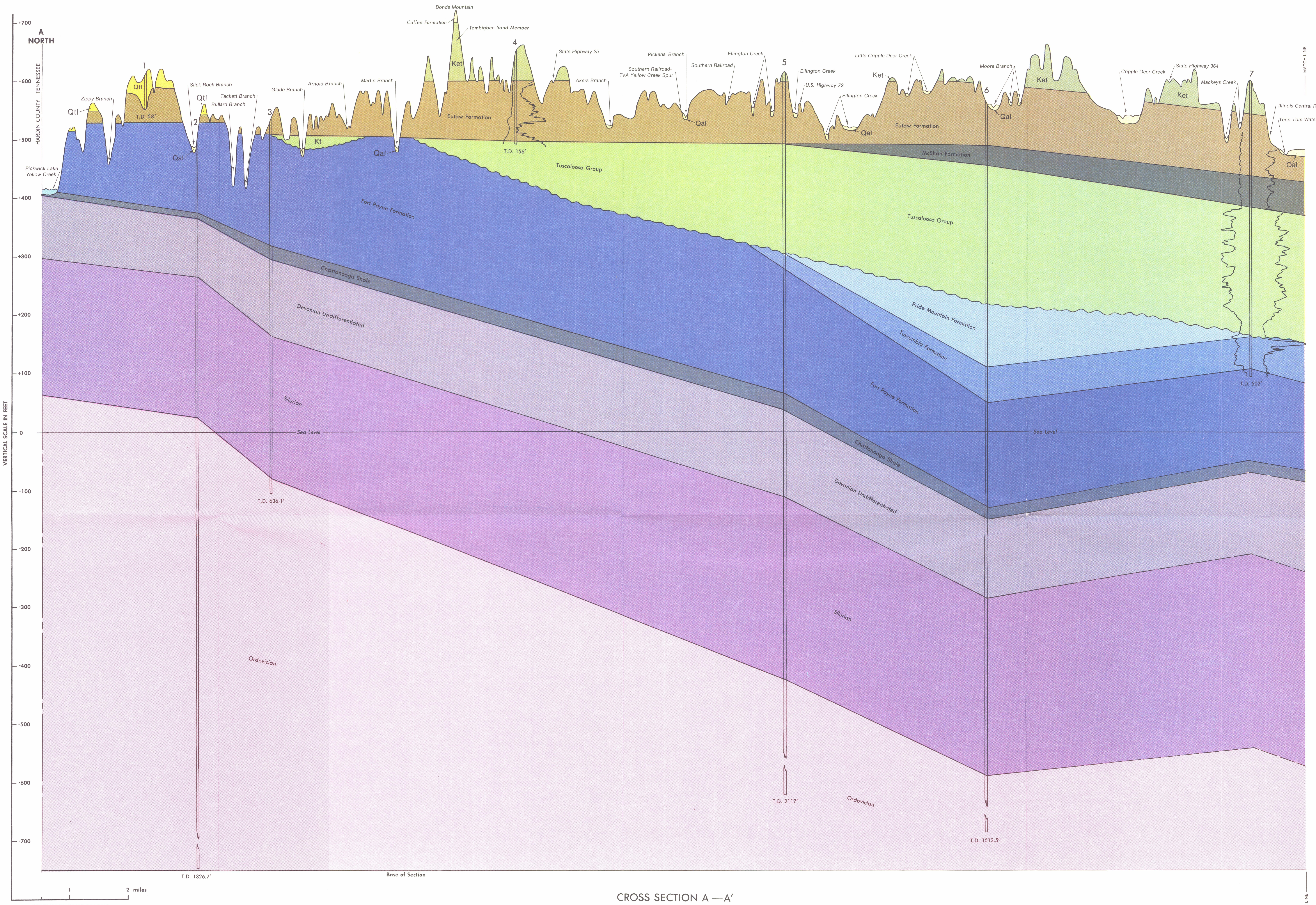

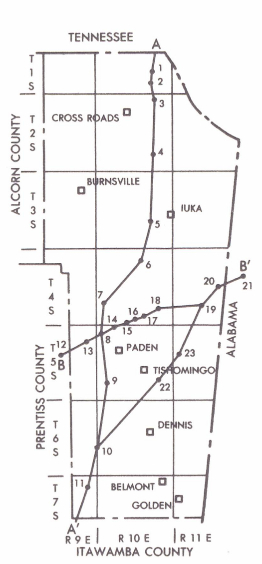

LOCATION MAP

NORTH HALF

STRATIGRAPHIC-STRUCTURAL CROSS SECTION

TISHOMINGO COUNTY, MISSISSIPPI

MISSISSIPPI BUREAU OF GEOLOGY

Robert K. Merrill, Geologist

1988

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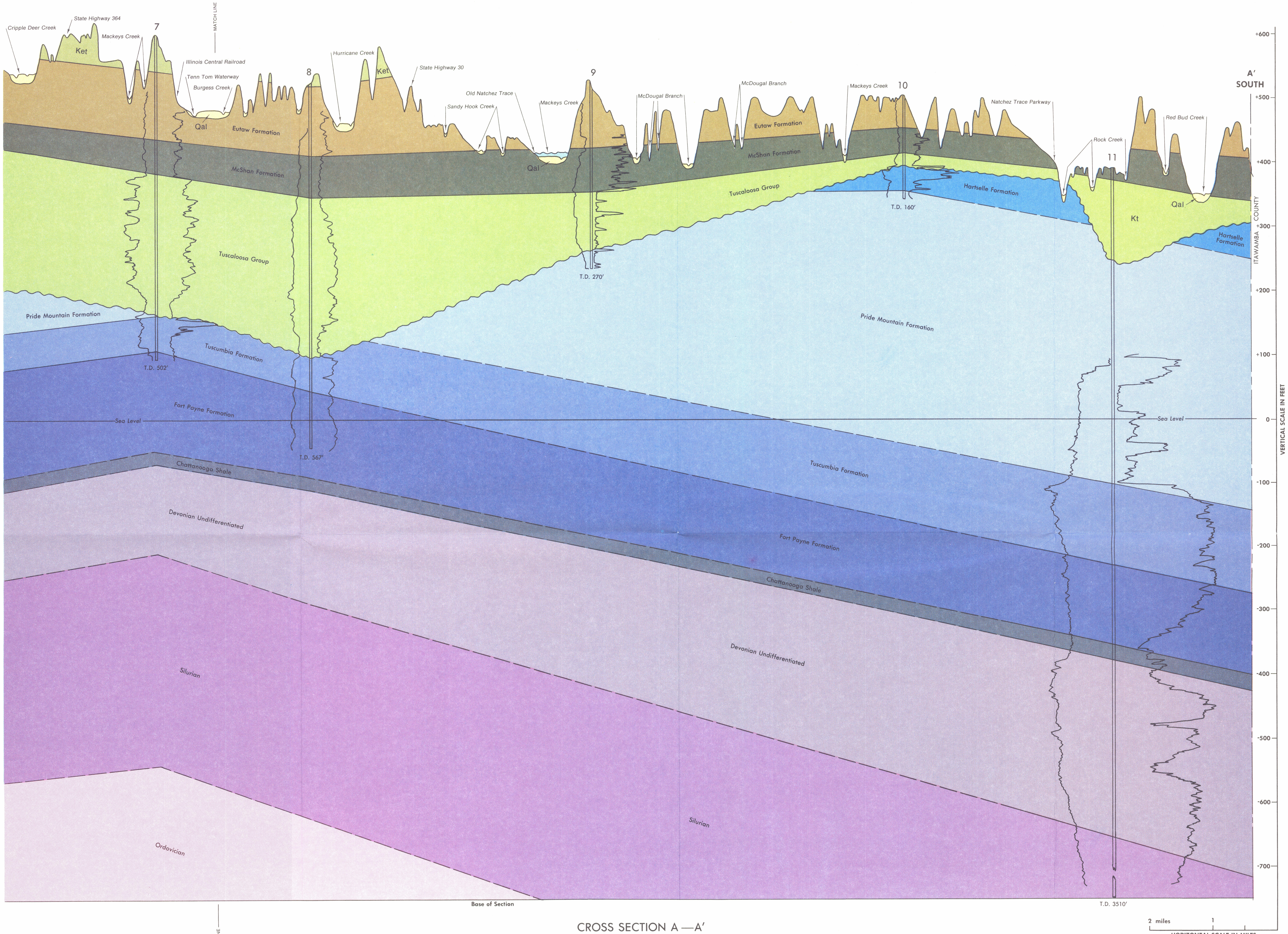
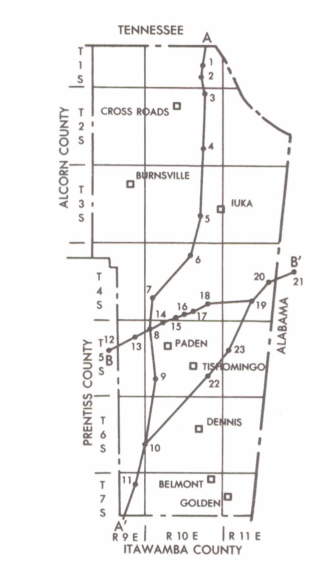


CROSS SECTION A — A'



LOCATION MAP

SOUTH HALF

STRATIGRAPHIC-STRUCTURAL CROSS SECTION

TISHOMINGO COUNTY, MISSISSIPPI

MISSISSIPPI BUREAU OF GEOLOGY

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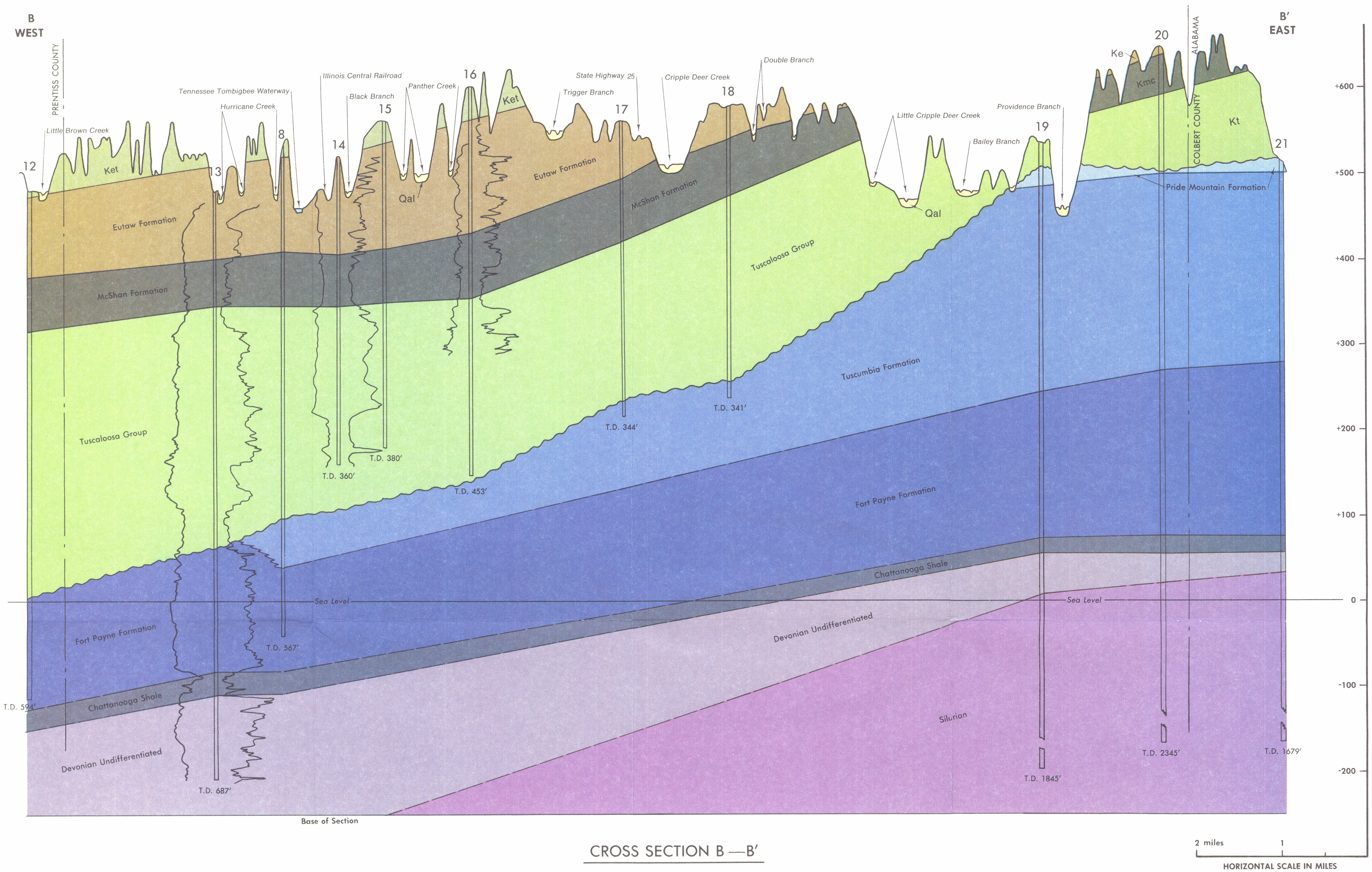
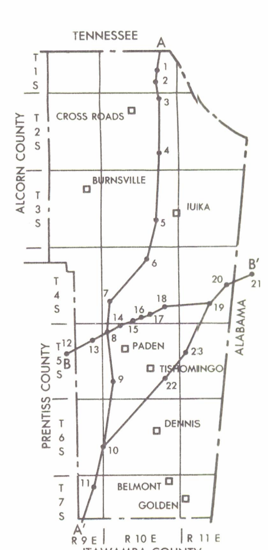


CROSS SECTION B —B′



LOCATION MAP

STRATIGRAPHIC-STRUCTURAL CROSS SECTION
TISHOMINGO COUNTY, MISSISSIPPI

MISSISSIPPI BUREAU OF GEOLOGY

Robert K. Merrill, Geologist

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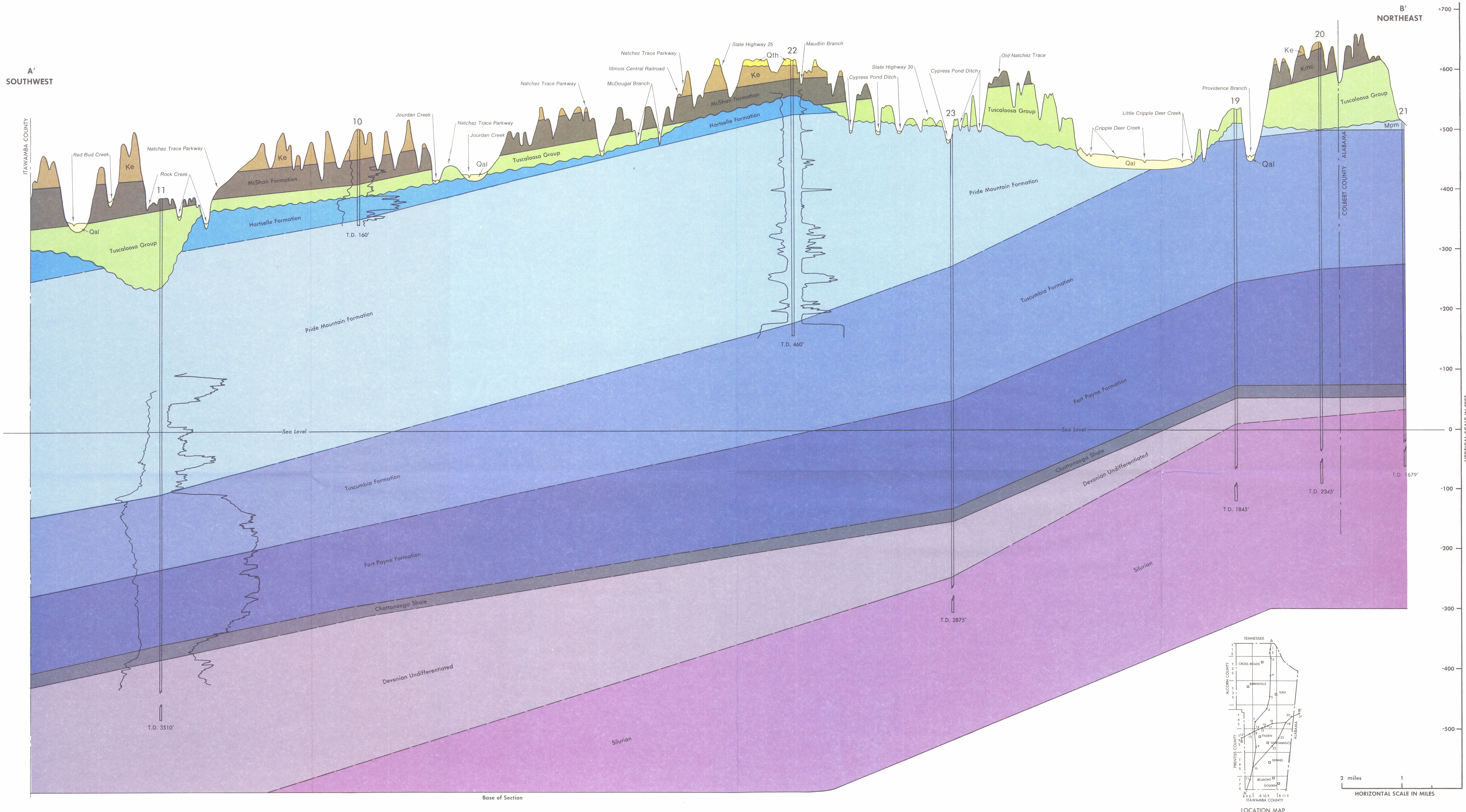

CROSS SECTION A'—B'

STRATIGRAPHIC-STRUCTURAL CROSS SECTION
TISHOMINGO COUNTY, MISSISSIPPI

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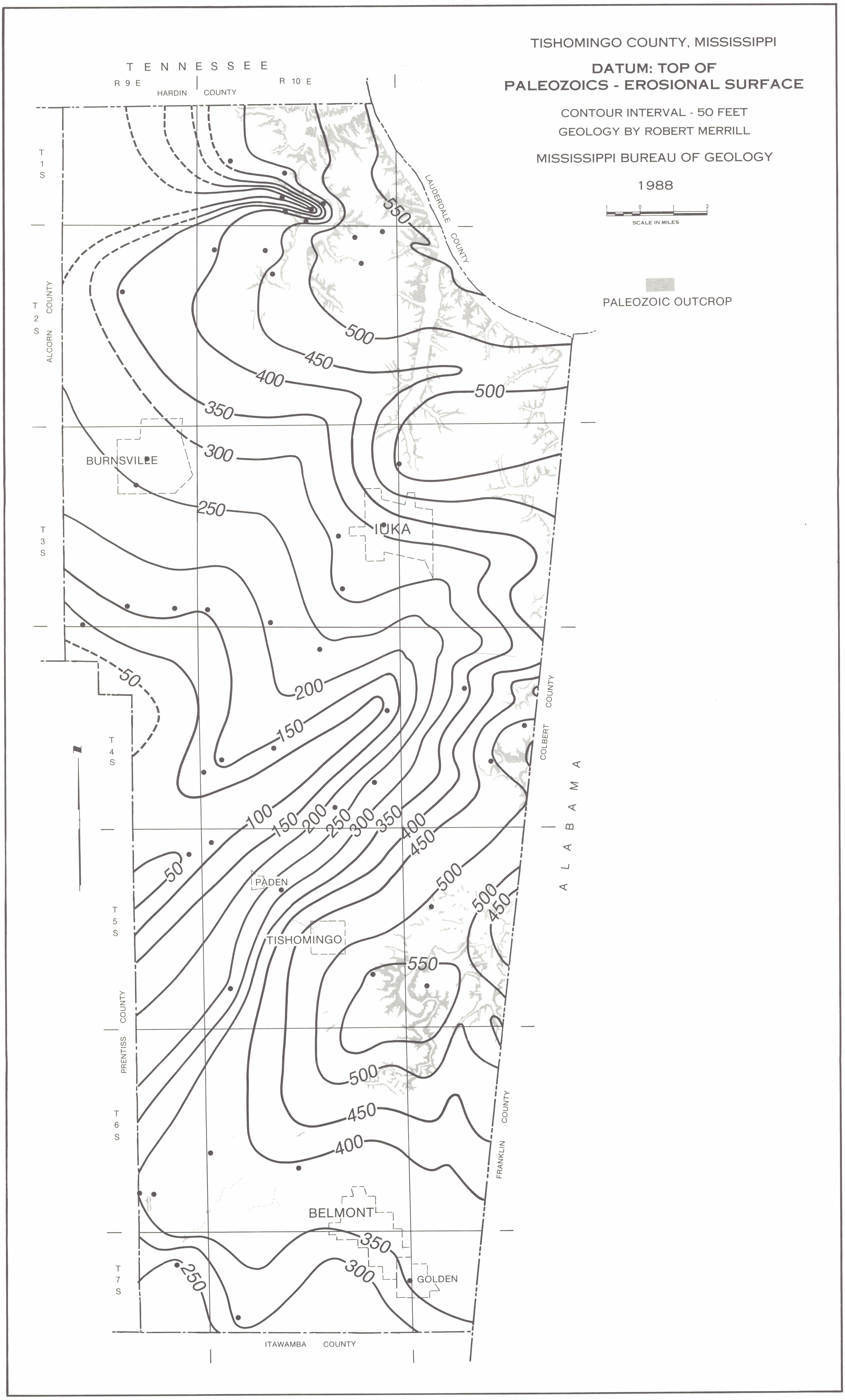
TISHOMINGO COUNTY, MISSISSIPPI
DATUM: TOP OF PALEOZOICS - EROSIONAL SURFACE
CONTOUR INTERVAL - 50 FEET
GEOLOGY BY ROBERT MERRILL
MISSISSIPPI BUREAU OF GEOLOGY
1988
SCALE IN MILES
PALEOZOIC OUTCROP
TENNESSEE
HARDIN COUNTY
R 9 E
R 10 E
LAUDERDALE COUNTY
ALCORN COUNTY
T 1 S
T 2 S
T 3 S
T 4 S
T 5 S
T 6 S
T 7 S
BURNSVILLE
IUKA
PADEN
TISHOMINGO
BELMONT
GOLDEN
COLBERT COUNTY
ALABAMA
PRENTISS COUNTY
FRANKLIN COUNTY
ITAWAMBA COUNTY