Wayne County
Geology and Mineral Resources

JAMES H. MAY

WILBUR T. BAUGHMAN
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BULLETIN 117

MISSISSIPPI GEOLOGICAL, ECONOMIC AND
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WILLIAM HALSELL MOORE
Director and State Geologist

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LETTER OF TRANSMITTAL

Office of the Mississippi Geological, Economic and
Topographical Survey
Jackson, Mississippi
February 21, 1974

Mr. Gordon W. Gulmon, Chairman, and
Members of the Board
Mississippi Geological, Economic and Topographical Survey

Gentlemen:

I am pleased to transmit to you Bulletin 117 entitled, "Wayne County Geology and Mineral Resources," by James H. May and others.

This Bulletin details the mineral resources of the County, and summarizes tests perfomed on certain of these minerals, several of which look promising for development of future mineral industries.

This County contains some of the most interesting geology in the State, and the section on stratigraphy deals with many complex and interesting geologic problems. This Bulletin should be an excellent contribution to the growing knowledge of the State's geology and the extent and value of its mineral resources.

Respectfully,
William H. Moore
Director and State Geologist

CONTENTS

ILLUSTRATIONS

FIGURES (MAY)

PLATES (MAY)

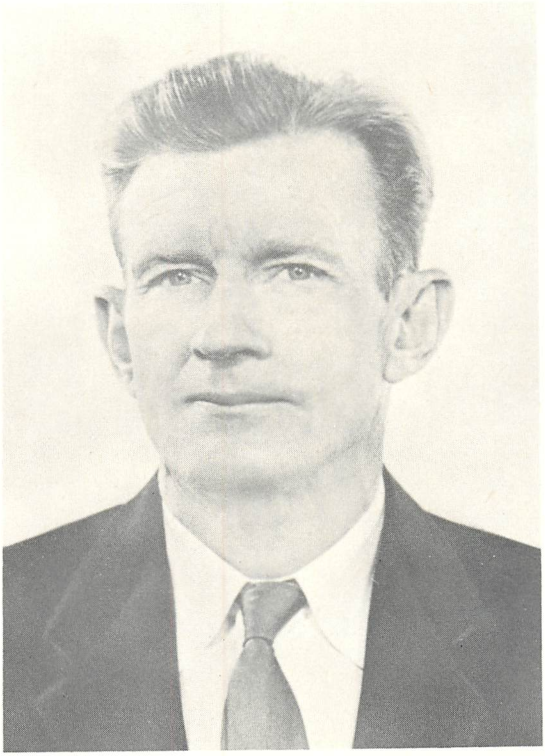
TABLES (MAY)

FIGURES (CLAY REPORT)

TABLES (CLAY REPORT)

FIGURES (BAUGHMAN AND McCARTY)

TABLES (BAUGHMAN AND McCARTY)



EDWARD HARRIMAN RAINWATER

September 20, 1909 November 10, 1972

The Mississippi Geological Survey dedicates this Bulletin to the fond memory of Edward Harriman Rainwater, born in Wayne County September 20, 1909, and died in Texas of a heart attack November 10, 1972. Rainy attended public school in Waynesboro, received a B.S. degree in Geology at Mississippi State University, and an M.S. Degree in Geology at Northwestern University. He taught at MSU for two years before joining Shell Oil Company as a geologist from 1937 until retirement in 1963. At the time of his death he was consultant to Tenneco, Inc., reporting on the stratigraphy and petroleum potential of sedimentary basins throughout the World. Rainy was an active member of many geological societies, a frequent lecturer at numerous universities, and author of about 50 publications, three of which were published by the Mississippi Geological Survey. "Harriman", as he was called by members of his family, was buried November 13, 1972 at Waynehaven, Highway 45 north of Waynesboro. He is survived by his wife Margaret (Peggy) Morse Rainwater, and their two sons, Charles Foster Rainwater and Norman Morse Rainwater, and by numerous other relatives. It is particularly appropriate to dedicate this book to this outstanding geologist of whom Wayne County, Mississippi, and the Nation can justly be proud. — by F. F. Mellen.

WAYNE COUNTY GEOLOGY

James H. May

ABSTRACT

Wayne County is located in southeast Mississippi within the parallels 31°25′ and 31°55′ north latitude and the meridians 88°25′ and 89°00′ west longitude. It is the fifth largest county in the State with an area of 827 square miles. The 1970 census shows a population of 16,650, a population density of 20.1 persons per square mile. Primary access is by State Highways 63, 510, and 536; U. S. Highways 84 and 45; the Illinois Central Gulf Railroad; and a noncommercial airport.

The County is located in the Gulf Coastal Plain physiographic unit and is further divided into three smaller provinces: the Jackson Prairie, the Vicksburg Hills, and the Piney Woods. The topography varies from gently rolling prairie to rugged hills.

Stratigraphic units exposed are part of the Eocene, Oligocene, and Miocene Series of the Tertiary System; and the Pleistocene and Recent Series of the Quaternary System. The units in ascending order are the Cockfield Formation of the Claiborne Group of Eocene age; the Moodys Branch and Yazoo Formations of the Jackson Group of Eocene age; the Red Bluff and Forest Hill Formations of Oligocene age; the Mint Spring, Marianna, Glendon, Byram, and Bucatunna Formations of the Vicksburg Group of Oligocene age; the Chickasawhay and Paynes Hammock Formations of Oligocene age; the Catahoula and Hattiesburg Formations of Miocene age; the Citronelle Formation and Terrace deposits of Pleistocene age; and alluvium of Recent age.

Wayne County is located along the east side of the synclinal structure known as the Mississippi Embayment, which is a part of the much larger Gulf Coast Geosyncline. Deep-seated salt tectonics and the Hatchetigbee Anticline influence the structural geology of the County. Deep-seated salt domes are very important structural features in the production of oil and gas. The County is located near the updip limit of the Louann Salt on the northeast margin of the Interior Salt Basin of Mississippi. The regional dip of the near-surface strata is about 38 feet per mile toward the southwest. Anomalous areas are indicated on the structural maps of the Moodys Branch and Glendon Formations.

Mineral resources of economic importance include oil and gas, clay and natural clay mixtures, sand, gravel, limestone, and marl. In 1972, Wayne County ranked fifth in the State in annual oil production with a total of 4,394,376 barrels, and fourteenth in the State in annual gas production with 1,146,182,000 cubic feet. Clays and natural clay mixtures found in the County have potential uses in the manufacture of lightweight aggregate, drilling mud, additives for poultry and livestock feed, brick, sewer pipe, drain tile, building block, bleaching clay, terra cotta, conduits, roofing tile, and quarry

tile. Limestone and marl are utilized in the County as agricultural lime. Potential uses of limestone and marl are in the production of Portland cement and rock wool.

A potential source of future energy is in the geopressured areas of the County. The highest pressure gradient in Mississippi, 1.06 psi/ft., was recorded in a well located in Sec. 22, T.6N., R.8W., in Wayne County.

INTRODUCTION

This report includes test results and conclusions from the geological and hydrological investigation of Wayne County, Mississippi. The purposes of the investigation were to locate and evaluate the mineral resources of actual or potential economic value; to determine the areal extent, thickness, and character of the geologic units; and study the surface and subsurface water resources of the County.

The investigation began with a thorough review of all pertinent literature concerning the geology of Wayne County and the neighboring counties. This included spotting the location of available electrical logs on a map of Wayne County. The obtainable information was a valuable aid in planning the field reconnaissance and drilling program.

The field reconnaissance began January 11, 1972. This phase of the investigation included: the study of outcrops (especially at type localities), the collecting of surface samples, establishing topographic map coverage, determining what mineral resources were being developed, and permitting test hole sites.

The drilling program for Wayne County began on June 12, 1972, and the last test hole was completed on September 28, 1972. A total of 49 test holes were drilled and/or cored during this period. Samples were taken from the drilled test holes at ten foot intervals for later study. The cored clay samples were collected for a series of laboratory tests. The total footage drilled and cored was 7,671 feet. The test holes were drilled and/or cored by the Survey's Failing 1500 Holemaster rig. Electrical logs measuring self potential and resistivity were run on most of the test holes with the Survey's Widco electrical logger.

After the completion of the drilling program the drill cuttings were washed and microscopically examined. The clay samples were sent to Mississippi State University and the U. S. Bureau of Mines Tuscaloosa Metallurgy Research Laboratory for testing.

The hydrological investigation, conducted by Wilbur T. Baughman and assisted by John E. McCarty, consisted of securing chemical analyses of water, running pumping tests, and evaluating the aquifers in selected wells. The details of this investigation are given in the Water Resources section.

ACKNOWLEDGMENTS

The writer is grateful for the assistance and cooperation which was rendered by the officials and other residents of Wayne County during the field investigation. Reports like this would not be possible without this type of response from the general public.

Special acknowledgments are extended to the representatives of the U. S. Forestry Service and various wood products companies for granting access to the thousands of acres under their jurisdiction. Electrical logs furnished by several oil companies and the water well logs provided by the Water Resources Division of the U. S. Geological Survey were invaluable for use in correlating information gained through this investigation.

Acknowledgment is also due Dr. James P. Minyard, State Chemist, for chemical analyses of clay samples. The U. S. Bureau of Mines was very cooperative in performing tests for oil decolorization and preliminary bloating tests on Wayne County clay samples. David T. Dockery, III, a graduate student at the University of Mississippi and a summer employee of the Survey, described and catalogued many of the fossils found in the County.

The staff members of the Mississippi Geological Survey were very helpful in all phases of the investigation. They rendered valuable assistance in the course of the field work as well as providing helpful suggestions in the preparation of the manuscript and in editing the proofs.

Wendell B. Johnson, head of the Millsaps Geology Department, supervised the X-ray analyses of several of the Wayne County samples.

PREVIOUS INVESTIGATIONS

Certain portions of Wayne County have been investigated previously in relation to geology and specific mineral resources. However, no comprehensive geologic report has been published concerning the entire County.

In his 1857 report on the geology and agriculture of the State of Mississippi, L. Harper[1] described in detail many outcrops in Wayne County. He drew diagrams representing sections of Oligocene (Eocene in Harper's report) formations near Red Hill on Limestone Creek and listed fossils that he found near what is now the type locality of the Red Bluff Formation. His report included quantitative analyses of samples from several limestone and marl localities. He also placed high values on the clays of Wayne County and discussed clays from several localities near Red Hill and on the Chickasawhay River as having excellent qualities for pottery clay.

Hilgard[2], in his 1860 report, listed much accurate and informative data concerning the geology of Wayne County. He called the beds intervening between the Jackson and Vicksburg Groups the Red Bluff Group and gave a list of fossils collected from this stratum. Hilgard stated that the limestones and marls of the Waynesboro area could hardly be distinguished from those found near Brandon Depot in Rankin County. He discussed the value of the marls as agricultural lime.

In 1907 A. F. Crider[3] agreed with Harper and Hilgard regarding the availability of valuable limestone deposits in Wayne County.

In 1911, E. N. Lowe[4] wrote about Wayne County pertaining to its material suited for structural purposes. He commented on sand, gravel, and limestone as structural material. He presented tables showing granulometric analyses of sand near Waynesboro, tensile strength of cement made with this sand, and chemical analyses of Wayne County limestone. In 1915 Lowe[5] again wrote about this area, correlating the soft limestone, locally called "chimney rock," with the Marianna Limestone of Florida.

William Logan[6], in 1916, commented on the Jackson Marls, "Their value for local agricultural uses cannot be questioned.

Chemical analyses show that they contain lime, potash, and phosphate." He also gave chemical analyses of and discussed several Vicksburg marl and limestone localities.

In 1920, Lowe[7] described an agricultural lime plant adjacent to the Mobile & Ohio Railroad (I.C.G.) three miles north of Waynesboro. The plant had a 50 ton per day capacity.

Stephenson, Logan, and Waring[8], in their 1928 report discussed the water-bearing formations in the County, including capacities and mineral analyses of certain wells.

The Shreveport Geological Society[9] conducted its eleventh annual field trip in October of 1934. The guidebook for this field trip contains an abundance of information concerning the stratigraphy and paleontology of the Eocene, Oligocene, and Miocene Series of Wayne and Clarke Counties.

The bentonitic clays of Wayne County were evaluated by Hugh McD. Morse[10] in 1934. He concluded that the quantity of the clays was favorable, but that the quality was inferior to those in Smith and Jasper Counties. Harry Bay[11], in 1935, discussed what he termed, a deposit of sub-bentonite located east of Matherville, in Wayne County. He also discussed bentonitic clay in the area of the Vicksburg outcrop in T.9 N., R.5 and 6 W.

Fred Mellen[12], in 1942, discussed high grade agricultural limestone in Wayne County. He described two localities; the State Penitentiary Agricultural Limestone Plant in Sections 25 and 26, T.9 N., R.7 W., and the Jim Stanley property in Section 23, T.10 N., R.8 W.

The Mississippi Geological Society[13] conducted its sixth field trip in June of 1948. This trip dealt with the upper Eocene, Oligocene, and Lower Miocene of central Mississippi. Their ninth field trip guidebook, published in 1952, was entitled Claiborne of Western Alabama and Eastern Mississippi[14].

C. Wylie Poag[15] studied the planktonic foraminifers of the Chickasawhay Formation and arrived at certain conclusions concerning stratigraphic correlation. His report was published in 1972. He placed the Paynes Hammock and the Chickasawhay in the Oligocene.

DESCRIPTION OF AREA

LOCATION AND SIZE

Wayne County is located in southeastern Mississippi. It is within the parallels 31°25′ and 31°55′ north latitude and the meridians 88°25′ and 89°00′ west longitude. It is bounded on the north by Jasper and Clarke Counties, on the south by Greene and Perry Counties, on the west by Jones County, and on the east by Washington and Choctaw Counties, Alabama. The maximum width of the County is 29 miles and the maximum length is about 31.5 miles. The area of the County is 827 square miles, or 529,280 acres, making it the fifth largest county in the state (Fig. 1).

POPULATION

The 1970 census shows a population of 16,650 for Wayne County. The population increased 2.4 percent since the 1960 census. The density of population is 20.1 persons per square mile. Waynesboro, with 4,368 people, contains 26.2 percent of the total population in Wayne County. People who live in rural areas, but not on farms, make up 51.0 percent of the total populace. People who live in rural areas, on farms, make up 22.7 percent. The town of State Line has about 653 people, but shares approximately half of them with Greene County, Mississippi. Waynesboro and State Line are the only incorporated towns in Wayne County.

The remaining population is distributed among small villages and communities. The names of the communities shown on the general highway map are: Buckatunna, Eucutta, Whistler, Hiwannee, Matherville, Boice, West King, Woodwards, Denham, Battles, Pine Bluff, Smithtown, Henderson, Mulberry, Water Oak, Strengthford, Clara, Chicora, Winchester, Robinson Junction, and Lightsey.

Large tracts of land owned or leased by wood products companies are very sparsely settled. The DeSoto National Forest, with roughly 180 square miles within its boundary in Wayne County, is also thinly settled.

CULTURE AND INDUSTRY

Wayne County is basically a rural county. Tree farming is taking the place of food crops and cotton growing in many

Figure 1.—Location of Wayne County.

areas of the County. There is also a continuing trend toward leaving the farm for jobs in industry.

According to information supplied by the Mississippi Employment Security Commission, Wayne County had a 14.6 percent increase in its total civilian labor force from 1962 to 1972. The labor force increased from 4,180 to 4,790, with fluctuations occurring during the ten year period. Persons employed in manufacturing increased from 870 in 1962 to 1,330 in 1972, a 52.9

percent increase. Persons employed in non-manufacturing jobs increased from 1,320 in 1962 to 1,910 in 1972, a 44.7 percent increase. Agriculturally related jobs, however, decreased in number from 1,100 in 1962 to 650 in 1972, a decrease of 40.9 percent. The 1970 census showed that the median income for Wayne Countians was $5,190.

The Mississippi Manufacturers Directory lists ten manufacturing plants in Wayne County. Eight of these plants are located in Waynesboro with one each in Chicora and Buckatunna. The ten Wayne County plants employ a total of 1,107 people. These plants produce products such as electric blankets, newspapers, magazines, livestock feed, ready-mix concrete, leather work gloves, plywood, commercial veneer, lumber, apparel, and electrical machinery. The oil and gas industry, as well as other mineral related industries, will be discussed in the Economic Geology Section of this bulletin.

Pulpwood cutting is a major industry as thousands of acres are harvested each year by several major paper and wood products companies. The second largest tree nursery in the world is located south of Waynesboro. The principal sources of farm income are livestock, poultry, dairying, cotton, and grain crops.

ACCESSIBILITY

Waynesboro, with its central location and concentration of industry, is the focal point for the arteries of transportation in Wayne County. There is no Interstate Highway system in Wayne County, but adequate access is obtained through the State and County highway system. The main state highways that serve Wayne County are State Highways 63, 510, and 536. Small sections of State Highways 57 and 42 are in Wayne County. U. S. Highways utilized are U. S. 84 and 45. There are also numerous county roads, many of which are surfaced with asphalt. The unpaved roads in the more remote parts of the County sometimes become impassable during prolonged wet periods. The main highways in Wayne County are also asphalt surfaced. U. S. 84, which has been recently widened, extends from the Jones County line east, through the community of Whistler, and into the center of Waynesboro. This is the most heavily travelled section of highway in the County. From Waynesboro, U. S. 84 takes a northeasterly direction through the community of Gretna and into Alabama. Another main transportation route is U. S. 45 from the Clarke County line south of Shubuta, through the communities of Hiwannee and Boice and into the center of Waynesboro. From Waynesboro it exits the County south of State Line.

The most heavily travelled State Highway is State Highway 63. Highway 63 extends from Waynesboro south through the communities of Clara and Water Oak into Greene County, Mississippi.

The Chickasawhay River is not commercially navigable, although it was used in the past to transport logs to mills downstream.

The Illinois Central Gulf Railroad parallels U. S. Highway 45 from Clarke County, through Wayne County, and into Greene County. To the south the I.C.G. extends through State Line, Mississippi, into Alabama. To the north it extends through Quitman, in Clarke County, and on to Meridian. The I.C.G. trains make one trip per day, each way, through Waynesboro.

Wayne County has a municipal airport 2 miles southeast of Waynesboro. The airport has a 3,000-foot by 50-foot, north-south runway. Commercial air service is not available.

CLIMATE

Wayne County is in the subtropical climate group. The type of climate is classified as subtropical humid. The above classification for Wayne County is readily confirmed by data compiled from available reports by U. S. Department of Commerce, Weather Bureau. The climatological data shown in Table 1 was taken from a reporting station at Waynesboro, Mississippi, over a ten-year period from December 1962 through November 1972.

Summers in Wayne County are distinctly warm to hot. The average summer temperature in the 10-year period was 78.9°. Winters are relatively mild, averaging 48.2° for the same period. The growing season for most crops is about 7 months. It rarely snows and freezing temperatures are restricted to a few days per year. Spring and fall temperatures are mild, averaging 65.3° and 64.5°, respectively. The highest recorded temperature for the 10-year period was 103° and the lowest was 4°.

Table 1

Normal, Monthly, Seasonal, and Annual Temperature and Precipitation in Wayne County, Mississippi.*

MONTH	TEMPERATURE			PRECIPITATION		
	Average	Absolute Maximum	Absolute Minimum	Average	Absolute Maximum	Absolute Minimum
	F°	F°	F°	inches	inches	inches
December	49.5	81	5	6.68	14.34	2.15
January	47.1	81	4	4.79	7.69	2.35
February	48.1	80	12	5.63	15.07	1.70
Winter	48.2	81	4	17.10	27.97	11.37
March	56.9	89	18	5.55	10.21	1.83
April	67.5	92	30	4.53	9.55	1.06
May	71.5	97	35	3.47	7.11	.79
Spring	65.3	97	18	13.54	19.71	7.80
June	77.9	103	44	3.53	4.74	2.24
July	79.6	101	52	5.82	9.96	3.26
August	79.3	102	51	4.58	6.85	2.62
Summer	78.9	103	44	13.92	20.62	9.41
September	75.1	99	32	2.94	6.59	.90
October	64.6	95	24	2.31	5.64	.00
November	53.7	86	14	2.54	5.08	.75
Fall	64.5	99	14	7.79	10.63	3.09
Year	64.2	103	4	52.36	61.07	35.76

*Average temperature and precipitation based on a 10–year record; compiled from available recordings in U. S. Department of Commerce, Weather Bureau, (Climatological Data,) December 1962 through Novermber, 1972.

Rainfall is relatively abundant, with a yearly average of 52.36 inches. Much of the summer precipitation is of the showery convective type which develops in warm humid air made unstable by a heated land surface. The most abundant precipitation occurs during the winter months. The average winter precipitation for the 10-year period mentioned earlier was 17.10 inches. The average for the summer precipitation for the same period was 13.92 inches. The absolute maximum precipitation for any year during the study period was 61.07 inches. The absolute minimum for any year was 35.76 inches.

Figure 2 shows the mean annual precipitation based on a 25-year period from 1931-1955. The mean annual precipitation for Wayne County during this period was between 56 and 60 inches.

TOPOGRAPHY

The topography in Wayne County is basically rugged. In some localized areas a karst topography has developed because of the underlying calcareous formations. In the northeast portion of the County is an area of gently rolling prairie underlain by the Yazoo Formation. The flat areas are mostly confined to the recent alluvial plains and, in some instances, the older elevated terraces. The maximum elevation shown by topographic maps of Wayne County is 480 feet. The location of the highest point is northeast of Eucutta near the Clarke County line. Elevations of 100 feet are shown in the Chickasawhay River Valley south of Buckatunna indicating the lowest elevations to be in that area. The highest elevations are found on a dissected ridge extending from Eucutta south toward Mulberry and into Greene County. Elevations along this ridge are generally from 200 feet to 400 feet. Another prominent ridge is located in the northeast section of the County and extends from just east of Shubuta (Clarke County), between the Chickasawhay River and Bucatunna Creek, terminating east of Winchester. Elevations along this ridge are from 300 feet to 400 feet. Topographic highs are usually located parallel to the direction of major stream flow. The two major valleys in Wayne County are the valleys of the Chickasawhay River and Bucatunna Creek. Other valleys are occupied by Eucutta, Thompson, Big, and Dry Creeks. The elevations in these valleys are from 100 feet to 300 feet. The higher ridge and valley elevations are located in the northern part of the County.

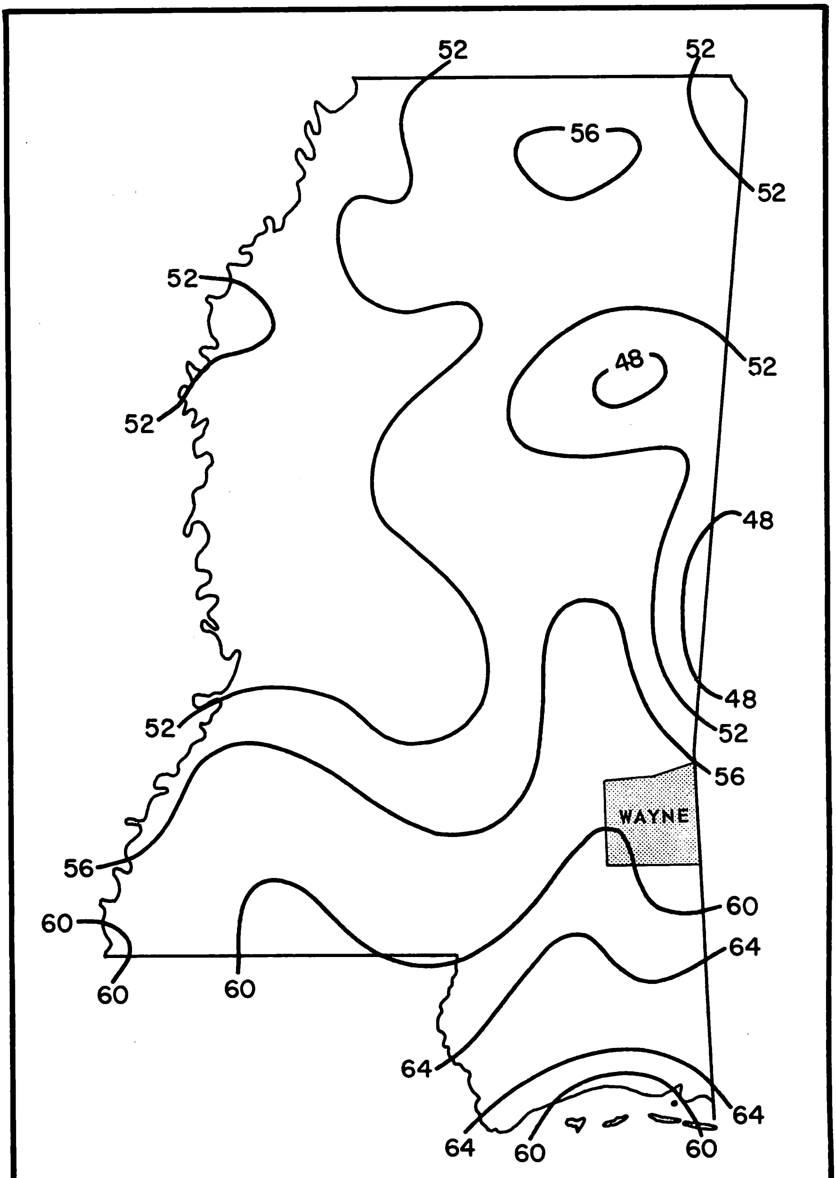


Figure 2.—Mean annual precipitation in inches. From U. S. Weather Bureau, 1959, "Climate of the States." Based on 25 year period 1931-55.

Wayne County has 7.5 minute topographic map coverage for approximately 85 percent of its total area (Fig. 3). These

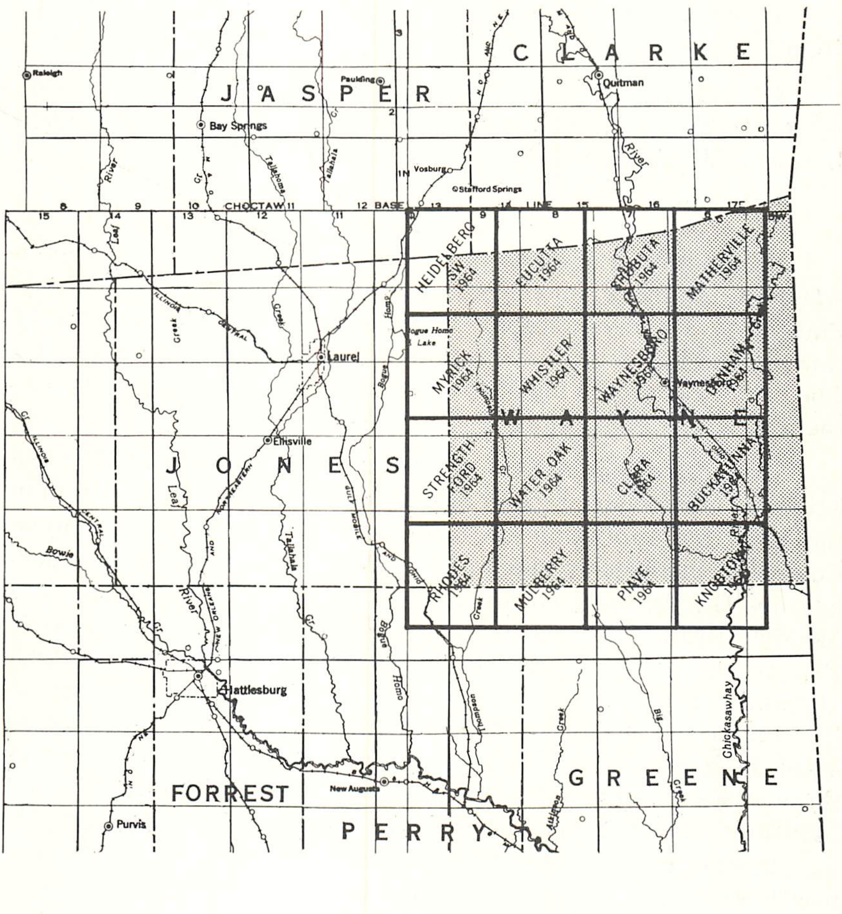


Figure 3.—Topographic map coverage of Wayne County.

topographic maps are prepared by the U. S. Geological Survey. The area not covered by the 7.5 minute quadrangles consists of a narrow strip along the Mississippi-Alabama boundary. The 7.5 minute quadrangles used for geologic surveying in Wayne County were Heidelberg S.W., Eucutta, Shubuta, Matherville, Myrick, Whistler, Waynesboro, Carmichael, Denham, Rhodes, Piave, Knobtown, Strengthford, Water Oak, Clara, and Buckatunna. These maps were all completed in 1964. A work map for the eastern strip was prepared by taking the Hattiesburg, Mississippi; Alabama; Louisiana map, which has a scale of 1:250,000 and enlarging it to a scale of 1:24,000. This enabled a correlation with the existing topographic quadrangles in the County.

All available topographic maps of Mississippi may be purchased from the Mississippi Geological Survey, P. O. Box 4915, Jackson, Mississippi (39216).

PHYSIOGRAPHY

Mississippi is located in the Gulf Coastal Plain of North America. R. R. Priddy[16] (revising earlier maps) divided the State into 12 physiographic provinces (Fig. 4). Portions of three of the physiographic provinces are found in Wayne County. The provinces occupying Wayne County are the Jackson Prairie, the Vicksburg Hills, and the Piney Woods.

The area designated as the Jackson Prairie is located in the extreme northeastern part of the County. Dr. Priddy's map indicates that approximately 8 percent of the total area of Wayne County is included in the Jackson Prairie. This area is underlain by the Jackson Group, which consists of the Yazoo and Moodys Branch Formations. In Wayne County, the Jackson Prairie has a somewhat different character than in the western portion of the State. This is due to changes in the lithology of the surface strata. The Yazoo Formation in western Mississippi is composed predominantly of clay. Toward the east these clays become more fossiliferous, and in Wayne County indurated marls and limestone are common. The topography has more relief because these more resistant strata do not weather into the gently rolling hills that characterize the Jackson Prairie in western Mississippi. This area is moderately hilly with broad, relatively smooth stream valleys.

The Vicksburg Hills extend from the northwest corner of the County, across the Waynesboro area, and into Alabama near Denham. Approximately 20 percent of the total area of the County is occupied by this province. A change in lithology occurs in this area as it does in the Jackson Prairie zone. The character for the Wayne County portion of the province is not

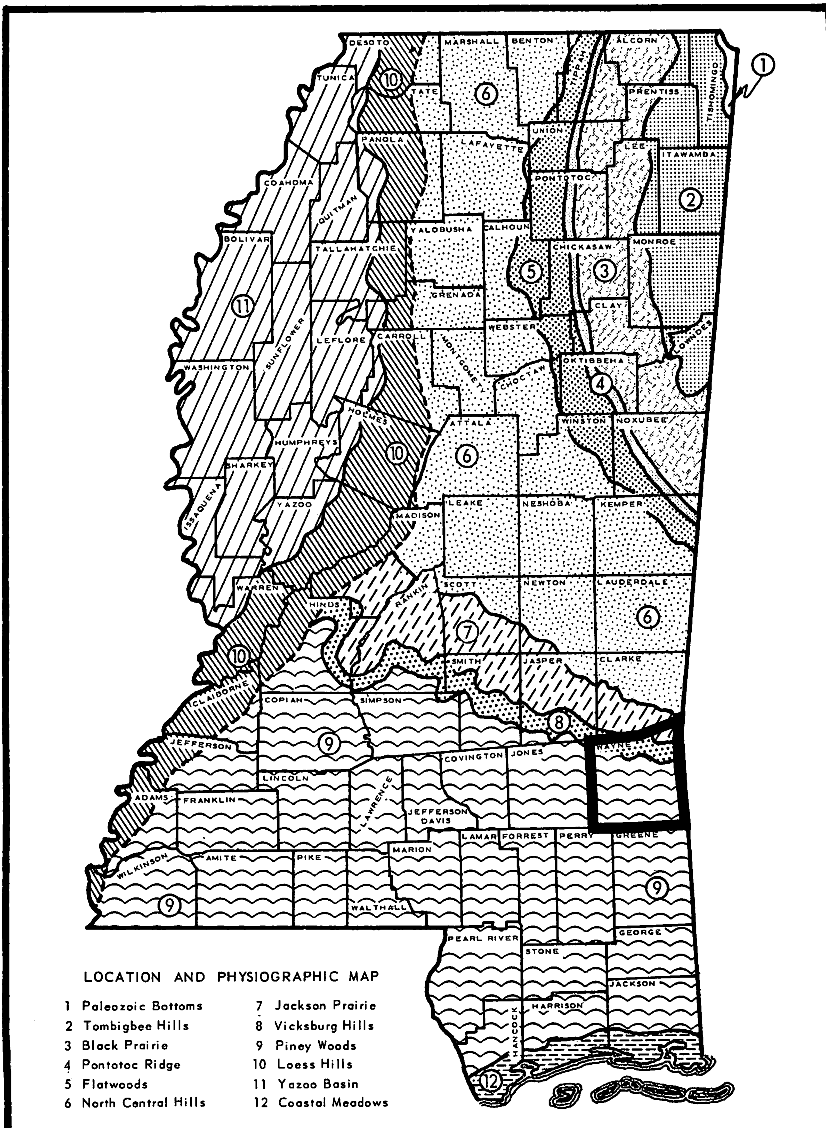


Figure 4.—Physiographic provinces of Mississippi. After R. R. Priddy.

the same as the portion to the west. The Wayne County portion of the province is underlain, not only by the Vicksburg Group, but by the Chickasawhay, Paynes Hammock, Forest Hill, and Red Bluff Formations. This combination of limestones, marls, sands, and clays produces a varied and commonly rugged topography. Many of the higher hills are capped by resistant ledges of limestone. These hills usually have high level terrace deposits overlying the eroded formational remnants.

The remaining southerly part of the County is occupied by the Piney Woods Province. This area is underlain by the Catahoula and Hattiesburg Formations. Locally the sands of the Catahoula are indurated into hard sandstone ledges. In these localities the topography is very hilly and rugged. Near Eucutta sandstone boulders 30 feet in diameter are weathered out on the tops of hills. Portions of the Hattiesburg Formation are also indurated and cause hilly surfaces when weathered.

DRAINAGE

Wayne County lies within the Pascagoula River Basin drainage area. (Fig. 5) The Chickasawhay River, which is the only river in the County, joins the Leaf River in northern George County to form the Pascagoula River. The Pascagoula River Basin is the second largest drainage basin in the State.

The three large drainage areas in Wayne County are the valleys of the Chickasawhay River, and Bucatunna and Thompson Creeks.

The Chickasawhay River and its tributaries drain the central portion of the County from south of Shubuta to State Line. It flows in a southerly direction, bearing southeasterly a few miles south of Waynesboro. The larger tributaries entering the Chickasawhay in Wayne County are Eucutta Creek, Yellow Creek, Big Creek, Bucatunna Creek, Sandy Creek, Patton Creek, Langs Creek, Taylors Creek, Limestone Creek, Hortons Mill Creek, and Carson Sand Creek. The Chickasawhay River is formed at the confluence of the Chunky River and Okatibbee Creek near Enterprise in northern Clarke County.

The second largest drainage area in the County is the area drained by Bucatunna Creek and its tributaries. The Bucatunna flows south from the Clarke County line 4 miles east of Mather-

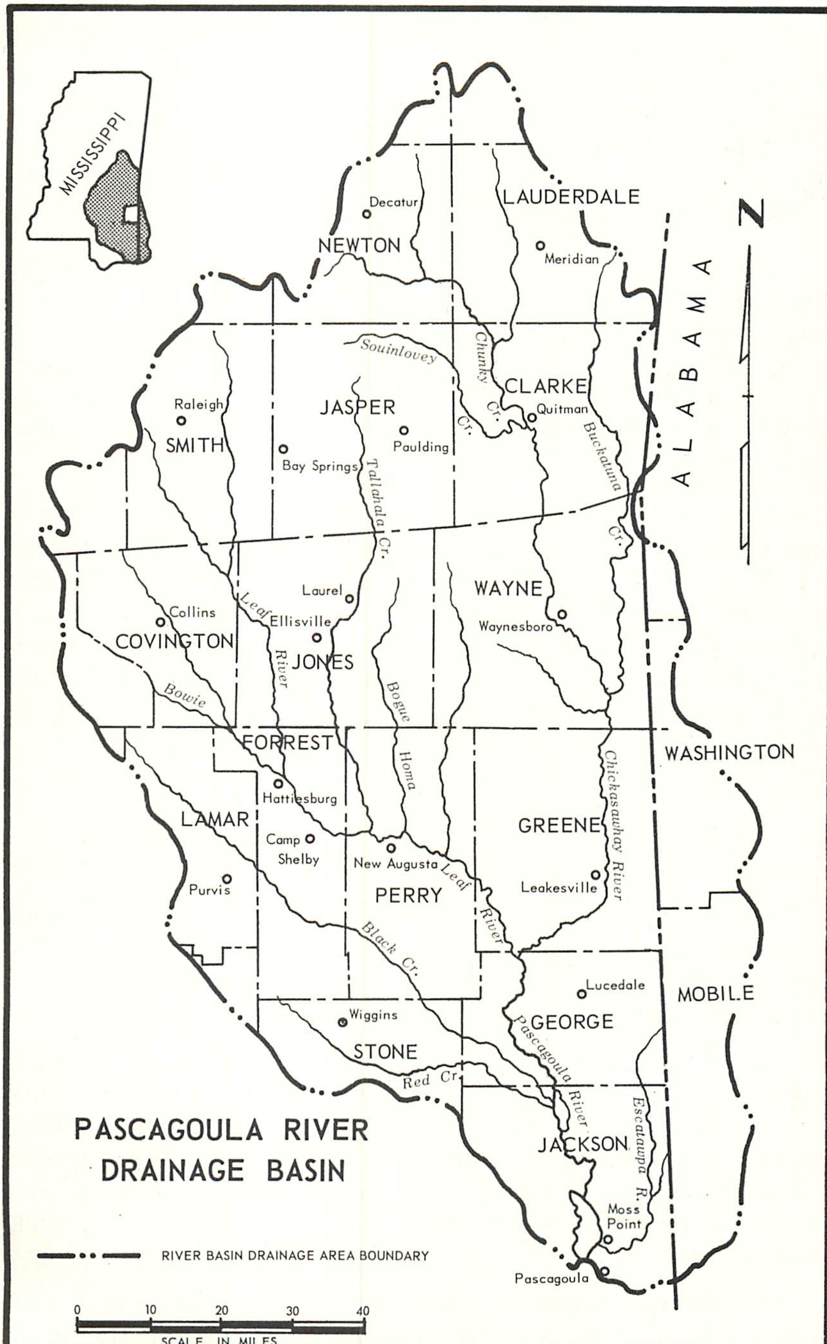


Figure 5.—Location of Wayne County in the Pascagoula River drainage basin.

ville to its junction with the Chickasawhay 2 miles south of Buckatunna. The larger tributaries entering Bucatunna Creek in Wayne County are Shiloh Creek, Dry Creek, Tick Creek, Coldwater Creek, Turkey Creek, Mill Creek, Big Red Creek, and Mongus Creek. The headwaters of Bucatunna Creek are north of Vimville in Lauderdale County.

The area drained by Thompson Creek is the smallest of the three major drainage areas in the County. Thompson Creek flows south from its headwaters southwest of Eucutta down the western side of the County and enters Perry County about 3.5 miles east of the Rhodes Community. Its major tributaries are West Little Thompson Creek, Hollis Creek, and Little Thompson Creek.

Eucutta Creek is the largest northeasterly flowing creek and drains a considerable area across the County's northern boundary. The headwaters of Eucutta Creek are formed in the southeastern corner of Jasper County. The Creek flows south and thence east in the vicinity of West Eucutta Oil Field. From there it flows northeast around North Yellow Creek Oil Field and southward into the Chickasawhay River at a point two miles northwest of Hiwannee.

SURFACE STRATIGRAPHY

GENERAL STATEMENT

The strata exposed in Wayne County are Tertiary and Quaternary in age. The Quaternary includes Recent and Pleistocene deposits, while the Tertiary includes Miocene, Oligocene, and Eocene deposits.

The stratigraphy shows the transgressive and regressive environments of the depositional material. These environments produced the varied lithologic character of the formations that crop out over the County. Figure 6 is a generalized stratigraphic section of exposed strata in Wayne County. As described in this figure, the formations are composed of sand, silt, clay, gravel, limestone, sandstone, siltstone, and marl.

The writer would, at this point, like to explain his use of the term "marl" in this report. The definition of the term "marl" is extremely varied. It is well known, however, that this

SYSTEM	SERIES	GROUP	STRATIGRAPHIC UNIT		THICK-NESS	LITHOLOGIC CHARACTER
QUATERNARY	RECENT		Alluvium		0-72'	Sand, yellowish gray to yellowish orange, fine- to coarse-grained, sub-angular to rounded quartz; argillaceous in part. Some pea gravel and organic material.
	PLEISTOCENE		Terrace deposits		0-39'	Sand, multicolored (usually various shades of orange and brown), fine- to coarse-grained, sub-angular to rounded quartz, ferruginous; quartz and chert gravel. Local clay lenses. Contains silicified wood in some areas.
			Citronelle Formation		0-100'	Sand, mostly dark yellowish orange, fine- to coarse-grained, ferruginous; clay lenses. Gravel, multicolored, quartz and chert. Banded agate, silicified wood and fossil imprinted chert are common.
TERTIARY	MIOCENE		Hattiesburg Formation		up to 48'	Clay, greenish gray to olive brown, smooth textured. Some silt and sand. Locally weathers to a ferruginous nodular clay with some induration.
			Catahoula Formation		up to 600'	Sand, brown to various shades of gray, fine- to medium-grained (channels contain pea size black chert and quartz); locally indurated near the surface. Clay, light gray, light green and moderate red (mottled), kaolinitic, micaceous, ferruginous. Silt, light gray to brown, ferruginous, argillaceous; locally indurated. Rare lignite.
	OLIGOCENE		Paynes Hammock Formation		5'-23'	Marl, olive gray to grayish yellow, fossiliferous, arenaceous, glauconitic; with alternating beds of silty to arenaceous limestone and fossiliferous clay. Some claystone ledges.
			Chickasawhay Formation		14'-42'	Limestone, olive gray to grayish yellow, fossiliferous (many fossil molds and rare silicified bone fragments), arenaceous, glauconitic; interbedded fossiliferous marls and clays.
		VICKSBURG	Bucatunna Formation		29'-102'	Clay, light to dark gray, silty to arenaceous, micaceous, carbonaceous, fossiliferous in part. Material in up-dip erosional lows includes fine- to medium-grained sand and bentonitic clays.
			Byram Formation		3'-12'	Marl, greenish gray to dark olive gray, argillaceous to arenaceous, glauconitic, fossiliferous. Fossils often have a weathered appearance.
			Glendon Formation		15'-36'	Limestone, medium gray to light olive gray, fossiliferous, pyritic, arenaceous. Very hard (limestone) ledges interbedded with gray to greenish gray marls.
			Marianna Formation		26'-47'	Limestone, light gray to yellowish gray, fossiliferous, argillaceous. Soft and more homogeneous than Glendon, with hard ledges in lower part.
			Mint Spring Formation		3'-17'	Marl, light greenish gray to dark gray, argillaceous to arenaceous, fossiliferous, glauconitic. In some places difficult to distinguish from Marianna.
			Forest Hill Formation		45'-128'	Clay, medium to dark gray, silty, carbonaceous, sparingly fossiliferous. Sandy in some localities.
			Red Bluff Formation		11'-32'	Marl, dark gray to light brown, fossiliferous, argillaceous, ferruginous; partially indurated.
	EOCENE	JACKSON	Yazoo Formation	Shubuta Clay	34'-92'	Clay, light olive gray to yellowish gray, calcareous, fossiliferous.
				Pachuta Marl	10'-30'	Marl, light gray to olive gray, fossiliferous; indurated ledges.
				Cocoa Sand	28'-62'	Sand, light gray, fine- to medium-grained, angular quartz, fossiliferous; partially indurated.
				North Twistwood Creek Clay	41'-58'	Clay, light gray to olive gray, calcareous, montmorillonitic.
			Moodys Branch Formation		7'-18'	Marl, olive gray to yellowish gray, fossiliferous, glauconitic; partially indurated.
		CLAIBORNE	Cockfield Formation		80'-114'	Clay, medium gray to dark gray, silty, lignitic, fossiliferous. Numerous grayish brown, medium-grained sand streaks.

Figure 6.—Generalized section of exposed strata in Wayne County.

term repeatedly occurs in sedimentary sample descriptions. This is especially true in southeastern geology. The writer feels that the reason this term has not been replaced by more easily definable words is because its varied meanings can be related to the varied lithologies in the Gulf Coastal Plain area. It would be somewhat misleading to describe a sample as clay, when only a few feet away it becomes calcareous sand. In keeping with the concepts of mappable units, the term marl, with correct descriptive terms, would certainly have its place. When the reader sees the term "marl", he automatically knows that he is not dealing with a unit that is homogeneous, but with one that may change within a few feet to many different percentages of sand, clay, $CaCO_3$, and other materials.

The color code used in describing samples is taken from the standard color chart of the Geological Society of America.

The Geologic Map of Wayne County (Plate 1) shows the areal extent of the outcrops of the various formations. A large part of the bedrock is covered by alluvium, terrace deposits, and soil. The formation exhibiting the largest areal distribution in the County is the Catahoula. The strata dip at an average of 38 feet per mile in a southwesterly direction. Consequently, the oldest outcropping formation is in the extreme northeastern corner of the County. The combined thickness of the strata exposed in the County is approximately 1,250 feet.

Figure 7 shows the locations of test holes drilled and cored in Wayne County. These holes were primarily for stratigraphic correlation, but many were drilled for specific economic reasons. This will be discussed in greater detail later in the section on Test Hole and Core Hole Records.

EOCENE SERIES

CLAIBORNE GROUP

Cockfield Formation

The Cockfield Formation was named by Vaughan[17], in 1895, for strata exposed near Cockfield Ferry on the Red River in Grant Parish, Louisiana. The U. S. Geological Survey prefers the term Cockfield for use in Mississippi, Louisiana, and Arkansas to replace the term Yegua which is restricted to Texas. The Alabama Geological Survey, in its reports on Choctaw and Wash-

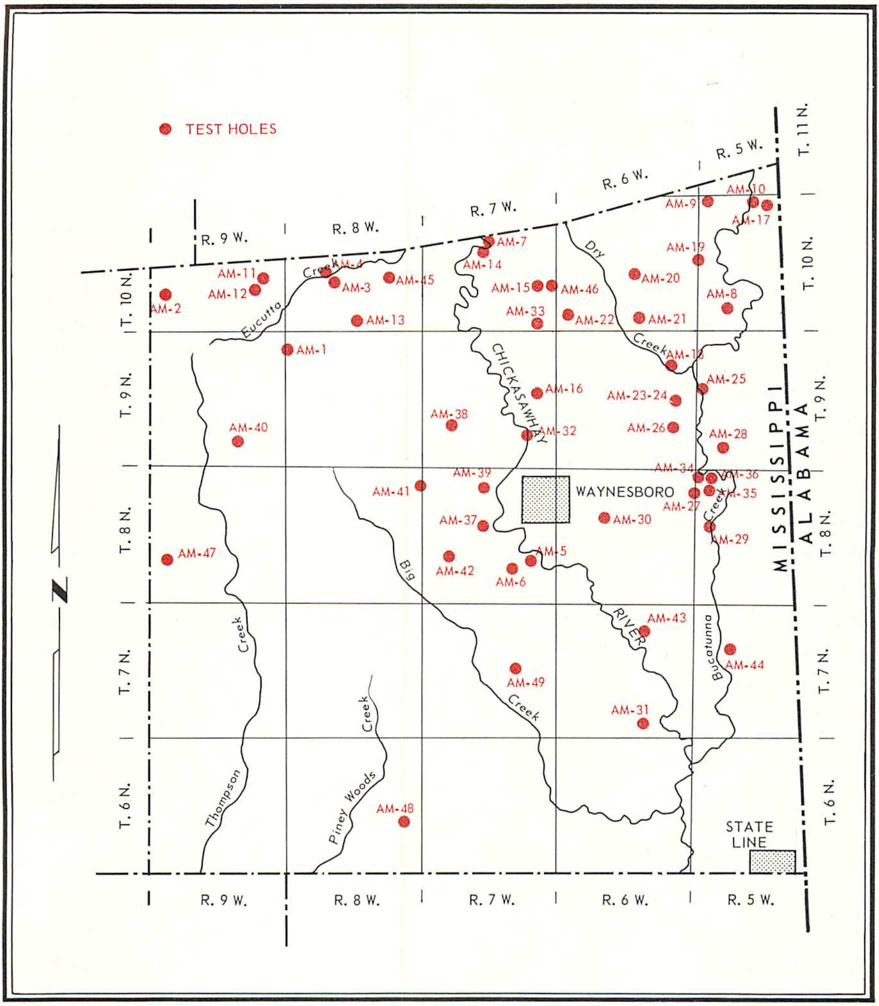


Figure 7.—-Locations of test holes in Wayne County.

ington Counties, does not use the term Cockfield. They refer to the Gosport Sand as the stratigraphic equivalent of the upper Cockfield in Mississippi.

The lithology of the Cockfield was determined primarily from cuttings and cores. Outcrop information was limited due to the small area of outcrop and the fact that much of this area lies under the alluvium of Bucatunna Creek. Several exploratory test holes were drilled and cored in this outcrop area.

Samples obtained from these test holes indicate that the lithology of the Cockfield here differs considerably from that to the northwest and southeast. In Wayne County the Cockfield consists mainly of medium-gray to dark-gray, lignitic, micaceous, silts and clays with numerous grayish-brown sand streaks. Two 12 inch thick seams of hard, brittle lignite were encountered in test hole AM-17. The lignite beds were about 165 feet below the surface. The lithology is very similar, in part, to the Cockfield described by Moore[18] in Hinds County, Mississippi, and by Baughman[19] in Ranking County, Mississippi, except for the presence of beds containing marine fossils. As stated before, the Cockfield is not recognized in Alabama where the Moodys Branch Formation disconformably overlies the Gosport Sand. A correlation chart designed by H. B. Stenzel[20] shows an interfingering of the Cockfield and Gosport near the Alabama-Mississippi state line. From the study of the Wayne County samples and from observations of the Gosport at Little Stave Creek, Alabama, the writer feels that the interfingering, as shown by Stenzel, is a reality in this area. Tourtelot[21], in 1944, discussed this sand as being present at or near the top of the Cockfield or as much as 25 feet below the top. He stated that it could be the western equivalent of the Gosport Sand of Alabama.

Mississippi Geological Survey Test Holes AM-17, AM-18, AM-19, and AM-20 all penetrated marine fossil zones in the Cockfield. Samples acquired from deep water well tests near Waynesboro, Mississippi, also confirmed the existence of these marine beds. The profusion of well preserved fossils emerging from the drill holes when these fossil zones were entered suggested a coquina-like assemblage similar to that in the Gosport at Little Stave Creek, Alabama. A typical washed sample from this fossiliferous zone can be seen in Figure 8. This sample is from a depth of 534 to 544 feet in test hole Griner-2. The predominance of well preserved fossils over clastic material indicates a coquina-like thickness exceeding that at Little Stave Creek.

The following fossils were identified from the Cockfield (Gosport tongue) :

Figure 8.—Drill cuttings from test hole located in the SW/4, NW/4, NE/4 of Sec. 13, T.8 N., R.7 W. The cuttings are from the 534-544 foot interval of the upper Cockfield Formation. This interval is similar to the Gosport Formation of Alabama. Numbered divisions are in centimeters. Photo by David T. Dockery, III. September 1973.

(1) in test hole Griner-2 from the 525-546 foot interval, the BIVALVIA-*Linga (Cavilinga) pomilia* (Conrad), 1833, *Callista* sp., and *Caryocorbula alabamiensis* (Lea), 1833; and the GASTRAPODA-*Turritella carinata* I. Lea, 1833, *Turritella ghigna* de Gregorio, 1890, *Mesalia vestusta* (Conrad), 1833, *Buccitriton* sp., *Athleta petrosus* (Conrad), 1833, and *Retusa (Cylichnina)* sp.

(2) in test hole Griner-1 from the 525-546 foot interval, the BIVALVIA-*Venericardia* sp., and *Callista* sp.; the GASTROPODA-*Calyptraphorus* sp., *Agaronia* sp.; from the 567-588 foot interval, the BIVALVIA-*Calorhadia bella* (Conrad), 1833, and *Linga (Cavilinga) pomilia* (Conrad), 1833; the SCAPHOPODA-*Dentalium* sp.; the GASTROPODA-*Turritella* sp.; from the 588-609 foot interval, the BIVALVIA-*Glycymeris* sp., *Calorhadia bella* (Conrad), 1833, *Caryocorbula* sp.; and the GASTROPODA-*Turritella* sp., *Calyptraphorus* sp., *Athleta* sp., and *Bullata* sp.

(3) in test hole AM-18 from the 270-280 foot interval, the BIVALVIA-*Nuculana* sp., *Venericardia* sp., and *Bathytormus* sp.; from the 280-290 foot interval the BIVALVIA-*Venericardia* sp., and *Caestocorbula* sp.; the SCAPHOPODA-*Dentalium* sp.; the GASTROPODA-*Turritella* sp., and *Calyptraphorus* sp.; and the ARTHROPODA-*Balanus*, sp.

(4) in test hole AM-19 from the 134 to 142 foot interval, the BIVALVIA-*Glycymeris* sp., *Nuculana* sp., *Venericardia* sp., *Bathytormus* sp., *Callista (Callista)* sp., *Spisula* sp., *Caestocorbula* sp.; the GASTROPODA-*Turritella ghigna* de Gregorio, 1890, *Mesalia vestusta* (Conrad), 1833, *Calyptraphorus* sp., *Mitrella (Columbellopsis) parva* (H. C. Lea), 1841, *Conomitra hammakeri* (Harris), 1894, *Bullata semen* (I. Lea), 1833, *Agaronia alabamensis* (Conrad), 1833, *Retusa (Cylichnina) galba* (Conrad), 1833, and *Acteon pomilius punctatus* (I. Lea), 1833; and the SCAPHOPODA-*Dentalium (Antalis) thalloides* (Conrad), 1833.

The above fossils were identified by David T. Dockery from specimens and fragments brought up in drill cuttings. Most of the fossils are typical of the Gosport in Alabama, but may also be found in other parts of the Claiborne.

Test hole records containing information about the Cockfield are AM-7, 17, 18, 19, 20, 25, and Griner-1 and 2.

The contact between the Cockfield and the overlying Moodys Branch is poorly exposed in Wayne County. In the NW/4 of Sec. 3, T.10 N., R.5 W., this contact is present, but extremely weathered. The viewing of the contact is further hampered by high level terrace sands weathering from higher elevations and covering the bedrock. A few miles northwest from this contact is another Moodys Branch-Cockfield contact located in NW/4 of Section 28, T.1 N., R.16 E., Clarke County, Mississippi, in the south bluff of Garland Creek. In test hole AM-19 the abrupt change from greenish-gray, fossiliferous, glauconitic marl to olive-gray, silty clay indicates a disconformity. This disconformity is comparable to the one seen at Riverside Park in Jackson, Hinds County, Mississippi. The contact of the Cockfield with the underlying Cook Mountain Formation is not exposed in Wayne County, but is reported by DeVries[22] to be conformable in adjoining Jasper County, Mississippi. Samples and electrical log information from holes which penetrated the contact in Wayne County yield nothing to dispute this. In test hole AM-17 a thin fine-grained sandstone ledge separated the medium dark-gray clay of the Cockfield from the olive-gray, silty, micaceous, fossiliferous clay of the Cook Mountain. As discussed previously, Cockfield-like sediments underlie fossil bearing strata which are very similar to the Gosport at Little Stave Creek, Alabama.

Moore[23] reported 550 feet of Cockfield in the southwestern part of Hinds County, Mississippi. To the southeast of Hinds County, in Jasper County, Mississippi, DeVries[24] reported a maximum thickness of 208 feet. The Cockfield thins continuously toward the southeast. The maximum thickness in Wayne County, Mississippi, is only 114 feet and at Little Stave Creek, Alabama, it is not recognized. The regional dip as shown on the cross section (Plate 4) averages about 38 feet per mile toward the southwest.

The discussion of the depositional environment of the Cockfield in Wayne County is divided into two parts. The major part of this formation was deposited under deltaic or lagoonal conditions, as indicated by the presence of lignite seams and the absence of marine fossils. The sand lenses were probably deposited when stream gradients on the deltaic plain were increased and the streams deposited coarser grained material. The stratum described in the sample descriptions of this report as the "fossil zone" of the Cockfield was deposited in a marine environment. The rounded edges of many of the fossil fragments indicate reworking of the fossils.

The outcrop belt of the Cockfield lies within the physiographic province known as the Jackson Prairie. In this area the Cockfield has very little effect on the surface topography. The major part of the outcrop area lies in the flood plain of Bucatunna Creek.

The Cockfield weathers to help form soils of the Bibb-Mantachie-Iuka association which are, "Nearly level and gently sloping, poorly, somewhat poorly and moderately well drained, loamy soils."[25]

JACKSON GROUP

Moodys Branch Formation

The Moodys Branch Formation was originally referenced as the Moodys Branch Member of the Jackson Formation by Meyer[26] in 1885. MacNeil[27], in 1946, replaced the term Moodys marl with Moodys Branch Formation. Due to the persistent character of the Moodys Branch, it is recognized from Louisiana, across Mississippi, and into Alabama. It is correlated with the lower part of the Ocala Limestone of Florida and Georgia, and lower part of the Jackson of Texas. The Moodys Branch is one of the best mapping horizons in the Tertiary section of Mississippi. The type locality for the Moodys Branch is near the intersection of Peachtree Street and Poplar Boulevard in the City of Jackson, Hinds County, Mississippi. The type locality is now on private property. The Moodys Branch can be observed at a well marked reference locality in Riverside Park in Jackson, Hinds County, Mississippi.

The lithology of the Moodys Branch in Wayne County is very similar to the lithology at its type locality in Jackson, Mississippi. It is composed mainly of olive to yellowish-gray, fossiliferous, glauconitic marl with the top three or four feet usually indurated. At the site of test hole AM-18 in SW/4 of Section 12, T.9 N., R.6 W., Wayne County, Mississippi, the Moodys Branch consisted of a four foot indurated marl ledge with fourteen feet of glauconitic, fossiliferous sand beneath. This was the thickest Moodys Branch section encountered in the County. In test hole AM-20 the Moodys Branch consisted of partially indurated, glauconitic marl. The glauconite had weathered to a light-brown color. In test hole AM-17 the grayish-olive marl was very fossiliferous and contained an abundant ostracod fauna.

Very few fossils were found on the Moodys Branch outcrop in Wayne County. The discussion of fossils will be based on those recovered from drill or core holes and those found on nearby Moodys Branch outcrops. The following is a list of fossils found in the Moodys Branch:

(1) from the Moodys Branch outcrop in the south bluff of Garland Creek in the NW/4 of Section 28, T.1 N., R.16 E., Clarke County, Mississippi the BIVALVIA-*Caestocorbula* sp., *Venericardia* sp., *Caryocorbula* sp., *Spisula* sp., *Bathytormus*

sp., *Nucula* sp., *Nuculana* sp., *Calorhadia* sp., *Callista* sp., and *Glycymeris* sp.; the GASTROPODA-*Turritella perdita, Natica* sp., *Polinices* sp., *Turritella arenicola, Agaronia media, Calyptraphorus* sp.; the SCAPHOPODA-*Dentalium (Antalis) mississippiense jacksonense* Palmer, 1947; the ANTHOZOA-*Platytrochus* sp., and *Flabellum* sp.; the FORAMINIFERA-*Lepidocyclina* sp.; and the ECHINOIDEA-*Periarchus lyelli.*

(2) in test hole Griner #1 from the 504-525 foot level, the BIVALVIA-*Chlamys* sp.; and the GASTROPODA-*Turritella* sp.

(3) in test hole Griner #2 from the 483-504 foot interval, the BIVALVIA-*Venericardia* sp.; the SCAPHOPODA-*Dentalium* sp., and *Cadulus* sp.; the GASTROPODA-*Turritella* sp., *Calyptraphorus* sp., *Ancilla* sp. (fragment), *Terebra* sp., and *Tornatellaea* sp.; and the ECHINOIDEA-*Periarchus lyelli.*

(4) in test hole AM-18 from the 260-270 foot interval, the BIVALVIA-*Nuculana* sp., and *Venericardia* sp.; the GASTROPODA-*Turritella* sp., and *Retusa* sp.; from the 270-280 foot interval the BIVALVIA-*Nuculana* sp., *Venericardia* sp., and *Bathytormus* sp.

Test hole records containing additional information about the Moodys Branch are AM-7, 9, 10, 17, 18, 19, 20, 25 and Griner-1 and 2.

Good outcrops of the Moodys Branch are rare in Wayne County because the area of possible outcrop is only several square miles. Taking into consideration the thinness of the stratum (less than 20 feet) and the covering of alluvium and terrace material, the possibility of finding a good outcrop is reduced. An outcrop of Moodys Branch is located in the NW/4 of Section 3, T.10 N., R.5 W., about 3,000 feet west of the Alabama State line. This outcrop is badly weathered and contaminated with terrace material from above.

Upon close observation the glauconite and fossil fragments are apparent. Core holes AM-9 and AM-10 were needed to confirm this outcrop as being definitely Moodys Branch. The nearest good exposure of Moodys Branch is at Garland Creek, just across the county line in Clarke County, Mississippi.

The contact of the Moodys Branch and the overlying North Twistwood Creek Clay member of the Yazoo Formation is conformable and gradational. Core holes AM-9 and AM-10 provided information concerning the lithology of the contact. Several feet above the indurated marl of the Moodys Branch, the North Twistwood Creek Clay, which is typically a light-gray, smooth textured clay, is increasingly glauconitic and grades into the fossiliferous marl of the Moodys Branch. This contact is usually easy to detect on electrical logs and is used as a mapping horizon by many geologists.

The lower contact of the Moodys Branch, however, is not easy to determine. In adjoining Jasper County, Mississippi, DeVries[28] divided the Moodys Branch into an upper and a lower member. The upper member consisted of greenish-gray, glauconitic, fossiliferous marls. The lower member consisted of stratified, lignitic, argillaceous, intercalated silts and sands with thinner interbeds of fossiliferous, glauconitic, marly sands. He discussed a break in deposition between the two members. This break was characterized by marl-filled burrows which penetrated the lower member. He interpreted the lower member as a "transition zone" between pro-deltaic deposition in the Upper Claiborne and shallow marine deposition in the Lower Jackson. In this report, the transition zone is included in the Cockfield Formation.

The writer could not make any comparison of the character of the above contacts in Wayne County due to a lack of good exposures. The writer did observe the Moodys Branch in Garland Creek in Clarke County, Mississippi. The Moodys Branch-Cockfield contact there appears to be disconformable. The lignitic Cockfield contained pockets and borings of glauconitic marl. Since the "fossil zone", or Gosport equivalent, was not observed in the Cockfield in this area, as it was downdip in central Wayne County, it could have been eroded prior to deposition of the Moodys Branch.

The thickest section of the Moodys Branch was recorded in test hole AM-18. The Moodys Branch is 18 feet thick at this locality. The thinnest section is in AM-19 where only 7 feet of sediments were assigned to the Moodys Branch.

The regional dip is to the southwest at about 38 feet per mile. The dip varies locally as seen on the structural contour map using the top of the Moodys Branch as datum (Plate 3). In some parts of the County faults have displaced the Moodys Branch.

The environment of deposition for the Moodys Branch was shallow marine. Huff[29] stated, that from a study of foraminiferal genera, it appeared that the lower part of the Moodys Branch was deposited well within the sublittoral zone of the shallow sea. His study of ostracod fauna suggested that the upper marl member of the Moodys Branch was deposited at depths exceeding those of the lower member, but not exceeding the mid-sublittoral range. The upper marl indicates a more rapid deepening of the transgressing Jackson sea.

The Moodys Branch underlies the junction of the Jackson Prairie and Vicksburg Hills physiographic regions. The outcrop area in Wayne County is very rugged, with 200 feet of relief from the location of AM-10 to the flood plain of Bucatunna Creek. Because of its limited areal extent within the County, the Moodys Branch has little influence on the overall topography.

The Moodys Branch contributes its weathered materials to three soil associations which converge in this small outcrop area. The Bibb-Mantachie-Iuka association receives the majority of the weathered material. The Vaiden-Eutaw-Sumter and Ruston-Falkner-Sweatman associations also occupy the area of the Moodys Branch outcrop belt. The Vaiden-Eutaw-Sumter is defined as, "Somewhat poorly drained, nearly level to sloping soils that have a clayey subsoil, poorly drained, nearly level soils that have a clayey subsoil, and well drained, gently sloping to sloping soils that have clayey subsoils."

The Ruston-Falkner-Sweatman association is defined as, "Well drained, gently to steeply sloping, loamy soils, somewhat poorly drained, nearly level to sloping soils that have a silty and clayey subsoil and well drained, strongly and steeply sloping soils that have a clayey subsoil."[30]

YAZOO FORMATION

Lowe[31] was the first to use the term Yazoo to designate the clays which are exposed along the Yazoo River bluffs near Yazoo City, Yazoo County, Mississippi. At this locality he described a section nearly 200 feet thick. The Yazoo is recognized as far west as Sabine Parish, Louisiana where, in 1960, H. V. Anderson[32] described a 65 foot section on Caney Creek. It is recognized as far east as eastern Alabama. In 1947, Murray[33] divided the Yazoo of Alabama and eastern Mississippi into four members:

(ascending) the North Creek Clay, Cocoa Sand, Pachuta Marl, and Shubuta Clay. In 1963, Murray formally renamed the "North Creek Clay" the North Twistwood Creek Clay.

The Yazoo Formation thins toward the east from an average of 450 feet in Hinds County, Mississippi, to an average of about 150 feet in Wayne County, Mississippi.

The Yazoo Formation crops out in the Jackson Prairie physiographic province. The Jackson Prairie has a considerably more rugged topography in this area than in central and western Mississippi. In the northeast portion of Wayne County the Yazoo crops out as a combination of clay, indurated marl, and sand. To the west of Wayne County the Yazoo is primarily composed of clay.

Major soil associations in the Yazoo outcrop area are the Vaiden-Eutaw-Sumter and the Ruston-Sweatman. The latter association is described as, "Well drained, nearly level to steeply sloping, loamy soils and strongly to steeply sloping soils that have a clayey subsoil." The Vaiden-Eutaw-Sumter association is, "somewhat poorly drained, nearly level to sloping soils that have a clayey subsoil, poorly drained, nearly level soils that have a clayey subsoil, and well drained, gently sloping to sloping soils that have clayey subsoils."[34]

North Twistwood Creek Clay Member

The type locality for the North Twistwood Creek Clay is on the west side of North (Twistwood) Creek in the SW/4, of Section 1, T.3 N., R.12 E., Jasper County, Mississippi, two miles southwest of Rose Hill on State Highway 18 to Gridley and Turnerville.

The North Twistwood Creek Clay Member is noted by DeVries as being recognizable in Jasper County, Mississippi. Moore[35] and Luper[36] found the Yazoo to be a more or less homogeneous unit in Hinds and Smith Counties, Mississippi.

This member in Wayne County, Mississippi, is composed of light- to olive-gray, calcareous glauconitic, montmorillonitic clay. The occurrence of glauconite is more frequent near the contact with the Moodys Branch. Macrofossils are usually very fragile and poorly preserved. This is probably the material that Bay[37] called sub-bentonite in his report on bleaching clays.

Huff[38] described the following ostracods as having terminal ranges in the North Twistwood Creek Member: *Cyamocytheridea hadleyi* (Stephenson), *Hemicythere* (?) *croneisi* n. sp., *Loxoconcha stavensis* n. sp., and *Paracypris licina* n. sp. Species which begin in this member and range higher are: *Absonocytheropteron watervalleyensis* Krutak, *Buntonia levinsoni* n. sp., *Cushmanidea keyserenis* Krutak, *Cushmanidea papula* Krutak, *Echinocythereis* (aff.) E. *nuda* Puri, *Hazelina couleycreekensis* (Gooch), *Loxoconcha cocoaensis* Krutak, *Loxoconcha watervalleyensis* Krutak, and *Triginglymus gnythophoreous* Krutak.

Detailed descriptions of test hole samples from the North Twistwood Creek Member are found in the records of test holes AM-7, 9, 10, 17, 18, 19, 20, 25, and Griner test holes 1 and 2.

A good outcrop of this member is located in Shiloh Creek in the SW/4 of Section 18, T.10 N., R.5 W., Wayne County, Mississippi, where approximately 40 feet of blocky, calcareous clay is exposed along the creek bottom (Figs. 9 and 10). Another

Figure 9.—Blocky North Twistwood Creek Clay in Shiloh Creek in the SW/4, SW/4 of Sec. 18, T.10 N., R.5 W. February 24, 1972.

Figure 10.—Rapids in Shiloh Creek over North Twistwood Creek Clay. SW/4, SW/4 of Sec. 18, T.10 N., R.5 W. February 24, 1972.

outcrop is in the road cut 400 feet west of test hole AM-9 in the NE/4 of Section 6, T.10 N., R.5 W. The clay here has weathered to a yellowish-gray color, but still exhibits a blocky bentonitic appearance. Another outcrop of the North Twistwood Creek Clay Member is in the banks of Bucatunna Creek north of Frost Bridge in the SW/4 of Sec. 28, T.10 N., R.5 W., where grayish-green (weathers gray) clay is exposed in the banks and channel of the creek.

The writer did not observe the contact of the North Twistwood Creek with the Moodys Branch on the surface, but samples from core and drill holes showed it to be conformable. The upper contact of the North Twistwood Creek where the Cocoa Sand grades imperceptibly into the underlying clay is not as abrupt as its lower contact.

The thickness of the North Twistwood Creek Member averages about 50 feet, as shown on the strike section B-B′ in Wayne County, Mississippi. This clay thins slightly downdip to a thickness of about 40 feet in the southwestern part of the County. The thickest section was observed in AM-18 where a thickness of 58 feet was recorded.

The North Twistwood Creek Member, according to Huff[39], was deposited in approximately the outer part of the inner sublittoral to the mid-sublittoral depth range.

Cocoa Sand Member

The Cocoa Sand was originally referenced by Cushman[40], in 1925, but was not defined until 1933 when Cooke[41] discussed deposits in Alabama and correlated it to part of the Yazoo Clay of Mississippi. The type locality is near the abandoned post office called Cocoa that once stood in the SW/4, Sec. 13, T.11 N., R.5 W., Choctaw County, Alabama.

The Cocoa is easily distinguished in central and eastern Wayne County and western Alabama. DeVries[42] mentioned, in his Jasper County report, a greenish-tan, silty clay facies at the top of the North Twistwood Creek that could possibly correlate with the Cocoa. Strike section B-B′ (Plate 4) illustrates the thickening of the Cocoa to the east.

The lithology of the Cocoa is mainly a light-gray, fine- to medium-grained, fossiliferous sand. In some areas the sand contains hard, calcareous sandstone ledges. Above the ledges there is commonly found 15 to 20 feet of clean, loose, even-grained sand which is a good aquifer. The Cocoa becomes more marine in character to the southeast.

The writer collected few fossils from the Cocoa in Wayne County.

Huff[43] identified the following ostracods as being found exclusively in the Cocoa: *Acuticythereis cocoaensis* Krutak, *Cushmanidea serangodes* Krutak, *Cushmanidea* sp. (very rare), *Pseudocytheromorpha* sp. (very rare), and *Triginglymus* sp.

Detailed descriptions of samples from this member are found in the records of test holes AM-7, 17, 18, 19, 20, 25, and Griner-1 and 2.

A good exposure of the Cocoa Member is located in the SW/4 of Sec. 18, T.10 N., R.5 W., Wayne County, Mississippi. The Cocoa here is well preserved, and several 10-inch ledges of hard sandstone are distinguishable interbedded with a compact, fossiliferous, bluish-gray sand (Figure 11). Another outcrop is

Figure 11.—Indurated ledge in the Cocoa Sand Member of the Yazoo Formation. Unweathered Cocoa underlies the ledge. The location is in the SW/4, SW/4 of Sec. 18, T.10 N., R.5 W. May 1, 1972.

located in the extreme southeast corner of Sec. 29, T.10 N., R.5 W. This locality was stop number 15 on the Mississippi Geological Society's sixth field trip in 1948.[44] The guidebook has a described section of the outcrop in this area.

At the aforementioned stop the contact between the Cocoa Member and the Pachuta Member is visible. Here the Cocoa appears as a white, clean, slightly glauconitic sand directly underlying a hard, calcareous, glauconitic ledge of the Pachuta Member. The upper and lower contacts of the Cocoa were difficult to distinguish exactly in most of the test holes due to the gradational nature of the contacts. Several contacts of the Cocoa can be observed in Choctaw County, Alabama. These are described in the Geology and Ground Water Resources of Choctaw County, Alabama.[45]

The thickness of the Cocoa varies from 28 to 62 feet within the County. The 62 foot section was drilled in test hole AM-25 located in SE/4 of Section 18, T.9 N., R.5 W., about 3 miles west of the Alabama-Mississippi state line. In this area the Cocoa makes up a major part of the Yazoo Formation, while in the northwestern part of the County it is very thin and sometimes not discernable.

Based on his study of Foraminifera and Ostracoda, Huff[46] concluded that the Cocoa was deposited in a depth range that approximates the outer part of the sublittoral zone.

Pachuta Marl Member

In 1947, G. E. Murray[47] proposed the name Pachuta marl "for 6 to 25 feet of buff, gray, or white, partly indurated, generally glauconitic, fossiliferous marl, overlain by Shubuta (Clay) Member and underlain by Cocoa Sand Member or North Creek Clay Member" (later named North Twistwood Creek).

The type locality for the Pachuta is on the south side of Pachuta Creek (possibly a tributary), 1¼ miles south and southeast of Pachuta in the SW/4, Sec. 8, T.2 N., R.14 E., Clarke County, Mississippi.

In Choctaw County, Alabama[48], the Pachuta is about 10 feet thick at the Mississippi-Alabama line and thins to about 5 feet in the south-central part of the county. This member, the "Zeuglodon bed" of early authors, consists of yellow sandy hard limestone with prints of fossils and light-gray, almost white, chalky marlstone irregularly indurated and containing white lime nodules. Bergquist[49] reported the bones of "Zeuglodon" (or *Basilosaurus*) in the Pachuta marl in Scott County, Mississippi. Monsour[50] stated that the Danville Landing beds of Louisiana are equivalent to the upper portion of the Pachuta.

In Wayne County the Pachuta consists of light- to olive-gray, fossiliferous, partially indurated marl. The fossiliferous nature of the Pachuta increases toward the southeast and in Wayne County it contains many well preserved fossils. On some outcrops the marl is hard and forms distinct ledges.

The outcrop of Pachuta near Frost Bridge in Sec. 29, T.10 N., R.5 W., contains numerous macrofossils including sharks teeth, fish vertebrae, and bryozoa. Many specimens of *Chlamys spillman* Gabb were collected by the writer. The internal cast of a chamber of a large nautiloid, *Aturia* sp., was found at this locality. Oysters (*Ostrea trigonalis*?) were also present.

The most abundant ostracod genera in the Pachuta are: *Actinocythereis, Argilloecia, Bairdia, Buntonia, Bythocypris, Cytherella, Cytheropteron, Digmocythere, Haplocytheridea, Henryhowella, Phractocytheridea,* and *Trachyleberis.* The most abundant foraminiferal genera are: *Cibicides, Globigerina, Robulus, Siphonina, Textularia,* and *Uvigerina.*

Descriptions of samples from this member are found in the records of test holes AM-7, 18, 20, 23, 25, 37, and Griner-1 and 2.

A well exposed outcrop of Pachuta is located in the NW/4 of Section 10, T.10 N., R.7 W., Clarke County, Mississippi, about six tenths of a mile north of the Wayne County line. Here the Pachuta consists of 6 feet of irregularly indurated, fossiliferous, bluish, glauconitic marl, which weathers to a yellowish-gray color. The best Pachuta outcrop that the writer observed in Wayne County is located in the SE/4 of Section 29, T.10 N., R.5 W. (Figure 12). Here the Pachuta was about 12 feet thick and

Figure 12.—Indurated Pachuta Marl in the SW/4, SE/4, SE/4 of Sec. 29, T.10 N., R.5 W. Scale is divided in feet. May 1, 1972.

was composed of soft calcareous marl with several indurated ledges. The lower ledge is very hard, glauconitic, and weathers to a light-gray color. Numerous fossils were collected at this locality.

The lower contact of the Pachuta is conformable and was described previously under the discussion of the Cocoa Sand Member. The contact of the Pachuta with the overlying Shubuta can be observed in Sec. 29, T.10 N., R.5 W., Wayne County, Mississippi. This contact is conformable, even though the change in lithology is commonly abrupt where the clay of the Shubuta overlies the indurated marl of the Pachuta.

The Pachuta, 10 to 30 feet in Wayne County, is thicker in Clarke County, Mississippi.

The Pachuta was deposited at depths from the mid-sublittoral to the inner part of the outer sublittoral zone.[51]

Shubuta Clay Member

The Shubuta was named by Murray[52] for exposures on the east side of the Chickasawhay River, north of the old U. S. Highway 45 bridge in SW/4, Section 3, T.10 N., R.16 E., Clarke County, Mississippi. He included in the Shubuta, all clays and clayey marls underlain by the Pachuta Marl and overlain by the Forest Hill Sand or Red Bluff Clay of the Oligocene.

DeVries[53] recognized the Shubuta in Jasper County, Mississippi, as varying in thickness from 100 to 216 feet and consisting of light-green, greenish-gray, calcareous to non-calcareous, glauconitic, fossiliferous, silty clays. In Choctaw County, Alabama[54], the Shubuta is 25 to 35 feet thick and resembles somewhat the North Twistwood Creek Member. The writer observed a thickness of only four feet of Shubuta at the Lone Star Quarry at St. Stephens, Washington County, Alabama. The Shubuta Clay in eastern Mississippi and western Alabama contains an abundant microfauna, which Monsour[55] believed to be equivalent in age to the Whitsett Formation of Texas.

The lithology of the Shubuta in Wayne County, Mississippi, is mainly a light-olive-gray to yellowish-gray, calcareous, fossiliferous clay. This member appears blocky on the outcrop and the fossils are often fragile and poorly preserved. It weathers to yellowish, blotchy, very sticky clays containing abundant selenite crystals and calcareous nodules. The gypsum is of a secondary nature and was formed by the chemical reaction between excess calcium carbonate and iron sulfate.

Most of the macrofossils observed in the Shubuta in Wayne County are fragile and difficult to identify in drill cuttings. Concentrations of *Flabellum cuneiforme* var. *wailesi* Conrad were observed near the top of the Shubuta in several parts of the County.

Huff[56] described the species of ostracods that terminate in the lower part of the Shubuta. These are: *Cytherella* sp., Howe and Chambers, *Cytherella* undet. sp. B., *Cytherelloidea montgomeryensis* Howe, *Eucythere aff.* E. *woodwardensis* Howe, *Hazelina conleycreekensis* (Gooch), *Loxoconcha inornata* n. sp., *Monoceratina mucronata* n. sp., and *Murrayina* sp.

The test hole records containing information about the Shubuta are AM-7, 8, 12, 18, 20, 23, 25, 37, and Griner-1 and 2.

Outcrops of the Shubuta Clay are found at the following localities in Wayne County:

(1) in the south bank of the Chickasawhay River, about 400 yards east of Illinois Central Gulf Railroad bridge, in the NE/4 of Section 16, T.10 N., R.7 W., where approximately 55 to 60 feet (hard to determine thickness due to slumping) of Shubuta Clay is overlain by the lower part of the Red Bluff Formation.

(2) in the east bank of the Chickasawhay River, about one-half mile southwest of Hiwannee, in the SW/4 of Section 28, T.10 N., R.7 W., where about five feet of massive, compact, olive-green, fossiliferous clay is exposed.

(3) west of Frost Bridge over Bucatunna Creek, in SE/4 of Section 29, T.10 N., R.5 W., where approximately 30 feet of grayish-yellow, calcareous, fossiliferous clay is overlain disconformably by terrace sands. (See test hole record of AM-8)

(4) in Sand Branch one-half mile southeast of Chaparral Church, in SW/4 of Section 18, T.10 N., R.6 W., where

the Shubuta crops out in the creek valley and weathered Red Bluff marl can be seen on the hillside 250 yards to the southeast.

The study of the contact of the Shubuta with the overlying Red Bluff was hampered by the weathered condition of most of the outcrops, and by the fact that the plastic Shubuta Clay commonly slumped, scattering Red Bluff fauna over the Shubuta below. DeVries[57], in Jasper County, Mississippi, described the contact as disconformable. In Choctaw County, Alabama[58], the light-gray Shubuta Member of the Yazoo Clay is overlain with apparent conformity by the yellowish marl of the basal bed of the Red Bluff. At stop No. 9 on the Mississippi Geological Society's Sixth Field Trip, the Red Bluff exposed in the SW/4 of Section 28, T.10 N., R.7 W., Wayne County, Mississippi, was reported to have a disconformable lower contact as indicated by the glauconite and fossil-filled borings extending into the non-glauconitic olive-green Shubuta Clay.[59]

In the writer's opinion, the latter observation concerning the evident break at the base of the Red Bluff, and the irregularity of the contact, as evidenced by numerous test holes, would indicate that the upper Shubuta contact is disconformable in the outcrop area in Wayne County.

The thickness of the Shubuta ranges from 34 to 92 feet within the study area. As mentioned previously the Shubuta thins toward the southeast to a thickness of only 4 feet in Washington County, Alabama. This is in contrast to a thickness of hundreds of feet in western Mississippi where it is believed to comprise a major portion of the Yazoo Formation.

After considering the ostracods and the foraminifers of the Shubuta, Huff decided that this clay was deposited in water depths approximating the outer sublittoral range.[60]

OLIGOCENE SERIES

Red Bluff Formation

Hilgard[61], in 1860, gave the name Red Bluff Clay to the ferruginous, fossiliferous, partially indurated marls exposed at Red Bluff on the Chickasawhay River, west of the Illinois Central Gulf Railroad bridge, 1.5 miles south of Shubuta in Wayne County, Mississippi. The writer visited this locality in 1972 and found it to be badly slumped. The Type Locality Project[62], sponsored by the Gulf Coast Section of the SEPM, gives a reference locality for the Red Bluff. It is located approximately one mile southwest of Hiwannee, along the cut bank on the east side of the Chickasawhay River, in the SW/4 of Sec. 28, T.10 N., R.7 W., Wayne County, Mississippi.

The Red Bluff Formation is recognized to the southeast as far as Little Stave Creek in Clarke County, Alabama, and to the northwest as far as Jasper and Jones Counties, Mississippi. Luper[63] thought that the Red Bluff possibly interfingered with the Forest Hill as far west as eastern Smith County, Mississippi, but careful examination of his test hole samples failed to identify any of the sediments as definitely Red Bluff material. The concept of the time stratigraphic equivalence of the Forest Hill and Red Bluff was first introduced by Cooke[64] in 1918 and later supported by MacNeil[65] in 1944. The Red Bluff is believed to correlate with the Bumpnose Limestone to the east (Fig. 13).

For the purpose of this report the writer adheres to the above concept that the Red Bluff Formation is the marine equivalent of the deltaic Forest Hill deposits in western Mississippi. On the Wayne County cross section (Plate 4), the section designated as the Red Bluff Formation is based on the 20 to 30 foot thick marine section as originally described by Hilgard[66]. This section has a distinctive resistivity kick on electrical logs and seems to be a persistent mapping horizon in the study area. It is important to remember, however, that the section designated as the Forest Hill Formation in Wayne County is considerably more marine in character than the Forest Hill to the west, and that at various intervals it contains tongues of marine material very similar to that in the specified Red Bluff Formation.

The Red Bluff is composed mainly of dark-gray to light-brown, fossiliferous, ferruginous, partially indurated marl. In certain areas, persistent yellowish-brown sideritic ledges containing numerous imprints of fossils can be traced and projected over considerable distances (Fig. 14). Another prominent feature of the Red Bluff is the presence of an olive-gray clay containing extremely well-preserved fossils, with *Spondylus dumosus* (Morton), 1834, being the most diagnostic fossil represented. The ferruginous nature of the indurated marl is not

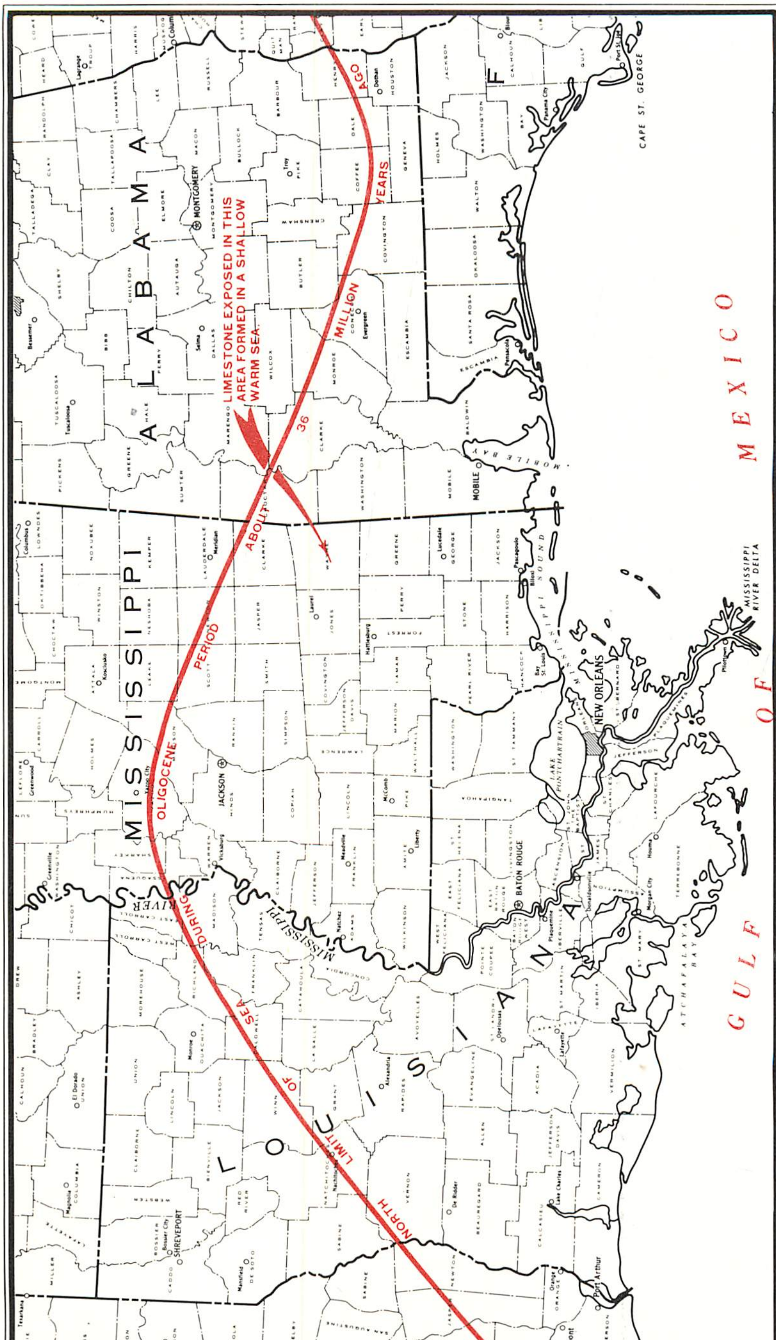


Figure 13.—Map showing extent of Oligocene sea. After E. H. Rainwater.

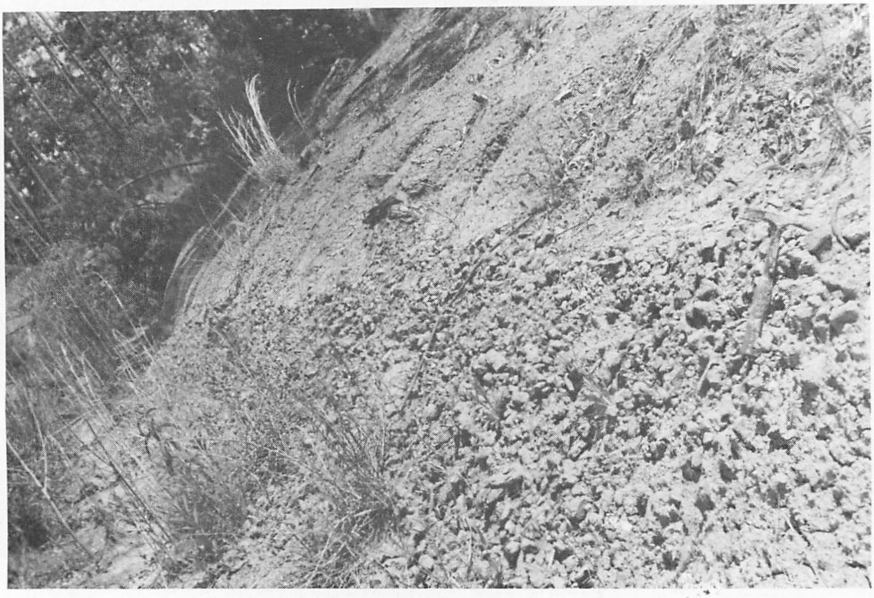


Figure 14.—Ferruginous nodules in the Red Bluff Formation. Above the rock hammer is gray clay. The location is in the NW/4, NE/4 of Sec. 13, T.10 N., R.7 W. May 17, 1972.

only observable on the outcrop, but was recorded in drill cuttings from as deep as 300 feet in the Waynesboro, Mississippi, area. The Red Bluff weathers to form unusual brown claystone concretions. Some of the sideritic concretions are very hard and when broken the pieces resemble chert, except for a lesser degree of hardness.

The exposures of the Red Bluff in Wayne County contain an excellent marine fauna. The fossils are well preserved, with some exhibiting traces of original color patterns. The identification of the mollusks was hampered by a lack of data on the Oligocene mollusks of the southeastern United States. Fossils were identified from two locations in the County (Figures 15 and 16).

From the type locality the following fossils were identified: the BIVALVIA-*Alectryonia vicksburgensis* (Conrad), 1848 var., *Chlamys* sp., *Glycymeris* sp., *Nuculana* sp., *Linga* sp.; the GASTROPODA-*Mambrinia brevidentata* (Aldrich), *Distorsio* sp., *Tri-*

Figure 15.—**Balanophyllia elongata** Vaughan, 1900, from the type locality of the Red Bluff Formation in the SW/4, SE/4, NE/4 of Sec. 16, T.10 N., R.7 W. Photo by David T. Dockery, III. September 1973. (Large divisions on scale are centimeters.)

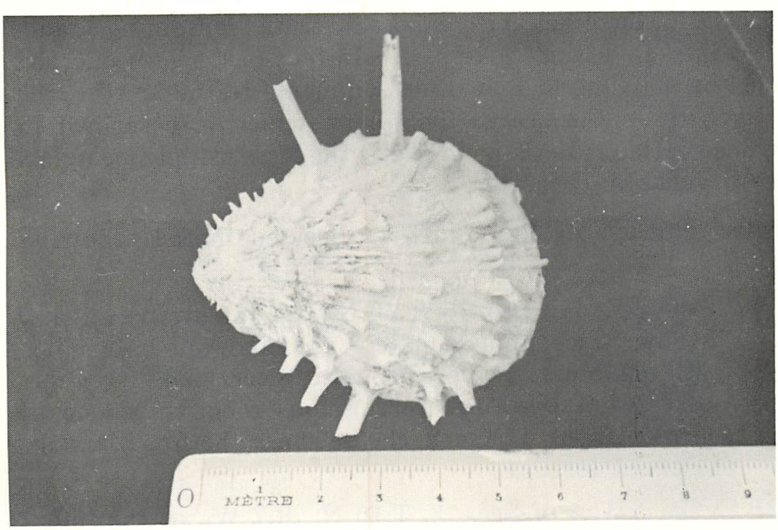


Figure 16.—**Spondylus dumosus** (Morton), 1834. Collected from the Red Bluff Formation, in a tributary of Sand Branch in the NE/4, SE/4 of Sec. 24, T.10 N., R.7 W. Photo by David T. Dockery, III. September 1973.

tiaria sp., *Busycon* sp., *Clavilithes* sp., *Fusimitra* sp., *Lyria* sp.; and the ANTHOZOA-*Flabellum* sp. (possibly from the Shubuta) and *Balanophyllia elongata* Vaughan, 1900.

The best-preserved fossils were found in the SE/4 of Sec. 24, T.10 N., R.7 W. At this locality the following fossils were identified: the BIVALVIA-*Alectryonia vicksburgensis* (Conrad), 1848 var., *Spondylus dumosus* (Morton), 1834, *Venericardia* sp.; the SCAPHOPODA-*Dentallium* sp.; the GASTROPODA-*Turritella* sp., *Distorsio* sp., *Tritiaria* sp., *Latirus (Dolicholatirus)* sp., *Scobinella* sp.; and the ANTHOZOA-*Balanophyllia elongata* Vaughan, 1900.

Descriptions of samples from this stratum are found in the records of AM-7, 12, 18, 20, 23, 25, 37, 46, and Griner-1, 2, 4, 5, 6, and 9.

The best outcrop of Red Bluff that the writer observed in Wayne County, surprisingly enough, was not at Hilgard's type locality, but about three miles to the southeast in the NE/4, SE/4, Sec. 24, T.10 N., R.7 W., where a tributary of Sand Branch is intersected by a gravel road. Hilgard's locality has been altered over the years by massive slumping. The area near this locality (Sec. 24, T.10 N., R.7 W.) has yielded much valuable information. The creek has exposed strata containing many well-preserved Red Bluff fossils. A 115-foot test hole was cored through Forest Hill and Red Bluff sediments to the level of the strata exposed in the creek. This core, which is described in sample description AM-46, is on file at the Mississippi Geological Survey in Jackson (Fig. 17).

Other outcrops of Red Bluff are located in the following areas:

(1) in the NE/4 of Sec. 16, T.10 N., R.7 W., on the Chickasawhay River approximately one and one-half miles south of Shubuta, where Hilgard[67] described "irregular masses of fine-grained ferruginous rock, embedded in a brownish or greenish clayey mass, both with well-preserved fossils."

(2) in the NW/4 of Sec. 18, T.10 N., R.7 W., at the intersection of an oil field road and the Clarke and Wayne County line, where fossiliferous sideritic clay and claystones are overlain by terrace sands and pea gravel.

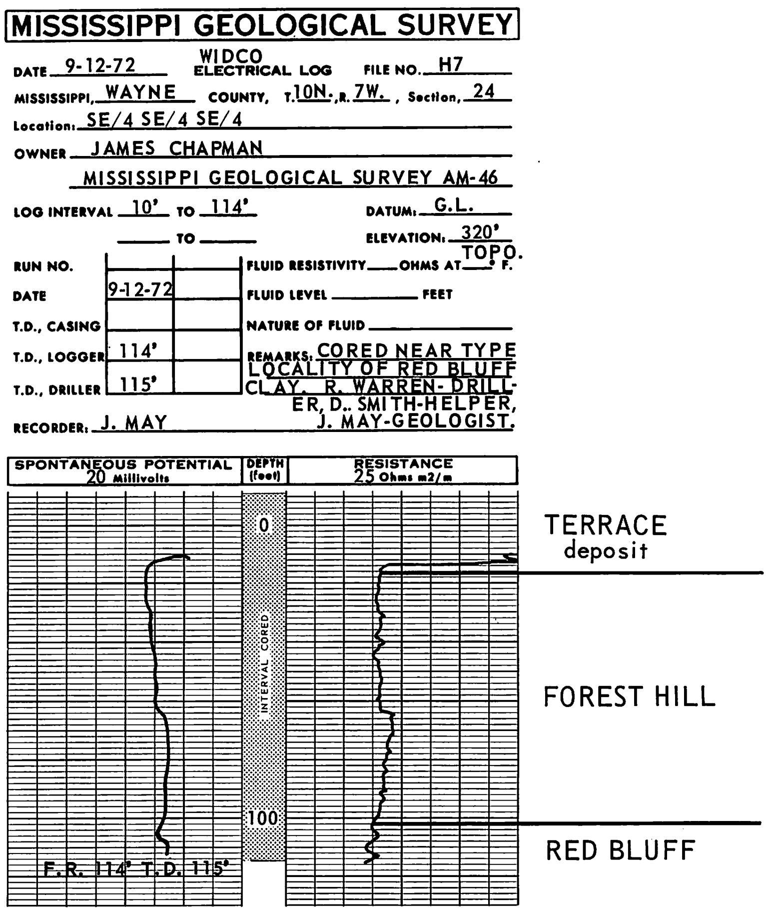


Figure 17.—Electrical log of test hole drilled near the type locality of the Red Bluff Formation.

(3) about one-half mile northwest of Chaparral Church and 300 yards north of blacktop road, at oil well test site in NE/4 of Sec. 13, T.10 N., R.7 W., where ferruginous strata containing many fossil imprints and some well-preserved fossils can be observed.

(4) near center of NE/4 of Sec. 28, T.10 N., R.7 W., on east bank of Chickasawhay River and 250 feet west of Hiwannee railway station, where several feet of con-

cretionary glauconitic clayey marls are exposed. This is Locality RBH in the Mississippi Geological Society's Sixth Field Trip Guide Book.

As mentioned earlier, the contact between the Red Bluff and the Forest Hill was penetrated by core hole AM-46. The material in this core indicated alternating environments of deposition as deltaic or swamp deposits graded into shallow marine deposits and then back to swamp deposits through several cycles. Of the above deposits the lowest and thickest partially indurated marine strata were mapped as the Red Bluff Formation by the writer. The contact of the two formations is therefore transitional in nature and the exact contact would be impractical to map due to varying degrees of interfingering in this area.

The thickness of the Red Bluff in Wayne County varies from 11 to 32 feet (Plate 4). The thickest section was near Waynesboro, in Griner test hole #5. The thinnest section was recorded in AM-20. For purposes of correlation, it should be remembered that DeVries[68] and LaMoreaux et al[69] included in their Red Bluff thicknesses some, or all, of the section that the writer has assigned to the Forest Hill in this report. The Red Bluff thins to the northwest and is not distinguishable in Smith County, Mississippi. The thickness of the Red Bluff at the Lone Star Quarry near St. Stephens, Alabama, was observed by the writer to be from 10 to 12 feet.

The depositional environment of the Red Bluff (as restricted in this report) was shallow marine.

The physiographic expression of the Red Bluff is in the province known as the Vicksburg Hills where it forms a series of hills from just south of Shubuta, in a southeasterly direction toward Sec. 32, T.10 N., R.5 W., near Bucatunna Creek.

On the General Soil Map[70] prepared by the U. S. Department of Agriculture, the soils that are shown developed on the outcrop area of the Red Bluff are those with clayey subsoils of the Vaiden-Eutaw-Sumter association.

FOREST HILL FORMATION

Lowe[71] suggested the name Madison Sands for this formation in 1915, because he had studied it in Madison County, Mississippi. It was later named the Forest Hill Sand by C. W.

Cooke[72] in 1918. The type locality is on the Jackson-Raymond Road, one-quarter mile northeast of Forest Hill School in NE/4, Sec. 22, and NW/4, Sec. 23, T.5 N., R.1 W., Hinds County, Mississippi.

E. T. Monsour[73], on his tentative Gulf Coast correlation chart, showed the Forest Hill in western Mississippi and Louisiana occupying the same stratigraphic interval as the Red Bluff in Texas and Mexico to the west, and Alabama and Florida to the east. Mellen[74], who called the Forest Hill a member of the Jackson Formation in Warren County, Mississippi, described in detail the character of the Forest Hill in that area. Moore[75] cored 51 feet of the Forest Hill at its type locality in Hinds County and found it to be composed mainly of very fine- to fine-grained, silty, micaceous sands and silty, carbonaceous clay. In western Alabama sediments similar in lithology to characteristic Forest Hill and which overlie the marine Red Bluff are usually included in the latter formation. However, at the Lone Star Cement quarry near St. Stephens, Alabama, the term Forest Hill Sand was used in the Geology of Washington County, Alabama[76], for approximately nine feet of carbonaceous, sparingly fossiliferous clay overlying the Red Bluff.

The lithology of the Forest Hill in Wayne County is similar to that described for this formation in the counties in central and western Mississippi. The main difference is the occurrence of fossiliferous lenses (marine fossils) in the otherwise dark-gray, silty to arenaceous, micaceous, carbonaceous clay. The term "Forest Hill Sand," which has been used in numerous publications, is a poor indicator of the formation's true lithology, as Bob Ainsworth[77] reported in his mineralogical and grain-size data paper published in 1967. His computed averages for Forest Hill samples collected in the Jackson and Vicksburg areas show 51 percent silt, 32 percent sand, and 17 percent clay. In Wayne County the percent of clay is considerably higher. In an analysis of samples from AM-46 the results were 4.8 percent sand, 43 percent silt, and 52.2 percent clay. The Forest Hill sediments in Wayne County are commonly very laminar (Fig. 18). When fragments are struck with a rock hammer they often break along parallel bedding planes. In many areas leaf imprints and fragments are common, and in core hole AM-46 a large piece of carbonized wood was brought up from a depth of about

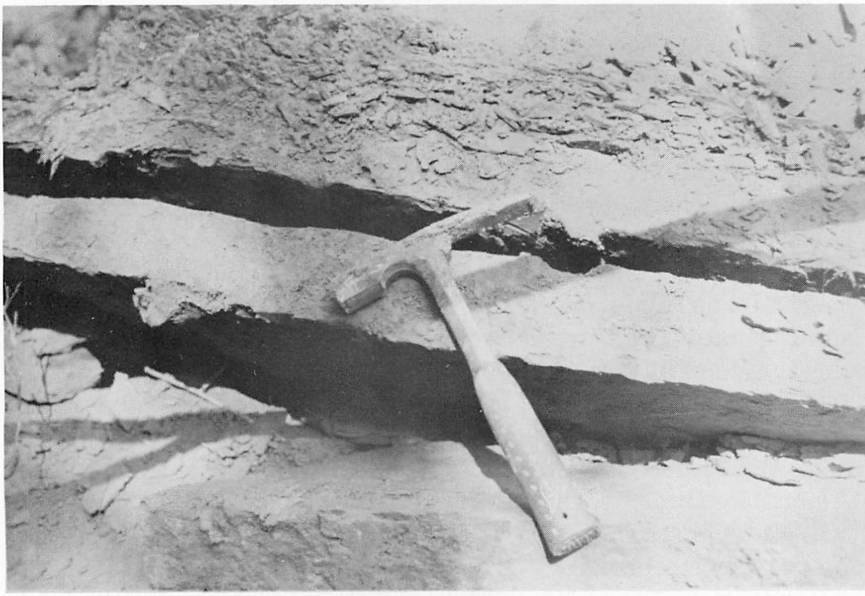


Figure 18.—Large block of Forest Hill silty clay. When struck with hammer the material parted along bedding planes. Located along Hortons Mill Creek in the SE/4, SE/4, NW/4 of Sec. 13, T.9 N., R.7 W. May 9, 1972.

70 feet. The outcrops of weathered Forest Hill usually retain their laminar appearance, but the colors vary according to the degree of oxidation and percentage of iron in the sediments. Gradational shades of reds, yellows, and browns are seen in the weathered outcrops.

Unlike the typical Forest Hill sediments in western and central Mississippi, the sediments in Wayne County contain lenses of marine fossils. Fossils were identified from two localities.

(1) In a core from AM-46 in the SE/4 of Sec. 24, T.10 N., R.7 W., the following macrofossils were identified: in the 26-26.7 foot interval *Nuculana* sp.; at 33.4 feet *Nuculana* sp. and a species in the family Turridae; at 39.5 feet *Dentalium* sp.; at 92 feet the SCAPHOPODA-*Dentalium* sp, the GASTROPODA-*Natica* sp., *Eulima* sp., *Retusa* sp., several species in the Turridae family, and echinoid fragments; at 102 feet *Eulima* sp.; and at 111 feet *Latirus* sp. and *Caestocorbula* sp.

(2) In the road cut near test hole AM-25 in the SE/4 of Sec. 18, T.9 N., R.5 W., from approximately 10 feet below the base of the Marianna, a 5-inch sand lens contained the following fossils: the BIVALVIA-*Alectryonia vicksburgensis* (Conrad), 1848, *Spondylus* sp., *Chlamys* sp., *Eburneopecten* sp., *Nuculana* sp., *Nucula* sp., *Venericardia* sp., *Timothynus* sp., *Linga* sp., *Chama* sp., *Nemocardium* sp., *Pitar* sp., *Callista* sp., *Tellina* sp., *Spisula* sp., *Vericardia* sp., *Caestocorbula* sp., *Caryocorbula* sp.; the SCAPHOPODA-*Dentalium* sp. and *Cadulus* sp.; and the GASTROPODA-*Diodora* sp., *Eulima* sp., *Natica* sp., *Calytraea* sp., *Architectonica* sp., *Turritella* sp., *Serpulorbis* sp., *Bittum* sp., *Ficus* sp., *Siphonochelus* sp., *Mitrella* sp., *Latirus* sp., *Agaronia* sp., *Cochlespira* sp., *Ringicula* sp., *Scaphander* sp., *Retusa (Cylichnina)* sp., *Mnestia* sp., *Acteocina* sp., *Acteon* sp., and *Clio* sp.

According to David Dockery, who identified the fauna, most of the specimens appeared to be immature.

Descriptions of samples from the Forest Hill are found in the records of AM-4, 12, 16, 18, 21, 22, 23, 25, 26, 29, 30, 32, 37, 46, and Griner-1, 2, 4, 5, 6, and 9.

Well-exposed outcrops are fairly common in Wayne County, but many are not easily accessible. A good exposure that can be reached with ease is located in the SE/4 of Sec. 18, T.9 N., R.5 W., on Highway 84, one-quarter of a mile northeast of the Bucatunna Creek bridge. Here the Forest Hill consists of thinly bedded, dark-gray, silty to arenaceous clay which is overlain disconformably by a thin layer of arenaceous marl, believed by the writer to be Mint Spring. Down the hill and to the northwest of this outcrop the Forest Hill has weathered to an unusual bauxitic-appearing clay. Under microscopic examination the spheroids in the clay were found to be ferruginous in nature.

Outcrops of Forest Hill were studied at the following localities:

(1) approximately 300 yards northeast of Gandy Cemetery, in the SE/4 of Sec. 21, T.10 N., R.6 W., where the Forest Hill has weathered to a light-gray clay.

(2) in the south bank of Horton's Mill Creek, approximately 250 yards north and slightly west of the center of Sec. 13, T.9 N., R.7 W., three to four feet of dark-gray, silty, thin-bedded, carbonaceous clay is overlain by one and one-half feet of Mint Spring Marl. Excellent leaf imprints were noted in the Forest Hill here (Fig. 19).

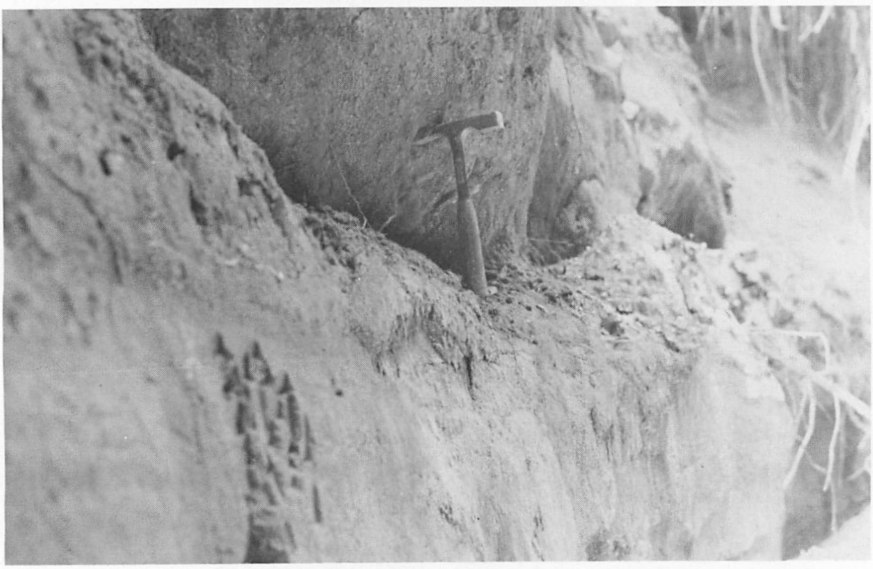


Figure 19.—Marianna-Forest Hill contact. Fossiliferous marl under hammer is similar to Mint Spring Marl. Located on Hortons Mill Creek in the SE/4, SE/4, NW/4 of Sec. 13, T.9 N., R.7 W. May 9, 1972.

(3) in the east bank of the Chickasawhay River, approximately 800 yards from the Illinois Central Gulf Railroad, in the NE/4 of Sec. 22, T.9 N., R.7 W., where laminated dark-gray clay is overlain disconformably by several feet of Mint Spring material. Well preserved fossil leaves were noted in the clay.

(4) about 300 yards south of gravel road, in SW/4 of Sec. 26, T.10 N., R.7 W., Sand Creek has exposed light- to dark-gray laminated clay. The hill to the southeast is capped by Marianna Limestone.

(5) approximately 300 yards east of asphalt road, in tributary of Dry Creek in NE/4 of Sec. 5, T.9 N., R.6 W.,

where dark-gray, thin bedded, carbonaceous clay is exposed.

(6) on gravel road one-half mile east of Hiwannee, in NW/4 of Sec. 27, T.10 N., R.7 W., clays along the road side have weathered to a bright red color.

The Forest Hill and the Mint Spring are separated by an apparent disconformity. The presence of rounded claystone pebbles and borings indicate a definite break in deposition. Another factor indicating a disconformity is the irregularity of the contact between the two formations. The description of this contact given by Mellen[78] in Warren County, Mississippi, is remarkably similar to what is present in Wayne County. Hendy[79] believed that the events which transpired at this contact were similar to those that occurred at the Moodys Branch-Cockfield contact. At the cement quarry near St. Stephens, Alabama, pockets of Mint Spring material extend into the carbonaceous Forest Hill material for one or two feet, which indicates the continuation of the disconformity in this area.

The upper contact of the Forest Hill was often hard to distinguish in drill hole samples and on electrical logs. In many of the test holes a sandy, glauconitic, fossiliferous zone was encountered under clay stratum that looked like Forest Hill. This zone was usually from 10 to 20 feet below the basal glauconitic sand and claystone pebbles of the Mint Spring. Future paleontological work might reveal if this stratum should be correlated with the Forest Hill or Mint Spring. For the purpose of this report the fossiliferous zones in the top of the Forest Hill, but underlying carbonaceous clays by more than ten feet, are included in the Forest Hill Formation. The Mint Spring could not be detected in some of the test holes because it had either pinched out or was too thin to be recognized.

The thickness of the Forest Hill varies from 45 feet to 128 feet in Wayne County. The thickest section of Forest Hill was encountered near Waynesboro in the Town of Waynesboro Test Hole #4, in the SE/4 of Sec. 11, T.8 N., R.7 W. The thinnest section was found in AM-12 in NE/4 of Sec. 26, T.10 N., R.9 W. The variable thickness of the Forest Hill is a characteristic that holds true across its outcrop belt in Mississippi. Across the state line in Alabama the Forest Hill thins abruptly. From Sec. 18, T.9 N., R.5 W., in Wayne County, Mississippi, to Sec. 33, T.7 N., R.1 W., Washington County, Alabama, it thins from over 104 feet thick to 9 feet thick. In the area of Jackson, Alabama, the Forest Hill, as described in this report, is absent.

The depositional environment for the Forest Hill in this area was one in which marine deposition alternated with periods of non-marine or estuarine deposition. MacNeil[80] mentioned a fresh-water gastropod, genus *Helisoma*, which was collected from the basal glauconitic clay at Hiwannee, as an indicator of the proximity of non-marine areas. The lignite and fossil leaf imprints are indicative of a swamp environment.

The surface expression of the Forest Hill is not as distinct in the study area as in other parts of the State. For example, Baughman[81] stated that in Rankin County, "The physiographic expression of the Forest Hill is noted by an abrupt scarp near the contact of the Forest Hill with the Yazoo." Due to changes in lithology in both the Yazoo and the Forest Hill, the physiographic change is not so abrupt in Wayne County. The area of surface expression extends roughly from three miles northeast of Eucutta to the Alabama line two and one-half miles east of Gretna. This area is included in the Vicksburg Hills Physiographic Province. The hills are frequently capped by Marianna or Terrace deposits, with Forest Hill material cropping out on the steep slopes. Where Forest Hill material forms the tops of hills, the terrain is more gently rolling.

The outcrop area lies within two soil association groups according to the General Soil map [82]. The central and western part of the outcrop area is in the Ruston-Sweatman association. The eastern area is in the Ruston-Falkner-Sweatman association. Both areas generally contain loamy soils with a clayey subsoil.

VICKSBURG GROUP

The fossiliferous strata exposed at Vicksburg, Mississippi, was referenced by T. A. Conrad[83] in 1846. In the present report the Vicksburg Group consists of the Bucatunna Formation, the Byram Formation, the Glendon Formation, the Marianna Formation, and the Mint Spring Formation. Earlier geologists thought that the Chickasawhay and Red Bluff-Forest Hill sediments should also be included in the Vicksburg Group. The writer feels that the Chickasawhay and Red Bluff-Forest Hill would fit better into the Vicksburg Stage than the Vicksburg

Group due to priorities in nomenclature. The Vicksburg Group is used as a rock-stratigraphic unit in this report, based on the original described section at Vicksburg, Mississippi.

MINT SPRING FORMATION

The original reference to this formation was by Cooke[84] in 1918. He named it the Mint Spring Marl member of the Marianna Limestone from an exposure under the waterfall on Mint Spring Bayou, near the center of Sec. 12, T.16 N., R.3 E., Warren County, Mississippi. The Mint Spring is here considered a formation since it is an established, relatively homogeneous, areally extensive, mappable horizon.

Monsour[85] recognized the Mint Spring in northeast Mexico and southwest Texas, but not in Louisiana or the remainder of Texas. He did not recognize it to the east of Mississippi in either Alabama or Florida. The Geological Survey of Alabama[86], in 1951, recognized the Mint Spring as a calcareous sand near the base of the Marianna in Mississippi and western Alabama. The one and one-half feet of marl underlying the Marianna at St. Stephens, Alabama, was described as Mint Spring. MacNeil[87] stated that the Mint Spring is the basal sand of the Marianna limestone and that all of the Mint Spring is of lowermost Marianna age.

DeVries[88] did not recognize the Mint Spring with certainty in Jasper County, Mississippi, but considered it to be locally present. Luper[89] in Smith County, Mississippi, described the Mint Spring from numerous test holes and several outcrops. In the present report the Mint Spring is considered to be a mappable unit from western Warren County, Mississippi, to eastern Washington County, Alabama. The writer feels that the Mint Spring shares a facies relationship with the Marianna. Both formations are in Wayne County because this is the transition area.

The Mint Spring is composed mainly of light-greenish-gray to dark-gray, argillaceous to arenaceous, fossiliferous, glauconitic marl. The glauconite is mostly green, but weathered samples contain brown glauconite grains. In test hole AM-16 the Mint Spring contains a considerable amount of medium-grained, subangular to subrounded quartz sand. The amount of quartz sand found in the Mint Spring seems to decrease toward the east from AM-16. As the formation thins eastward, fossils and glauconite are among the major constituents. In some cases the fossils are worn and weathered, but often the marl produces fossils in an excellent state of preservation. The molluscan fauna are often small in size.

Mississippi Geological Survey test holes that provide information about the Mint Spring are: AM-12, 15, 16, 21, 29, and 32. Additional samples from Griner test holes 6 and 8 were described.

On the property of George Rainwater, in the south bank of Hortons Mill Creek, in the NW/4 of Sec. 13, T.9 N., R.7 W., can be found about one and one-half feet of arenaceous, fossiliferous, glauconitic marl. The marl has well-preserved fossils and claystone pebbles at its base (Fig. 19).

Other outcrops of the Mint Spring Formation in Wayne County are as follows:

(1) in the east bank of the Chickasawhay River about one and one-quarter miles southwest of Boice, in the NE/4 of Sec. 22, T.9 N., R.7 W., about one foot of arenaceous marl overlies, disconformably, the dark gray, laminated clay of the Forest Hill.

(2) on Highway 84 one-quarter of a mile northeast of Bucatunna Creek bridge, in SE/4 of Sec. 18, T.9 N., R.5 W., the Mint Spring is represented by about two feet of irregularly bedded, arenaceous, fossiliferous marl. The claystone pebbles that are seen at other outcrops in this area are not visible at this locality.

The exact contact of the Mint Spring and the Marianna is often difficult to distinguish. The writer usually picked the contact in the subsurface at the base of a two to three foot ledge in the lowermost Marianna. In areas where the underlying Mint Spring is arenaceous and glauconitic this method of picking the contact seemed satisfactory. In some areas, however, the basal Marianna ledge does not persist. This fact, along with variations in the Mint Spring from arenaceous to argillaceous marl, makes picking the exact contact difficult. At visible contacts there seemed to be a gradation from one formation to the other. The gradation is more abrupt in some areas than in others. In some of the test holes the Mint Spring is not recognizable and the descriptions show the Marianna resting on the Forest Hill. It should be taken into consideration that in some of the deeper test holes the evidence of a formation which is only one or two feet thick could easily go undetected in the samples and on the electrical log.

The thickest Mint Spring encountered in Wayne County was in test hole AM-16. In this hole 17 feet of light-gray, medium-grained, fossiliferous sand was recorded. This sand is similar to the Mint Spring in central and western Mississippi, where locally it serves as an aquifer. Thicknesses of this magnitude are rare in Wayne County, where the average thickness is 3 to 6 feet. The thinnest section was studied on the Chickasawhay River in Sec. 22, T.9 N., R.7 W., where approximately a foot of marl is exposed. It is entirely probable that locally there are areas where the Mint Spring pinches out completely.

The Mint Spring was deposited in the study area under shallow marine conditions. MacNeil[90] stated, "The small molluskan fauna in the Mint Spring at St. Stephens, Alabama, contains genera, among them *Bathyarca,* suggestive of deposition in deeper water than that suggested by the fauna of surface exposures in Mississippi." In Wayne County the conditions indicate that the Mint Spring was deposited rather abruptly on the Forest Hill. The large numbers of fossil young, that were apparently buried before maturity, lend support to the above theory. As stated earlier, more detailed paleontological work would be helpful in this area.

The Mint Spring has little effect on the physiography of the region due to its small areal extent. It is usually exposed in the bank of a creek or river, or on the side of a hill that was formed by the remnants of another formation. The physiographic expression of the Mint Spring is dwarfed by the expression of the relatively massive Marianna above. The Mint Spring crops out in the Vicksburg Hills physiographic province.

From the Wayne County general soil map[91], it can be seen that areas where the Mint Spring outcrops are found are in several soil association categories. These are the Ruston-Falkner-Sweatman association and the Ruston-Sweatman association. It should be noted that the Mint Spring has a negligible effect on the soils of this area.

MARIANNA FORMATION

The Marianna, locally known as "chimney rock", was referenced by L. C. Johnson[92] in 1892. The term was applied to soft, orbitoidal limestone quarried at Marianna, Jackson County, Florida. The type locality[93] of the Marianna may be regarded as the exposures west of the Chipola River at Marianna.

The formation has not been recognized east of the Chattahoochee and Apalachicola Rivers, either in Florida or Georgia. It extends westward with remarkable uniformity across Alabama into Mississippi, where it becomes more variable[94]. DeVries[95] believed that the Marianna was only locally represented at or near the surface in Jasper County, Mississippi. Luper did not recognize it in Smith County, Mississippi. The writer considers some of the old "chimney rock" quarries in Jasper and Smith Counties, Mississippi, to be in strata that are correlative to the Marianna. MacNeil[96] stated that the Marianna is represented by a thin wedge as far west as Vicksburg, Mississippi.

Certain characteristics of the Marianna in Wayne County make it relatively easy to identify. The term "orbitoidal limestone", which is often applied to this formation, was derived from the numerous occurrences of the large foraminifera *Lepidocyclina (Lepidocyclina) mantelli* (Morton), 1834 (Fig. 20). The homogeneous nature of the Marianna is another helpful identification characteristic. On the electrical logs the softer Marianna has a decidedly lower resistive kick than the harder overlying Glendon.

The Marianna consists mainly of light-gray to yellowish-gray, argillaceous, fossiliferous limestone. The upper part of the formation is usually homogeneous, but the lower part contains indurated ledges. These ledges are not as hard as the Glendon ledges. In drilling through the Glendon and into the Marianna it was observed that the Glendon ledges required a rock bit, while the Marianna could be penetrated with a clay bit. The Marianna, although fossiliferous, did not seem to contain a large variety of well preserved fossils. The occurrences of glauconite increased in the lower part of the formation. The upper part of the formation contains a very high percentage of calcium carbonate. The lithology of the Marianna is remarkably consistent from western Wayne County, Mississippi, to St.

Figure 20.—Close view of Marianna Limestone showing large foraminifera **Lepidocyclina (Lepidocyclina) mantelli** (Morton), 1834. Location at abandoned quarry in the SE/4, NW/4, SE/4 of Sec. 16, T.9 N., R.7 W. Note hand lens. March 17, 1972.

Stephens, Washington County, Alabama. It weathers to a light-yellowish-gray.

The fossils preserved in the Marianna, although often numerous and conspicuous, represent only a small number of genera. Some of the fossils that appear consistently in the Marianna are *Lepidocyclina (Lepidocyclina) mantelli* (Morton), 1834; *Pecten perplanus poulsoni* Morton, 1834; *Alectryonella vicksburgensis* (Conrad), 1848; and *Pecten perplanus perplanus* Morton, 1833. A bryozoan that was repeatedly collected by the writer on Marianna outcrops was identified as *Metrarabdotes grande* Canu, 1920 (Fig. 21). Specimens of the echinoid *Clypeaster rogersi* (Morton), 1834, were collected from the old abandoned quarry three hundred yards south of West King Church in SE/4 of Sec. 16, T.9 N., R.7 W.

Detailed descriptions of the Marianna are found in the test hole records of Holes AM-12, 15, 16, 21, 22, 23, 26, 29, 30, 32, 27, and Griner Test Holes 1, 2, 4, 5, 6, 7, and 9.

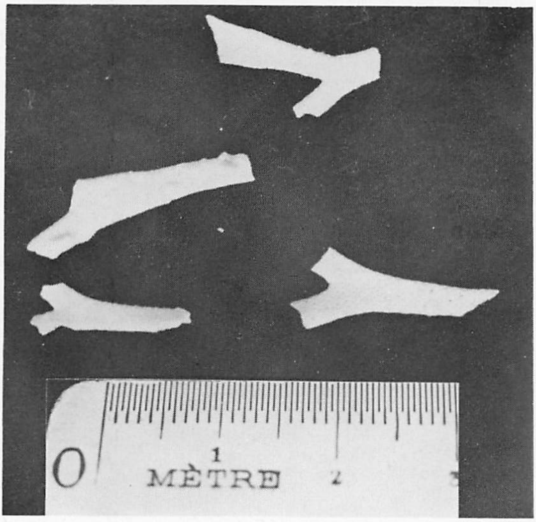


Figure 21.—**Metrarabdotes grande** Canu, 1920. Collected in the NE/4, NE/4, NE/4 of Sec. 12, T.9 N., R.7 W. Very common in the Marianna Formation. Photo by David T. Dockery, III. September 1973.

Well exposed outcrops of Marianna are common in Wayne County. One of the more spectacular outcrops of this formation is along the Chickasawhay River where Limestone Creek flows under the Illinois Central Gulf Railroad bridge, in the NE/4 of Sec. 26, T.9 N., R.7 W. Here approximately 40 feet of Marianna are exposed under prominent ledges of Glendon limestone. This was the most massive outcrop of Marianna observed by the writer (Fig. 22).

Impressive outcrops of Marianna are located in two areas in Sec. 16, T.9 N., R.7 W. In the southeast quarter of the section, about 300 yards south of West King Church, is an old abandoned agricultural limestone quarry (Fig. 23). In the northeast quarter of this same section a new agricultural lime quarry is presently in operation.

Other outcrops of Marianna were observed at the following localities:

(1) on a gravel road, about 200 yards west of Hortons Mill Creek, in the NW/4 of Sec. 7, T.9 N., R.6 W., where

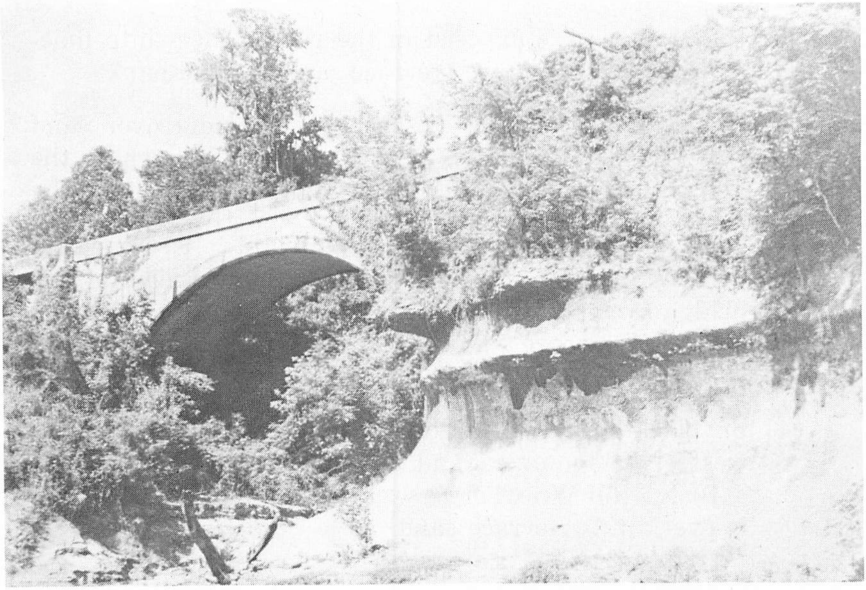


Figure 22.—Marianna underlying Glendon at Illinois Central Gulf railroad bridge where Limestone Creek enters the Chickasawhay River in the SW/4, SE/4, NE/4 of Sec. 26, T.9 N., R.7 W. June 2, 1972.

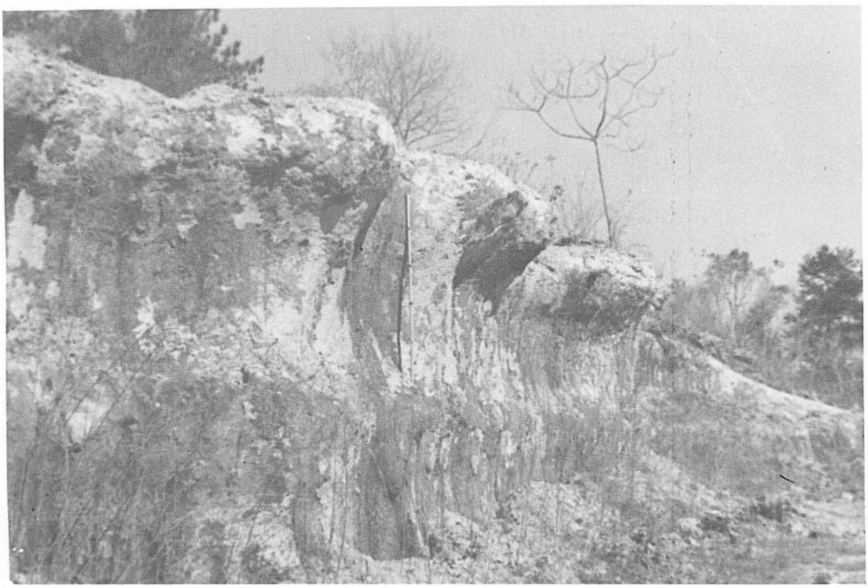


Figure 23.—Marianna Limestone overlain by Glendon Limestone at abandoned agricultural lime quarry in the SE/4, NW/4, SE/4 of Sec. 16, T.9 N., R.7 W. March 17, 1972.

the Marianna is exposed in the road. The white limestone is overlain by red terrace sand on road bank.

(2) approximately 350 yards southeast of bridge over Sand Creek, in SW/4 of Sec. 26, T.10 N., R.7 W., where the Marianna forms a cuesta-like hill with local dip to the southeast.

(3) on Highway 84, one quarter of a mile northeast of the bridge over Bucatunna Creek in SE/4 of Sec. 18, T.9 N., R.5 W., where 35 to 40 feet of Marianna are exposed in road cut.

(4) on blacktop road, approximately one-half mile southwest of bridge over Sand Branch, in SE/4 of Sec. 32, T.10 N., R.6 W., where a weathered Marianna outcrop is overlain by terrace sand.

(5) in Bucatunna Creek, at bridge crossing 200 yards southwest of center of Sec. 30, T.9 N., R.5 W., where 30 to 40 feet of Marianna can be observed underlying alluvium.

(6) 900 yards south of Eucutta Creek, on old Indian Treaty Boundary, in SE/4 of Sec. 23, T.10 N., R.8 W., where 30 to 35 feet of Marianna are overlain by weathered Glendon ledges.

(7) about 200 yards south of the Clarke-Wayne County line and 400 yards east of Bogue Flower Creek, in SE/4 of Sec. 17, T.10 N., R.8 W., where a section of weathered Marianna can be observed on the hillside.

The contact of the Marianna with the overlying Glendon is usually easy to determine. On the outcrop, the hard crystalline Glendon stands in sharp contrast to the softer, more homogeneous, Marianna below. The hard ledges of the Glendon characteristically exhibit what is known as "horsebone weathering" features. The weathering produces fragments containing large tubular cavities. These fragments often resemble the pelvic bones of large animals. As stated earlier, the harder, more dense Glendon is easily differentiated from the Marianna on electrical logs. MacNeil[97] stated that in western Mississippi it is difficult to draw a lithologic boundary between the two.

The upper contact of the Marianna, however, is not always with the Glendon. Locally the Byram and Glendon formations have been eroded, and the Bucatunna rests disconformably on the Marianna. Descriptions of this type of contact can be seen in the records of test holes AM-16 and AM-23. The Marianna shows the results of erosional channels in its area of outcrop, but downdip the disconformity either doesn't exist, or is not as apparent. Where the Glendon and Marianna were not subjected to erosion, the contact is conformable.

Another distinctive characteristic of the Marianna and Glendon contact is the occurrence of solution cavities between the two formations.

Caves are formed in the Marianna with the lowest indurated ledge of the Glendon serving as the roof. Some of these caves will be discussed in detail later in the report.

The thickest section of Marianna was encountered in test hole AM-12 located in the NE/4 of Sec. 26, T.10 N., R.9 W. Forty-seven feet of Marianna were described at this locality. This thickness is unusual because the Marianna characteristically thins to the west. AM-12 is in the northwest part of the County just north of the Eucutta Oil Field. As seen on Plate 2, this area has undergone structural deformation, which could possibly account for the unusually thick Marianna section. The thinnest section described was in test hole AM-16. Here the Marianna was channeled and filled in with Bucatunna sediments. Throughout the County the thickness is in the 30 to 45 foot range. In the NE/4 of Sec. 1, T.8 N., R.4 W., Washington County, Alabama, 40 feet of Marianna are exposed. At St. Stephens, Washington County, Alabama, an estimated 47 feet of Marianna were observed.

The depositional environment of the Marianna was in marine waters that were deeper than the shallow marine waters that received the Mint Spring sediments.

The Marianna, because of its thickness, has considerable influence on the physiography of the area where it crops out in Wayne County. The Marianna outcrop belt lies in the physiographic province known as the Vicksburg Hills. It underlies hills in an arcuate band from the vicinity of Eucutta, southeast approximately one mile north of Waynesboro, through the area of the Gretna community, and into Alabama. Where the overlying Glendon has been weathered away, the Marianna forms gently rolling hills. In areas where the Glendon is still in place the topography is mostly rugged, with the Marianna cropping out from hillsides and deep gullies. In Sec. 26, T.10 N., R.7 W., hills capped by lower Marianna have beds that dip to the southeast. The strike of these hills forms a conspicuous lineation along Sand Creek toward a right angle turn in the Chickasawhay River (Sec. 4, T.9 N., R.7 W.). This lineation could be the surface expression of faulting.

The weathering of the Marianna contributes to several soil association groups. They are the Ruston-Falkner-Sweatman association and the Ruston-Sweatman association[98].

CAVES OF THE MARIANNA

From time immemorial caves have intrigued and fascinated man. Caves have evoked feelings of security and fear. Primitive men often sought the warmth and protection found within the mouths of caves. However, they rarely ventured past the point where the light of day failed to penetrate. They feared the dark unknown mysterious world of the inner cave. This same feeling of fascination drives today's scientist and spelunker to wriggle and squirm their way into the subterranean world of the cave.

Mississippi does not have many surface formations that are suitable for the development of caves. Outcropping limestone formations of the right homogeneity and thickness are rare throughout the State. The Marianna Formation which crops out in Wayne County is, however, suitable for the development of caves. This formation, well-known in Florida for its beautiful caverns, contains the best-developed limestone caves in Mississippi.

The best known, and probably the most extensive, cave in Wayne County and the State is Pitts Cave. This cave has two entrances 50 yards apart and an estimated 1,200 to 1,300 feet of passageways. Many of the passageways are partially filled with water and mud which makes access difficult. The temperature in the cave is a fairly constant 67°F. Numerous speleothems are present in the cave such as stalactites, stalagmites, columns, flowstone and rimstone pools. The fauna includes crayfish, salamanders, and bats. The north entrance is 15 feet wide by 10 feet high and the south entrance is 18 feet wide by 12 feet high (Figures 24 and 25).

Figure 24.—John Carter Cave. Photo by Frederic F. Mellen. October 1973.

The details of the caves discussed in this section were obtained from David R. Williamson[99], a member of the Staff who has done extensive exploration of Mississippi caves. Some of the cave dimensions are based on estimates.

Another cave in the area is Jim Tom Cave. The entrance to this cave is 12 feet wide and 4 feet high. The cave consists of one 75 foot passageway ending in two rooms, one above the other, the larger of which is 10 feet wide, 12 feet long, and 8 feet high. This cave is not as well known as Pitts Cave and is therefore in a better state of preservation.

John Carter Cave is another Wayne County cave that is not very well known. Its 150 to 200 feet of passageway contain some interesting and relatively undisturbed cave formations. It is the most interesting and most easily explored cave that the writer visited during the study. Beautiful rimstone pools are of prime interest.

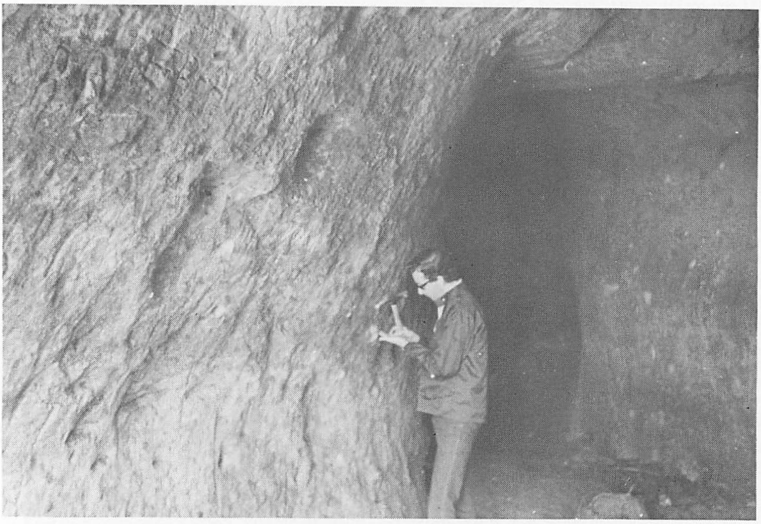


Figure 25.—Pitts Cave. November 1972.

The locations of the above caves have been omitted. Any responsible person wishing to visit these caves can obtain the needed information from the Geological Survey's office in Jackson. People visiting the caves are urged to respect the uniqueness and delicate nature of the cave environment. What took nature 35 million years to create can be destroyed in a few careless minutes.

People wishing to visit the caves should acquire the permission of the person on whose property the cave (or caves) is located.

Glendon Formation

The term "Glendon Limestone" was first proposed by C. W. Cooke[100] in a report written for the Mississippi Geological Survey. In this report, which was never published, he considered the Glendon to be a member of the Marianna Limestone. O. B. Hopkins[101], in 1917, published a description of the Glendon, at which time he gave Cooke credit for the original description. The type locality for the Glendon is at Glendon Station, Alabama, on the Southern Railroad between Jackson and Walker Springs in the southern half of Sec. 31, T.7 N., R.3 E. A reference section is located at the Lone Star Cement Quarry near St. Stephens, Alabama.

In this report the Glendon will be referred to as a formation in the Vicksburg Group.

For correlation purposes, it should be remembered that the Geological Survey of Alabama considers the Glendon to be a member of the Byram Formation. In Mississippi the Byram Formation, along with the Glendon and Bucatunna Formations, is included in the Vicksburg Group. The Byram Formation, as used by the Mississippi Geological Survey, probably correlates with the "unnamed marl member"[102] in Washington County, Alabama. In the vicinity of Marianna, Florida[103], the Glendon is about 18 feet thick and has undergone secondary dolomitization. In Warren County, Mississippi, an average thickness of 42.3 feet of Glendon was recorded by Frederic F. Mellen[104]. Toward the west from Wayne County, the correlation of the Glendon and the underlying Marianna becomes more difficult. The writers of Mississippi Geological Survey bulletins on counties from Smith County westward to Warren County do not recognize the Marianna. It is concluded by the writer that the lithology of the Marianna changes to such a degree, from east to west, that differentiation was not possible without a detailed faunal study. It is also assumed, that if any strata correlative to the Marianna do exist in areas west of Jasper County, they are included in the pertinent bulletins under the Glendon Section, or in some cases the Mint Spring. Toward the east in Conecuh and Covington Counties, Alabama, the Glendon becomes more uniformly indurated and difficult to differentiate lithologically from the Marianna.[105]

The unweathered Glendon usually appears as a medium-gray to light-olive-gray, fossiliferous limestone. Hard ledges of limestone are interbedded with gray to greenish-gray marl. The weathered Glendon is commonly yellowish-gray. At many of the outcrops weathered exposures of Glendon have a waterworn appearance. The fragments often exhibit holes and cavities (Fig. 26). This characteristic, known locally as "horsebone weathering," is not restricted to the Glendon. It is, however, so common in the area of Glendon outcrops that it is a prevalent term in much of the literature about the Glendon (Fig. 27). When badly

Figure 26.—Cave under Glendon ledge. March 30, 1972.

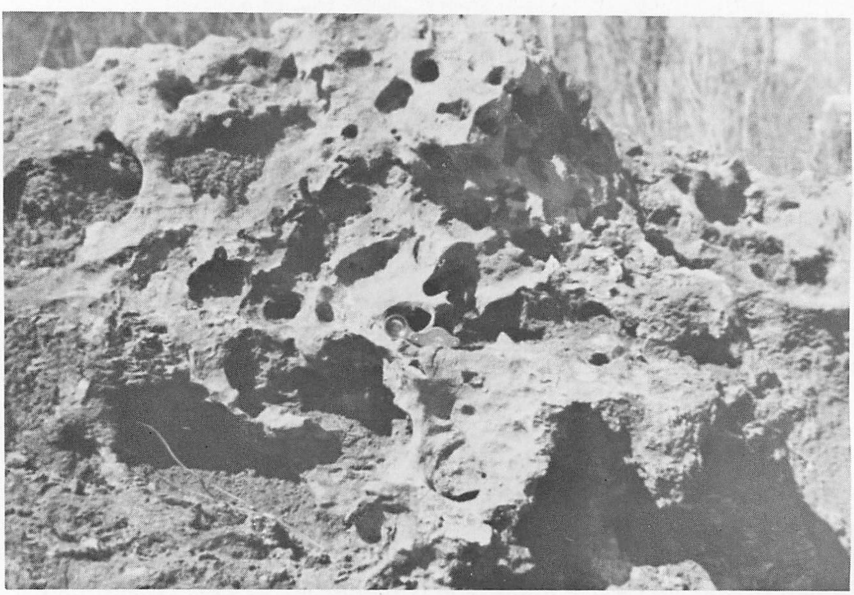


Figure 27.—Close view of weathered Glendon limestone in SE/4, NW/4, SE/4 of Sec. 16, T.9 N., R.7 W. Note hand lens. March 17, 1972.

weathered the Glendon has the appearance of brown montmorillonitic clay.

In the study area the ledges in the Glendon are composed of hard, semi-crystalline, fossiliferous limestone. There are characteristically three or four of these hard ledges in the Glendon. These ledges consistently show more resistance on electrical logs than the underlying Marianna. Resistivity of the Glendon ledges is sometimes 100 Ohm m^2/m higher than the resistivity of the Marianna. As mentioned earlier, the use of a hard rock bit was necessary to penetrate the Glendon ledges (Fig. 28). The top of the uppermost ledge was used as datum for the Glendon structure map.

Figure 28.—Glendon ledges overlying Marianna on the east bank of the Chickasawhay River in the NE/4 of Sec. 26, T.9 N., R.7 W. Photo by Edwin E. Luper. January 17, 1971.

To the west of Wayne County, beds of bentonite have been reported between ledges of the Glendon. Luper[106] stated that bentonite was being mined in September of 1972 near Lorena, Smith County, Mississippi, in the SE/4 of Sec. 19, T.4 N., R.8 E. He also stated that the bentonite appeared to be resting on Glendon, but insufficient excavation prevented a thorough study of its depositional characteristics. In Wayne County the bentonite occurs on an erosional surface that in some areas extends below the Glendon, and into the Marianna. Bay[107] stated that the Wayne County bentonite is the same age as the commercial grade bentonite in Smith County. If this is true, the writer feels that it would be an interesting study to compare the limestone ledges above the bentonite to the west with the Chickasawhay overlying the bentonite in Wayne County. The writer believes these ledges could be correlative. No bentonite was noted in the Glendon from test hole samples in Wayne County.

Fossils that are characteristic of the Glendon are: *Alectryonella vicksburgensis* (Conrad), 1848; *Pecten perplanus poulsoni* Morton, 1834; *Pecten perplanus byramensis* Gardner, 1945; *Lepidocyclina supera* (Conrad), 1865; and *Clypeaster rogersi* (Morton), 1834.

Henry Howe[108] described the fauna of the Glendon at its type locality in Alabama. His informative report was published in the Journal of Paleontology in 1942.

Information concerning the Glendon can be found in the test hole records of AM-1, 2, 3, 11, 12, 13, 26, 27, 28, 29, 30, 32, 35, 37, 38, 42, 44, 45, 47, and 49. Additional information is in the records of Griner test holes -1, 2, 4, 5, 6, 7, and 9.

Two interesting outcrops of Glendon are located just north of Waynesboro along the Chickasawhay River. One of the outcrops is at the point where Yellow Creek and Sand Creek converge and discharge into the Chickasawhay River, in Sec. 35, T.9 N., R.7 W. Here about 4 feet of bluish-gray, hard, dense, crystalline limestone can be seen when the river is low. The upper surface is very uneven and the overlying marl fills the hollows. The other outcrop lies about 2 miles northeast of the aforementioned exposure where the Illinois Central Gulf Railroad bridge spans Limestone Creek, in Sec. 26, T.9 N., R.7 W. The Chickasawhay River flows in the direction of formational dip between the two above localities. By boat, it is possible to maintain an almost continuous view of the Glendon between the two points. Going up river (updip) the Glendon crops out increasingly higher in the river bank. At the Limestone Creek railroad bridge the Glendon ledges are 50 to 60 feet above the water level.

Outcrops of Glendon were observed at the following localities:

(1) 350 yards south of West King Church (abandoned), in the west side of the old agricultural limestone quarry, in the SE/4 of Sec. 16, T.9 N., R.7 W., where about 15 feet of hard, honeycombed limestone overlies the Marianna. The present quarry is operating northeast of here where there is little overburden and the operators can quarry directly into the soft Marianna.

(2) 900 yards south of Eucutta Creek along the old Indian Treaty Boundary, in the SE/4 of Sec. 23, T.10 N., R.8 W., where weathered Glendon is overlain by light-brown bentonitic clay.

(3) on a ridge 400 feet south of Eucutta Creek, in the extreme NW/4 of Sec. 29, T.10 N., R.8 W., the Glendon is exposed as weathered limestone boulders on the hillside.

(4) a quarter of a mile east of the Illinois Central Gulf Railroad and 30 feet south of gravel road (on section line), in the NE/4 of Sec. 23, T.9 N., R.7 W., weathered honeycombed limestone ledges are visible on the hillsides.

(5) in a railroad cut of the Illinois Central Gulf, in the NE/4 of Sec. 26, T.9 N., R.7 W., the Glendon displays an unusual laminated appearance and contains a prominent non-horizontal ledge (Fig. 29).

(6) in the south bank of Turkey Creek at bridge for county gravel road, in the NE/4 of Sec. 31, T.9 N., R.5 W., ledges of hard, fossiliferous, eroded Glendon are exposed under the bridge at this locality. Glendon is apparently displaced about 50 feet from that in AM-26.

(7) a quarter of a mile northeast of Highway 84 bridge over Bucatunna Creek, in the SE/4 of Sec. 18, T.9 N., R.5 W., weathered boulders of Glendon are scattered on hillside over good Marianna outcrop.

The contact of the Glendon and the overlying Byram appeared to be conformable in most of the test holes that penetrated it. In some cases the Byram is very thin or non-existent. Where

Figure 29.—Unusual attitude of ledge in Glendon Formation in the SE/4, NW/4, NE/4 of Sec. 26, T.9 N., R.7 W. October 6, 1973.

the Byram has eroded the upper contact of the Glendon is with Bucatunna. This is the case at the outcrop in the SE/4 of Sec. 23, T.10 N., R.8 W. A light-brown bentonitic clay is overlying the Glendon. If any Byram is present it is represented by a thin layer of fossiliferous marl that could not be differentiated from weathered Glendon. Test hole AM-45 was drilled about 300 yards southeast of the above outcrop. The Byram was not identified in this hole. The Bucatunna rests unconformably on the Glendon. This unconformable condition was noticed in several areas along the outcrop belt of the Byram and Glendon.

The Glendon-Byram contact was placed at the top of the uppermost Glendon ledge. The Glendon-Marianna contact was placed at the base of the lowest Glendon ledge. Both contacts were conformable except where erosion had altered them prior to deposition of the Bucatunna. Both contacts were easily detectable on electrical logs and while drilling.

The thickness of the Glendon varied from 15 to 36 feet in Wayne County. The 36 foot thick section was drilled in Waynesboro in the NW/4, SW/4, SW/4, Sec. 1, T.8 N., R.7 W., in Griner

T.H. #6. The Glendon here is composed of yellowish-gray, fine-grained, hard, limestone ledges, and soft, dark-gray, fossiliferous marl. The Byram marl was not recognizable in this test hole. The thinnest section was drilled in the NW/4 of Sec. 25, T.9 N., R.6 W. At this locality the Glendon consists of light-olive-gray, hard, fossiliferous limestone ledges and olive-gray, silty, fossiliferous marl. Here the Glendon is overlain by 4 feet of dark-gray marl. Throughout the County the thickness of the Glendon is usually within the range of 20 to 25 feet.

The Glendon was deposited in a shallow marine environment. MacNeil[109] stated that a much sharper faunal break exists between the Marianna and the Glendon in western Alabama than in the vicinity of Vicksburg, Mississippi. He stated that a more continuous deposition took place around Vicksburg than in eastern Mississippi, where a short period of non-deposition followed the deposition of the Marianna. This could explain the easily detectable lithologic break between the Glendon and the Marianna observed by the writer in Wayne County and western Alabama.

The highest hills in Wayne County are found along the area of the Glendon outcrop (Plate 2). In the SW/4 of Sec. 13, T.10 N., R.9 W., the highest elevation in the County (480 feet ASL) was recorded. To the southeast in the Eucutta Creek Valley the Glendon is exposed. The Glendon does not cap the hills in the outcrop area, but is exposed on their steep slopes. From the above location the physiographic expression of the Glendon can be traced in a southeasterly direction to the Alabama line east of Gretna. Along the outcrop area several hills with elevations in excess of 400 feet have Glendon exposures on their slopes. The Glendon in test hole AM-26 is about 50 feet higher than in AM-28. These holes are along the formational strike and the variation is believed to be the result of faulting.

In local areas the Glendon has influenced the surface by forming a karst topography. In the SW/4 of Sec. 35, T.9 N., R.7 W., three sinkholes are shown on the Waynesboro quadrangle topographic map. One sink is approximately 200 feet wide and 400 yards long. The sinks were most likely caused by the collapse of Glendon ledges which were serving as the roofs of subterranean caves.

Material from the weathered Glendon is found in several soil association groups. In the northwestern and central portions of the County the weathered Glendon contributes to the Ruston-Sweatman association[110]. Ir the northeastern portions the Ruston-Falkner-Sweatman association receives the weathered Glendon.

Byram Formation

The original reference to the Byram was by T. L. Casey[111] in 1902. He placed the Byram Marl in the Vicksburg Group, but at a lower stratigraphic position than the Glendon. In 1943, C. W. Cooke, Julia Gardner, and W. P. Woodring[112] described the Byram Limestone as being made up of (ascending) the Glendon Limestone, Byram Marl, and Bucatunna Clay Members. The type locality for the Byram is on the west bank of the Pearl River in the S/2, NW/4, NW/4, Sec. 19, T.4 N., R.1 E., Hinds County, Mississippi.

In this report the Byram is considered to be a formation in the Vicksburg Group. The lower boundary is picked at the top of the uppermost Glendon ledge. The upper boundary is picked at an arbitrary point where the marine marl grades into the sands and clays of the estuarine Bucatunna deposits. This interpretation is based on the description of the Byram at its type locality near Byram, Mississippi.

As discussed previously, the Alabama Geological Survey's term "Byram Formation" does not correlate with the Byram Formation in Mississippi. In Alabama, the Byram contains the Bucatunna, an "unnamed" marl, and the Glendon as members. The "unnamed" marl correlates with Mississippi's Byram Formation. The Glendon and Bucatunna Formations of Mississippi are referred to as the Glendon and Bucatunna Members in Alabama. The Byram, as restricted by the present writer, can be traced from Vicksburg, Mississippi, to St. Stephens, Alabama. The term "Byram" has been correlated westward into Louisiana and Texas and eastward into Florida. Due to the varied meanings of the term, the writer assumes that these correlations would not necessarily apply to the Byram Formation of this report.

In Wayne County the Byram consists of greenish-gray to dark-gray, argillaceous to arenaceous, glauconitic, fossiliferous marl. In outcrop areas the marl typically has a weathered or leached appearance. The fossil fragments are commonly worn and rounded. No indurated Byram was observed on the surface in Wayne County, but electrical logs indicate that the Byram is more resistive in certain downdip areas. A consistent feature of the Byram in Wayne County was the presence of a foraminiferal zone near its base. This zone can be observed in the core from test hole AM-36. This core was taken near the type locality for the Bucatunna Formation and is on file at the Mississippi Geological Survey office in Jackson. The lower Byram contains a thick concentration of foraminifera. The foraminifers have a weathered appearance, as do the other fossil fragments from this interval. In AM-36 the foraminiferal bed is 2.4 feet thick. Apparently this same zone was described by MacNeil[113] as a basal foraminiferal marl in Smith County, Mississippi.

In many areas of Wayne County the Byram had been eroded prior to deposition of the Bucatunna. The erosional features were observed in updip areas of the Byram. Downdip the Byram was found to occupy its correct stratigraphic level. The Byram was observed to be thinner in Wayne County than in western Mississippi. The Byram weathers to a light-brown to reddish-brown arenaceous clay.

The discussion of Byram fossils collected in Wayne County is limited because of the small number of good collecting sites. The following fossils were collected near West King in the SW/4 of Sec. 15, T.9 N., R.7 W.: *Lepidocyclina supera* (Conrad), 1865; *Pecten perplanus byramensis* Gardner, 1945; *Dentalium (Antalis) mississippiense* Conrad; *Latirus protracta* (Conrad). The above fauna were collected at an elevation of about 250 feet (topographic map).

A few fossils were identified from core AM-36 which came from near Dyess Bridge, in the NE/4 of Sec. 6, T.8 N., R.5 W. The fossils at this locality show signs of weathering or of being reworked. The fossils identified were: *Camerina* sp.; *Lepidocyclina* sp.; oyster fragments (probably *Alectryonella vicksburgensis* (Conrad), 1848); and *Pecten perplanus byramensis* Gardner, 1945. These fossils came from a depth of 53.1 to 56.9 feet. The surface elevation is 200 feet (topographic map).

Test hole records containing descriptions of Byram samples are: AM-1, 2, 3, 11, 12, 13, 26, 27, 28, 35, 36, 37, 42, and 49.

Outcrops of Byram are difficult to locate in Wayne County. The marl deteriorates easily because of its softness and thinness of stratum.

The Byram can be seen at a point 500 yards south of the Chickasawhay River bridge at Woodwards, in the NE/4 of Sec. 3, T.8 N., R.7 W., Wayne County, Mississippi. Here the Byram consists of dark-olive-gray to greenish-gray, finely argillaceous marl. Abundant foraminifera are contained in the marl. The overlying Bucatunna contains well preserved leaf imprints.

North of the Woodwards bridge, where the converged Yellow and Sandy Creeks flow into the Chickasawhay River, is another Byram exposure. This locality is in the SW/4 of Sec. 35, T.9 N., R.7 W. The Byram overlies indurated Glendon ledges that extend below the water level of the river. The marl, which appears to be reworked, fills hollows in the uneven surfaces of the Glendon ledges.

Badly weathered Byram is exposed in the SW/4 of Sec. 15, T.9 N., R.7 W., about one-half mile east of the old West King Church. Weathering has exposed many Byram fossils. Many of the fossils are in a good state of preservation. The writer found this to be one of the better fossil collecting areas for Byram macrofossils in the County.

An outcrop in the NE/4 of Sec. 23, T.10 N., R.8 W., would require more detailed paleontological study to determine if the weathered marl exposed there is the Byram or interbedded marl within the Glendon.

The Byram-Bucatunna contact, as observed in core AM-36, was conformable and gradational. The highly fossiliferous Byram grades upward into the sparingly fossiliferous Bucatunna. The rounded fossil fragments in the Byram suggest local reworking of the sediments. The Bucatunna in the Waynesboro area fills erosional channels that extend down into the Marianna. For this reason, the writer feels the Bucatunna could rest unconformably on the Byram in certain instances. The marls that are interbedded with the limestone ledges in the Glendon are similar to the Byram. Where, due to erosion, the Bucatunna rests on a Glendon marl bed this could be mistaken for a Byram-Bucatunna contact. The Byram-Bucatunna contact was not observed on the surface.

The Glendon-Byram contact was also penetrated in core hole AM-36. The contact at this locality appeared to be conformable. As stated above, the similarity of the marl interbeds in the eroded Glendon with the marl of the Byram makes interpretation of contacts in the study area very difficult.

The thickest section of Byram drilled in Wayne County was in the SE/4 of Sec. 20, T.8 N., R.7 W. Test hole AM-42 penetrated 9 feet of greenish-gray, fossiliferous, silty marl at a depth of 320 feet. The Byram was overlain by 90 feet of clay assigned to the Bucatunna. The thinnest section of Byram drilled was in the SW/4 of Sec. 6, T.9 N., R.8 W., at a depth of 159 feet. Test hole AM-1 sampled 3 feet of Byram overlain by 32 feet of Bucatunna. Electrical logs from oil well tests indicate as much as 12 feet of Byram.

The environment of deposition for the Byram was shallow marine. The rounded fossil fragments encountered in many of the test holes could indicate the possibility of a shoreline environment.

The Byram in the study area has little effect on the overall topography. It underlies the physiographic province known as the Vicksburg Hills.

Along with other formations in the Vicksburg Group, the Byram contributes weathered material to soils of the Ruston-Sweatman association in the north-central and northwestern part of the County, and to the Ruston-Falkner-Sweatman association in the northeastern area.[114]

Bucatunna Formation

The name Bucatunna was first applied by B. W. Blanpied[115] and other members of the Eleventh Annual Field Trip of the Shreveport Geological Society (1934). The exposures chosen for the type locality are along Bucatunna Creek, north of Denham Post Office (abandoned), in Sec. 19, T.8 N., R.5 W., Wayne County, Mississippi. The Bucatunna can be observed from a point one-half mile upstream from Dyess Bridge (near test hole AM-36 in the NE/4 of Sec. 6, T.8 N., R.5 W.) to a bend in Bucatunna Creek 800 feet northeast of the center of Sec. 8, T.8 N., R.5 W.

Blanpied[116] assigned the Bucatunna to the Miocene on the basis of the erosional break at its base. The break, however, is not continuous along the area of the Bucatunna outcrop. The Bucatunna, in this report, is considered to be the youngest formation in the Vicksburg Group. It is easily recognized from Warren County, Mississippi, to central and eastern Alabama. In Alabama, although it is considered Oligocene in age, it is reduced to the rank of member in the Byram Formation. The Byram Formation in Alabama is equivalent to the Bucatunna, Byram, and Glendon Formations in Mississippi, as previously stated.

The Bucatunna in Wayne County has an extremely varied lithologic character. Generally, it is composed of light- to dark-gray, silty to arenaceous, micaceous, carbonaceous, fossiliferous clays. Material deposited in updip erosional lows includes fine- to medium-grained sand and bentonitic clays.

Water well drillers in the Waynesboro vicinity are familiar with a sand stratum in the Bucatunna that is used as a fresh water aquifer. The water supply for Waynesboro is taken from this aquifer, which is known locally as the "Waynesboro Sand." From information obtained from water well and oil well tests and correlated with Mississippi Geological Survey test holes, a general idea of the nature of this interesting sand body was derived. The sand was deposited as channel sands from a large stream in the approximate area of the present Chickasawhay River valley. This is in agreement with W. J. Hendy[117], who stated, "A fairly large stream in the general vicinity of the present Chickasawhay River eroded a surface well down into the Marianna in an area centering approximately two miles west of the common corner of Townships 9 and 10 N., and Ranges 6 and 7 W. Areas to the east of here also were eroded at this time. Contemporaneously, lignitic silts, clays, and some fine sands seem to have been deposited downdip." Descriptions and thicknesses of these sands in the Bucatunna can be found in the test hole and core hole records section.

Bentonitic clays were also deposited on an erosional surface that apparently extended down into the Marianna. In test holes AM-16 and 24 bentonitic material assigned to the Bucatunna is resting on weathered Marianna limestone. The clay in test hole AM-24 has the textural and swelling properties of high grade bentonite. The bentonitic clays were observed in outcrops and test holes from the SW/4 of Sec. 24, T.10 N., R.9 W., southeastward to the area of Dyess Bridge on Bucatunna Creek, in the NE/4 of Sec. 6, T.8 N., R.5 W. This area corresponds to the general outcrop area of the Bucatunna Formation in Wayne County. Most of the bentonite studied contained a large percentage of silt and other detritus. The bentonite will be discussed in more detail under the section on Economic Geology.

Another characteristic sediment contained in the Bucatunna is a dark-gray, carbonaceous, sulfurous clay. The results of a chemical test from this type material obtained from test hole AM-11 indicated a sulfur content of 5.37 per cent. The most abundant clay mineral in this sample is montmorillonite. It also contains small amounts of mica and kaolinite (Clay report).

The Bucatunna commonly has a laminated appearance, with some of the thin sand layers containing macrofossils. The Bucatunna was cored near its type locality. This core (AM-36) indicated an upper fossiliferous zone, a thick middle zone with rare fossils, and a lower zone with fossils increasingly numerous (Figures 30-31).

Most of the Bucatunna fossils are thin and fragile; however, some identification was possible. The core from the type locality yielded the following fauna: from a depth of 12 feet, *Terebra* (probably *Terebra divisura* Conrad); at 13.7 feet, *Nucula* sp., occurring in sandy glauconitic partings; at 14 feet, Bryozoa, *Pecten perplanus byramensis* Gardner, 1945, *Nuculana* sp., *Dentalium (Antalis) mississippiense* Conrad, *Turritella* sp., and otoliths.

Test hole records containing descriptions of the Bucatunna are test holes AM-1, 2, 3, 11, 12, 13, 16, 23, 26, 27, 28, 29, 30, 32, 35, 36, 37, 38, 42, 44, 45, 47, and 49. Griner Test Holes are G-1, 2, 4, 5, 6, 7, and 9.

A very important outcrop of the Bucatunna in Wayne County is at the type locality. The brown laminated clays of the Bucatunna are visible below the Dyess Bridge over Bucatunna Creek, in the NE/4 of Sec. 6, T.8 N., R.5 W. Approximately one-half mile west of Dyess Bridge the contact of the Bucatunna and the overlying Chickasawhay is exposed. The Bucatunna is visible in the banks of the creek for several miles downstream.

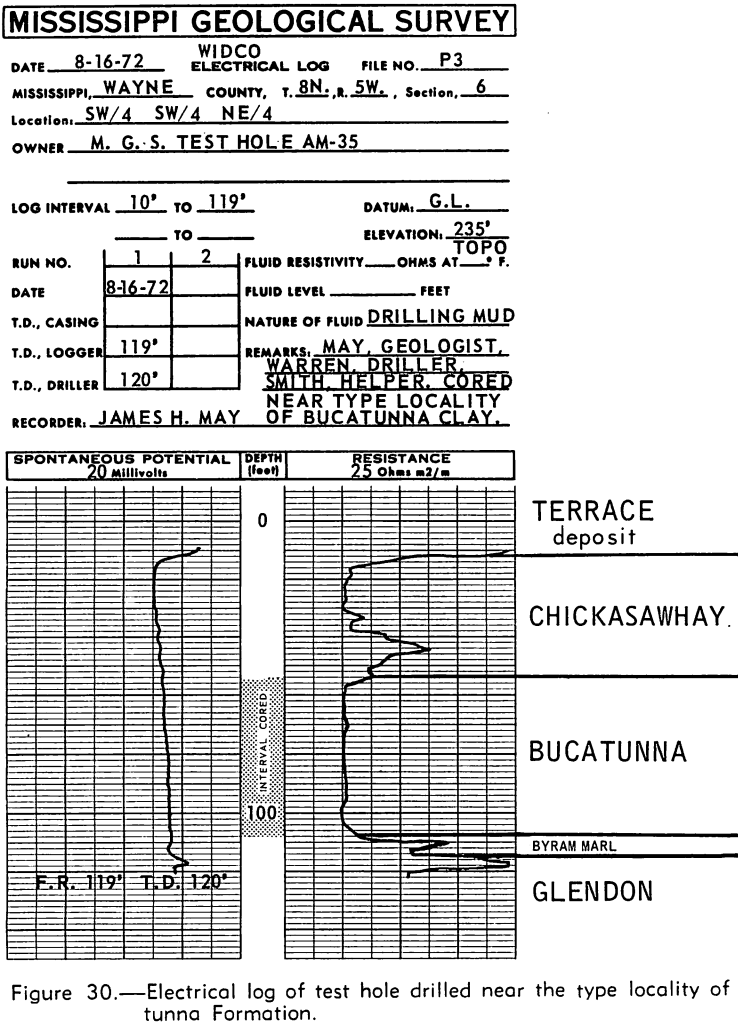


Figure 30.—Electrical log of test hole drilled near the type locality of the Bucatunna Formation.

Other outcrops of Bucatunna can be observed at the following localities:

(1) along the roadside, about 350 yards east of intersection, in the SE/4 of Sec. 32, T.9 N., R.5 W., the Bucatunna has weathered to a light-gray, blocky clay.

(2) in the ditch along a gravel road, about one-half mile northwest of small bridge over Bucatunna Creek in the NE/4 of Sec. 25, T.9 N., R.6 W., a light, grayish-yellow,

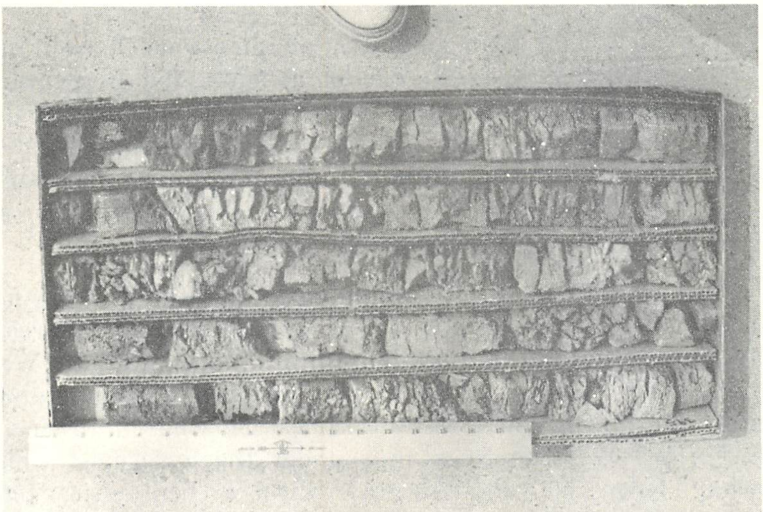


Figure 31.—Bucatunna core with laminae visible. Cored near the type locality in the NE/4 of Sec. 6, T.8 N., R.5 W. Photo by David T. Dockery, III. September 1973.

bentonitic clay is exposed. Information from test hole AM-26 placed the bentonitic clay in the stratigraphic horizon of the Bucatunna.

(3) in ditch along a gravel road, one-half mile west of the old Tokio community, in the SE/4 of Sec. 14, T.9 N., R.6 W., bentonitic clay similar to that above is overlain by Chickasawhay ledges.

(4) one-quarter mile east of intersection, in the SE/4 of Sec. 12, T.9 N., R.7 W., laminated gray clay and fine sand can be seen in road ditch. The clay is blocky and has a bentonitic appearance.

(5) on oil field road, one-half mile north of paved road, in vicinity of old Indian Treaty Boundary, in the NE/4 of Sec. 23, T.10 N., R.8 W., 5 feet of yellowish-gray, fine-textured, bentonitic clay is exposed behind oil well site. AM-45 was drilled on the hill to the southeast.

(6) in Sugar Hill Creek valley, 40 feet northwest of gravel road, in the SW/4 of Sec. 24, T.10 N., R.9 W., dark-gray,

lignitic clay is overlain by yellowish-gray bentonitic clay.

(7) about 400 yards northwest of Limestone Church, in the NW/4 of Sec. 24, T.9 N., R.7 W., the Bucatunna is represented, in part, by a fine- to medium-grained, crossbedded sand. This sand occupies the stratigraphic interval of the eroded Glendon. The sand rests on the Marianna and is probably correlative with the sand which supplies Waynesboro with water.

The contact of the Chickasawhay and the Bucatunna is rarely visible on the surface. The writer viewed only one reasonably unweathered Chickasawhay-Bucatunna contact in Wayne County. This contact is located at the intersection, approximately 300 yards northwest of Limestone Church in Sec. 24, T.9 N., R.7 W. The Bucatunna under the lowermost Chickasawhay ledge is yellowish-gray with a bentonitic, blocky appearance. Other reported contacts have weathered to a point where they are not recognizable. The writers of the Sixth Field Trip Guidebook of the Mississippi Geological Society[118] discussed pockets and borings at the top of the Bucatunna as being indicative of a disconformity. Due to weathering of the contacts, the present writer could not adequately distinguish the borings. However, the writer did observe an apparent erosional channel at the top of the Bucatunna in the limestone quarry at St. Stephens, Alabama.

The lower contact of the Bucatunna is disconformable in many areas along its outcrop belt in Wayne County. Because of the highly eroded surface on which the Bucatunna was deposited, it rests disconformably on three formations. These formations are the Byram, Glendon, and Marianna. Where erosion had not taken place prior to deposition of the Bucatunna, the Bucatunna-Byram contact appears to be conformable. Evidence of faulting and some displacement was observed in these "pre-Bucatunna" eroded areas. This will be discussed in more detail in the section on Structural Geology.

It can be observed from the dip-section (Plate 4) that the Bucatunna thickens downdip. Test holes AM-47 and AM-49 were located to penetrate farthest downdip of all the Mississippi Geological Survey test holes. AM-47, which was located in the

SW/4 of Sec. 20, T.8 N., R.9 W., penetrated 74 feet of medium- to dark-gray, lignitic, micaceous, fossiliferous clay. Along strike to the southeast, AM-49 penetrated 102 feet of mostly dark-gray, silty carbonaceous clays and some thin fossiliferous sand streaks. The thinnest section of Bucatunna drilled was in the NE/4 of Sec. 29, T.9 N., R.7 W. Here AM-38 revealed 29 feet of dark-gray, silty, lignitic, pyritic, calcareous clay.

The Bucatunna was deposited in a variety of environments. The channel sands in the vicinity of Waynesboro were deposited as a result of a large stream. The lignitic clays and fossiliferous, glauconitic streaks indicate an estuarine environment. The bentonitic clays are believed to be the altered products of volcanic ash. The purity of the bentonite is variable. Some of the ash probably fell on the land surface and was consequently mixed with detritus before it reached its final resting place. Portions of the ash could have settled in deeper quieter water and remained relatively uncontaminated. This may have been the situation with the clay in core hole AM-24. Downdip the depositional environment, as observed from samples, was estuarine to shallow marine.

The physiographic effects of the Bucatunna are difficult to determine. As discussed earlier, the Bucatunna thins considerably near its outcrop area. Where the overlying Chickasawhay has weathered away, the Bucatunna soon becomes unrecognizable. Also, the outcrop area is overlain by younger high level terrace deposits which often cover the Bucatunna. Where the Bucatunna-age sands ("Waynesboro"-local) crop out, they are hard to distinguish from the more recent terrace sands.

The Bucatunna contributes weathered material to soils of the Ruston-Sweatman association in the north-central and northwestern part of the County, and to the Ruston-Falkner-Sweatman association in the southeastern area of outcrop.[189]

CHICKASAWHAY FORMATION

The name Chickasawhay was applied to marine beds overlying the Bucatunna by B. W. Blanpied[120] and other members of the 1934 Shreveport Geological Society's Eleventh Annual Field Trip. They divided these beds into an upper and a lower Chickasawhay Member. MacNeil[121] later defined the Chickasawhay as being only the strata previously called the lower Chickasawhay Member of the Byram. He renamed the upper Chickasawhay Member the Paynes Hammock Sand. The Chickasawhay Formation of this report is equivalent to MacNeil's lower Chickasawhay Member. The type locality for the Chickasawhay is located in the NE/4 of Sec. 25, T.9 N., R.7 W., from the Highway 45 bridge over Limestone Creek, south to the top of the hill. During the period of the current survey this outcrop was not visible due to weathering and undergrowth. Because of the condition of the type locality, the writer would like to suggest a reference locality for the Chickasawhay. The reference locality is in the NW/4 of Sec. 10, T.8 N., R.7 W., below the Highway 84 bridge, on the west side of the Chickasawhay River. This is near the location of test hole AM-39 (Fig. 32).

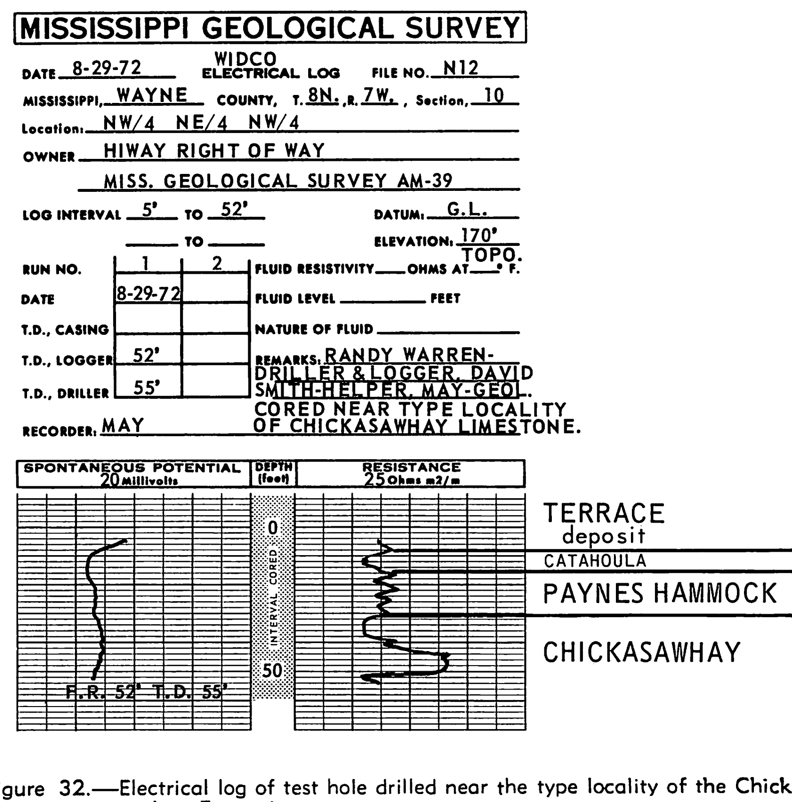


Figure 32.—Electrical log of test hole drilled near the type locality of the Chickasawhay Formation.

The Chickasawhay Formation was sampled by the writer in an area extending from the extreme northwest corner of Wayne County to a limestone quarry at St. Stephens, Alabama. Poag[122] correlated the Chickasawhay on the basis of planktonic foraminifers. He stated, "foraminifers of Chickasawhay (as well as Paynes Hammock) age occur in the upper part of the Suwannee Formation and basal portion of the Chattahoochee Formation of northern Florida, the subsurface Frio Formation of Texas and Louisiana, and the Alazan and portions of the Meson, Palma Real, and Huasteca Formations of Mexico." The Chickasawhay is considered to be of Oligocene age in the present report, primarily because the majority of paleontological evidence supports this conclusion.

The Chickasawhay is composed of olive-gray to grayish-yellow, fossiliferous, argillaceous to arenaceous limestone and interbeds of bluish-green, fossiliferous marls and clays. In core hole AM-39 the lowermost ledge of the Chickasawhay was a very hard, glauconitic limestone containing numerous fossil molds (Fig. 33). Ledges containing fossil imprints, rather than

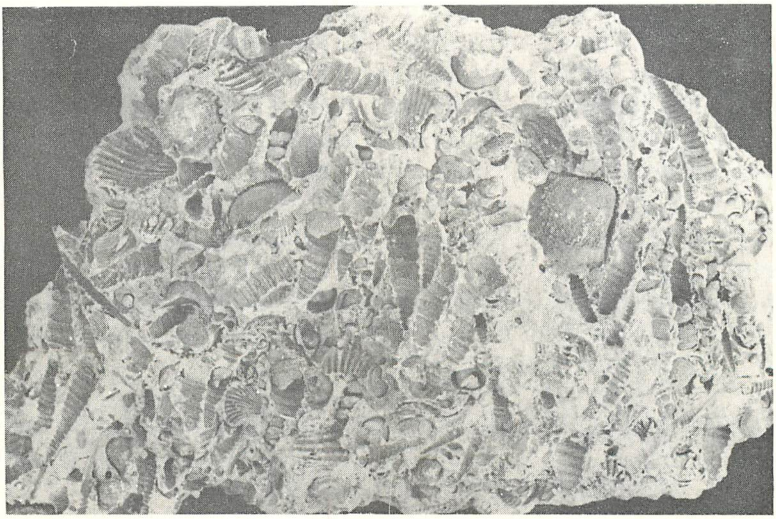


Figure 33.—Fossil imprints, internal and external molds, in Chickasawhay Limestone. Collected in the SE/4, SW/4, NW/4 of Sec. 8, T.8 N., R.5 W. Photo by David T. Dockery, III. September 1973.

original material, are characteristic of the Chickasawhay throughout the County. In Sec. 8, T.8 N., R.5 W., about 400 yards west of where Mill Creek enters Bucatunna Creek, Chickasawhay ledges exhibiting large *Turritella* imprints were observed. The Chickasawhay ledges were usually well-indurated, but not as hard as the Glendon ledges. On electrical logs the Chickasawhay ledges show a higher resistivity than the ledges in the overlying Paynes Hammock. They could usually be drilled slowly with a clay bit. The Glendon always required the use of a rock bit. The Chickasawhay weathers easily to a yellowish-gray, silty clay. The interbedded clays often have a blocky montmorillonitic appearance. The 10- to 15-foot thick clay section at the top of the uppermost Chickasawhay ledge is included in the Chickasawhay in this report. This clay is olive to dark-gray and contains some fossils and glauconite. It is similar to some of the interbedded clays that occur lower in the formation.

Wayne County has many outcrops where Chickasawhay fossils can be collected. Most of the fossils collected did not compare favorably with the excellently preserved Chickasawhay fossils from the quarry at St. Stephens, Alabama. Many of the Wayne County fossils were badly weathered, but identification was possible in many instances. Chickasawhay fossils collected were: *Kuphus incrassatus* (boring clam); *Pecten howei howei* (Mansfield), 1940; *Turritella* sp.; *Nemocardium* sp.; *Chlamys* sp.; *Alectryonella vicksburgensis* (Conrad), 1848; *Lepidocyclina undosa* Cushman, 1919; and *Echinolampus aldrichi* Twitchell, 1915. Some of the specimens of *Echinolampus aldrichi* Twitchell, 1915, were 3¾ inches in diameter. Another fossil that was found repeatedly was in the form of silicified rib fragments that may be the "manatee ribs" described by earlier writers (Figs. 34, 35, and 36). The bivalves *Chione bainbridgensis* Dall and *Chione-perduensis* Mansfield are abundant.

Descriptions of the Chickasawhay are found in the test hole records of AM-1, 2, 13, 16, 26, 27, 29, 30, 32, 34, 35, 38, 39, 40, 42, 44, 45, 47, Griner-1, 2, 4, 5, 6, 7, and 9.

A good outcrop for collecting Chickasawhay fossils is in the NW/4 of Sec. 10, T.8 N., R.7 W., below the Highway 84 bridge over the Chickasawhay River. When the river level is

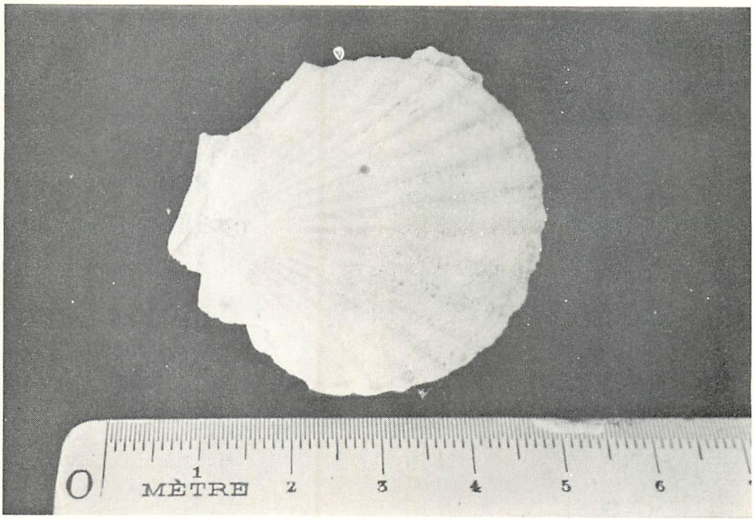


Figure 34.—**Pecten howei howei** (Mansfield), 1940. A characteristic fossil of the Chicaksawhay Formation. Photo by David T. Dockery, III. September 1973.

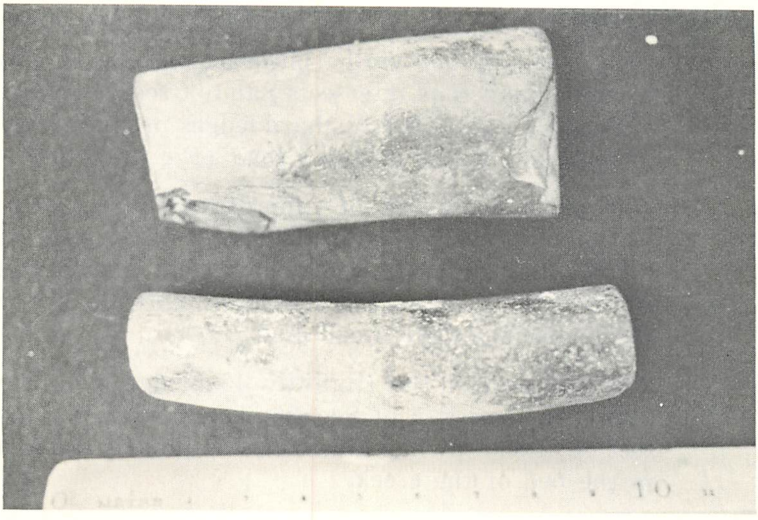


Figure 35.—The above objects are believed to be silicified manatee ribs. Manatee ribs have often been reported in the Chickasawhay Formation. Photo by David T. Dockery, III. September 1973.

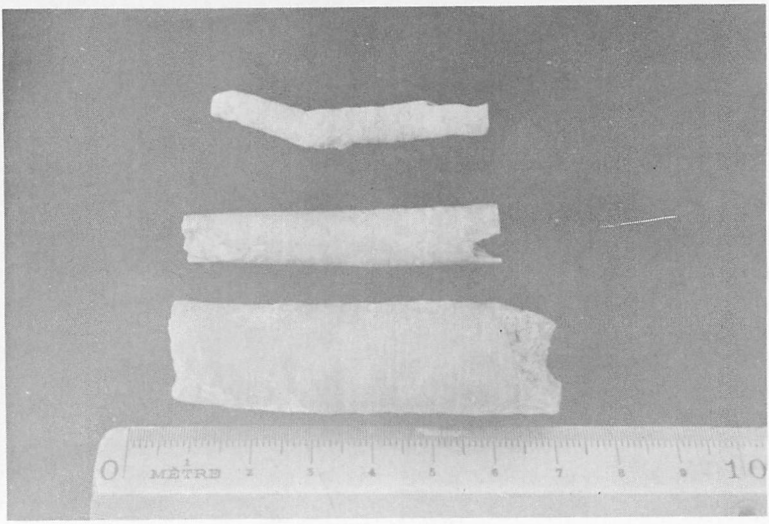


Figure 36.—**Kuphus incrassatus**-boring clam from the Chicksasawhay Formation. Photo by David T. Dockery, III. September 1973.

low the Chickasawhay limestone and marls are exposed for several hundred feet south of the bridge.

The Chickasawhay was observed at the following localities:

(1) approximately 500 yards southeast of Liberty Church, where asphalt road intersects Sandy Creek, in the SW/4 of Sec. 34, T.9 N., R.7 W., hard ledges produce waterfall in the creek to the north of road (Fig. 37).

(2) 400 yards northwest of Limestone Church, at intersection of gravel roads, in the NW/4 of Sec. 24, T.9 N., R.7 W., indurated Chickasawhay ledge overlies yellowish bentonitic clay. *Echinolampus aldrichi* Twitchell, 1915, specimens were collected.

(3) 150 feet east of the Highway 45 bridge over Taylors Creek, in the SE/4 of Sec. 36, T.9 N., R.7 W., about 8 feet of Chickasawhay limestones and marls are exposed in the bed of the creek.

(4) in the north roadcut of Highway 84, approximately 1¼ miles southwest of the Bucatunna Creek bridge, in

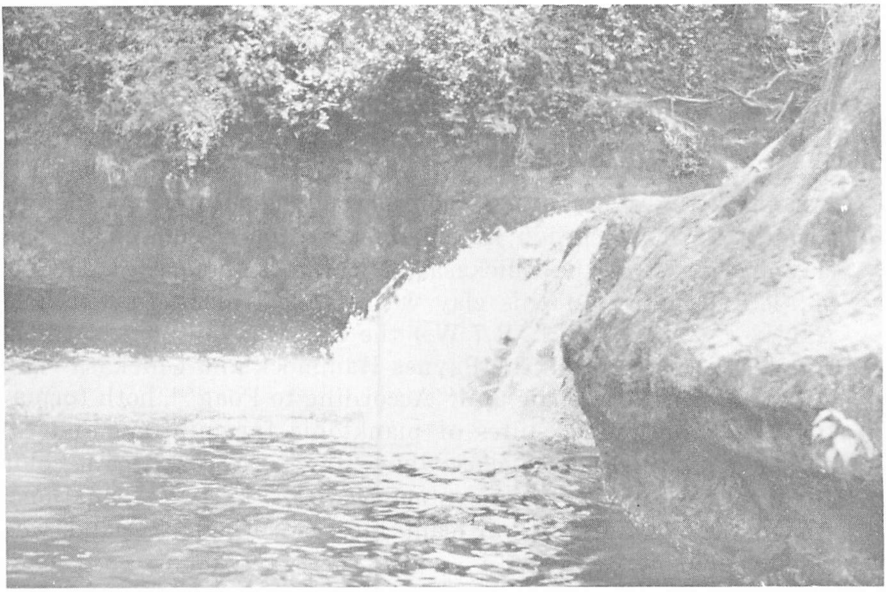


Figure 37.—Waterfall over ledge of Chickasawhay Limestone. Located in Sandy Creek northeast of asphalt road in NE/4, SE/4, SW/4 of Sec. 34, T.9 N., R.7 W. Waterfall is about 4 feet high. August 1972.

the NW/4 of Sec. 24, T.9 N., R.6 W., indurated Chickasawhay ledges are exposed. Bentonitic clay overlies the uppermost ledge.

(5) on hillside west of gravel road, about one mile west of Bucatunna Creek, in the NE/4 of Sec. 25, T.9 N., R.6 W., badly weathered light-yellowish-gray limestone underlies terrace sand.

(6) where trail crosses Alexanders Branch, in the NW/4 of Sec. 1, T.8 N., R.6 W., Chickasawhay ledges and marls crop out. This is one of the better macrofossil collecting areas in Wayne County.

(7) on the east bank of Bucatunna Creek, in the extreme NE/4 of Sec. 8, T.8 N., R.5 W., a 20-foot exposure of Chickasawhay can be observed.

The Chickasawhay-Bucatunna contact, as stated earlier, showed some evidence of being disconformable. The borings and channels indicate a break in deposition, at least on a local scale.

The Paynes Hammock-Chickasawhay contact was rarely visible. A disconformity based on borings and pockets was described in the Mississippi Geological Society's Sixth Field Trip Guidebook[123]. This contact was drilled through many times during the writer's study of Wayne County. Some information that might be interpreted as confirming the theory of a disconformity is the variation in the thickness of the greenish-gray clay at the top of the Chickasawhay. In test hole AM-40 (Sec. 26, T.9 N., R.9 W.,) this clay was 15 feet thick. In test hole AM-38 (Sec. 29, T.9 N., R.7 W.) the clay was only 6 feet thick. Where this clay is thin the Paynes Hammock and Chickasawhay appear almost as a single unit. According to Poag[124], both formations contain similar suites of planktonic foraminifers and together constitute the Chickasawhay Stage. No significant color changes were noted at the contact between the two formations. Above the contact, a significant increase of quartz sand was usually evident.

The thinnest section of Chickasawhay was recorded in test hole AM-38 in Sec. 29, T.9 N., R.7 W. Here 14 feet of fossiliferous marls and limestone were assigned to the Chickasawhay. The upper samples from this hole contain weathered fossil fragments in material that looks like it had been reworked. The structure map of the Glendon (Plate 3) indicates a structural anomaly in this area. The reworked material and the thinness of the Chickasawhay may reflect this anomaly.

The thickest section was drilled in the NW/4 of Sec. 19, T.8 N., R.6 W., in test hole Griner-1. The writer studied samples obtained from this hole and picked 42 feet for the thickness of the Chickasawhay. About 4½ miles north of Griner-1, in AM-32, only 16 feet of Chickasawhay was noted. The Chickasawhay appears to thin updip. Its outcrop belt, however, is often in structurally disturbed areas, which could account in part for the reduced thicknesses.

In the area just north of Denham the dip of the Chickasawhay was calculated at 37 feet per mile to the southwest. The average dip of the Chickasawhay in the subsurface throughout the County is also approximately 37 feet per mile (Plate 4). In the area just northeast of Waynesboro the angle of dip decreases slightly as the underlying Bucatunna thins.

The environment during deposition of the Chickasawhay was basically shallow marine. The thin interbeds of clay strata indicate fluctuations in the environment from shallow marine to marginal estuarine. Some of the dark, montmorillonitic, pyritic, clay strata, especially the uppermost clay unit, are similar to parts of the downdip Bucatunna.

The Chickasawhay underlies the physiographic province known as the Vicksburg Hills. This formation is usually overlain by the Catahoula Formation or terrace deposits. Where it is weathered on the surface it causes a gently rolling topography. It weathers rapidly, as indicated by reported "good outcrops" that have almost disappeared. In the NE/4 of Sec. 7, T.8 N., R.5 W., solution cavities in the subsurface Chickasawhay have caused the development of a karst topography. Sinkholes as much as 25 yards wide and 12 yards deep were noted in this area. The writer was informed by local residents that some of the cave-ins happened rather abruptly. In the SE/4 of Sec. 8, T.8 N., R.5 W., a tributary of Bucatunna Creek disappears into cavernous Chickasawhay limestone. A large sinkhole at the common corners of Sections 17, 18, 19, and 20, T.8 N., R.5 W., is probably caused by collapse in the Chickasawhay. Test hole AM-29 indicates that the Chickasawhay is just below the alluvium in this area.

The Chickasawhay weathers to contribute to the soils of the Ruston-Sweatman and Ruston-Falkner-Sweatman soil associations.[125]

PAYNES HAMMOCK FORMATION

The Paynes Hammock Formation was originally called the "Upper Chickasawhay Member" by B. W. Blanpied[126] and other writers for the Eleventh Annual Field Trip of the Shreveport Geological Society. F. S. MacNeil[127], in 1944, renamed the "Upper Chickasawhay Member" the Paynes Hammock Sand. The type locality for the Paynes Hammock is at Paynes Hammock Landing on a cutoff of the Tombigbee River, in the NW/4, SW/4, Sec. 16, T.5 N., R.2 E., Clarke County, Alabama. Since the type locality is not accessible during periods of high water, the writer would like to suggest a reference locality. An excellent exposure of the Paynes Hammock can be seen at the original type section for the "Upper Chickasawhay member." This outcrop is located on the west bank of the Chickasawhay River, in the NW/4 of Sec. 10, T.8 N., R.7 W., Wayne County, Mississippi.

The Paynes Hammock is easily traced from northwestern to east-central Wayne County. To the east in Alabama it is recognized in certain areas, but does not seem to have the areal persistence that it has in Wayne County. MacNeil[128] correlated the oyster-bearing sands near Keys Mill Creek in Smith County, Mississippi, with the Paynes Hammock. Poag[129], using foraminifers for correlation, compares the Paynes Hammock with the upper part of the Suwanee Formation and basal portion of the Chattahoochee Formation of northern Florida, and the subsurface Frio Formation of Texas and Louisiana. In this comparison the Chickasawhay and Paynes Hammock are grouped into the Chickasawhay Stage, which he considers to be late Oligocene in age. In Alabama the Paynes Hammock is regarded as Miocene in age.

In this report the Paynes Hammock is placed in the Oligocene. This placement is based primarily on accumulation of paleontologic information and reinforced by certain stratigraphic observations by the writer. It was observed that the Paynes Hammock and Chickasawhay Formations were very similar lithologically. It was also noted that in some of the test holes the Paynes Hammock appeared to be eroded. In these holes the Catahoula rested directly and unconformably on the Chickasawhay. This unconformity can be observed on the surface at the limestone quarry at St. Stephens, Alabama. It is believed that toward the west the Chickasawhay has also been eroded and replaced by the Catahoula. A calcareous, fossiliferous, arenaceous clay was detected in some of the downdip holes in Wayne County (AM-47 and AM-49). This calcareous zone overlies non-calcareous material that appears to be Catahoula. This zone, which could correlate with the "*Heterostegina* zone"[130], is apparently Miocene in age. The "*Heterostegina* zone" is in the Anahuac Formation in Texas and Louisiana. It is the writer's belief that in the past this zone may have been misinterpreted to be Paynes Hammock, especially where the Paynes Hammock had been eroded. This could have led to improper correlation of the two formations. The "*Heterostegina* zone" was not recognized on the outcrop in Wayne County. It is believed to interfinger with the non-fossiliferous Catahoula and pinch out in southern Wayne County. In 1964, D. H. Eargle[131] renamed the "*Hetero-*

stegina zone" the Tatum Limestone Member of the Catahoula Sandstone. He tentatively correlated the Tatum with the Paynes Hammock. From test hole information obtained during this study the writer could not determine a sound basis for this correlation in Wayne County.

The lithology of the Paynes Hammock, as stated earlier, is similar to the Chickasawhay. It is composed of olive-gray to grayish-yellow (weathered), fossiliferous, arenaceous, glauconitic marl. It also contains interbeds of fossiliferous clay, sandstone ledges, and silty limestone. The limestone and sandstone ledges were penetrated with a clay bit during the drilling operations in the County. They were slightly softer than the ledges in the underlying Chickasawhay. On electrical logs the resistivity of the Paynes Hammock was usually lower than the resistivity of the Chickasawhay. An indurated ledge of the Paynes Hammock forms a waterfall in Patton Creek, in the NE/4 of Sec. 18, T.8 N., R.6 W. The olive-green clay in the Paynes Hammock is smooth textured and appears to be bentonitic. The Paynes Hammock is mappable across Wayne County.

The most characteristic fossil found in the Paynes Hammock is a large oyster (Fig. 38). This oyster was identified by the writers of the Guidebook for the Sixth Field Trip of the Mississippi Geological Society as *Ostea blanpiedi.* Oyster fragments were detected in many of the test hole samples from the Paynes Hammock. Echinoid spines were also present in many test hole samples. An abundance of these spines was observed in a bluish clay in Patton Creek southeast of Waynesboro. C. W. Poag[132] identified and discussed planktonic foraminifers from the Paynes Hammock. An excellent ostracod fauna was recorded in test hole AM-39.

The test hole descriptions containing information about the Paynes Hammock are test holes AM-1, 2, 30, 32, 34, 35, 37, 38, 39, 40, 42, and Griner-1, 2, 7, and 9.

Outcrops of Paynes Hammock are more numerous in Wayne County than anywhere else. In Clarke County, Alabama, where the type locality is located, other outcrops of Paynes Hammock are rare. The most easily accessible outcrop is located south of the U. S. 84 bridge over the Chickasawhay River, in the NW/4 of Sec. 10, T.8 N., R.7 W. Test hole AM-39 was cored near the west end of the bridge on highway right-of-way. From core

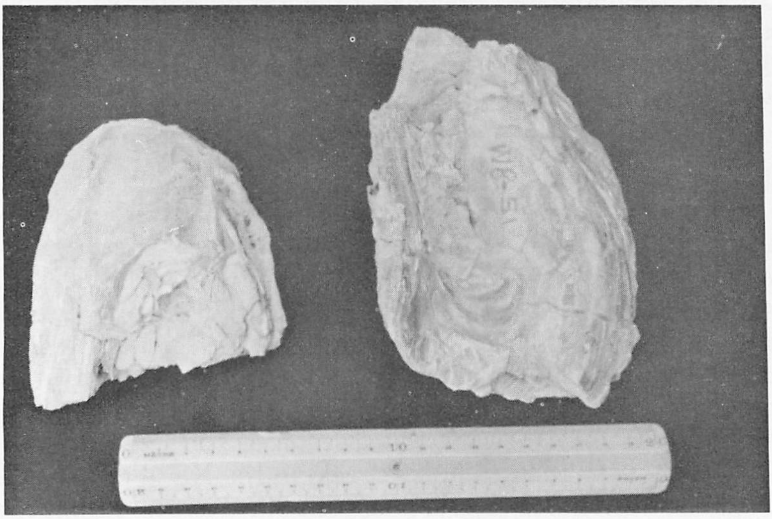


Figure 38.—Large oysters from the Paynes Hammock Formation. The above specimens came from the south bank of the Chickasawhay River about 300 yards west of the Highway 63 bridge in the SW/4 of Sec. 24, T.8 N., R.7 W. Photo by David T. Dockery, III. September 1973.

samples and the electrical log, the writer identified 18 feet of Paynes Hammock at this locality. These 18 feet of fossiliferous marls, limestone, and sandstones crop out in the river bank south of the bridge. The contact of the Paynes Hammock and Chickasawhay is at an elevation of 138 feet.

The Paynes Hammock crops out at the following localities:

(1) on south bank of Chickasawhay River, 350 yards west of State Highway 63 bridge, in the SW/4 of Sec. 24, T.8 N., R.7 W., the fossiliferous marls and claystones contain fossils of large oysters.

(2) on the east bank of Chickasawhay River, in bend of right angle turn in river, in the SE/4 of Sec. 14, T.8 N., R.7 W., approximately 8 feet of fossiliferous marls and limestone ledges can be observed at low river stages. Large oysters were collected at this locality. Live boring clams were noted boring into the marls and limestone.

(3) north of Patton Creek bridge on gravel road in NE/4 of Sec. 18, T.8 N., R.6 W., large and small oysters and echinoid spines were collected near a small waterfall formed by an indurated marl ledge in Patton Creek (Fig. 39).

Figure 39.—Waterfall in Patton Creek over Paynes Hammock ledge in NW/4, NE/4 of Sec. 18, T.8 N., R.6 W. Waterfall is about 2.5 feet high. Photo by Frederic F. Mellen. October 1973.

(4) in the extreme S/2 of Sec. 10, T.8 N., R.7 W., on east bank of Chickasawhay River, almost on section line, where fossiliferous, oyster-bearing Paynes Hammock underlies alluvium. A photograph was taken of ledge showing borings (Fig. 40).

(5) near the center of Sec. 10, T.8 N., R.7 W., on the west bank of the Chickasawhay River, the Paynes Hammock is exposed for several hundred yards along the river's edge.

The Paynes Hammock-Catahoula contact was not observed on the surface. This contact was studied with the aid of test hole cuttings and cores. The top of the Paynes Hammock was

Figure 40.—Bottom of Paynes Hammock ledge showing borings. The ledge has fallen from its original position and is inverted. The location is in the east bank of the Chickasawhay River in the S/2 of Sec. 10, T.8 N., R.7 W. June 2, 1972.

picked from cuttings by the first appearance of fossils or calcareous material. Due to the leaching of calcium carbonate, the top is probably picked lower in some holes than in others. In test hole AM-39 the top was picked at the base of a dark-greenish-gray, pyritic clay. Beneath this clay was 3 feet of calcareous sand which extended in borings into a hard ledge of non-calcareous sandstone. The sandstone was similar to the Catahoula except for the calcareous borings. The non-calcareous sandstone evidently represents a break in deposition.

Although the above contact could indicate only a minor fluctuation in sea level, many of the test hole samples revealed the Catahoula resting unconformably on the Chickasawhay. It is the writer's opinion that the Paynes Hammock and Chickasawhay sequence extended farther to the west than previously suspected. In some Mississippi counties west of Wayne County pre-Catahoula erosion has removed all but isolated remnants.

The thickest section of Paynes Hammock was recorded in test hole AM-30, in the NW/4 of Sec. 16, T.8 N., R.6 W., where

23 feet of limestone and marls were penetrated. It was observed that where the Paynes Hammock is the thickest, indications of a disconformity are less apparent. In this hole the Paynes Hammock was picked at the first appearance of calcareous material in a greenish-gray, pyritic clay.

The thinnest section was pentrated in test hole AM-34, Sec. 6, T.8 N., R.5 E., where the Catahoula overlies 5 feet of fossiliferous clay and marl. The marl contains echinoid spines.

The average thickness of the Paynes Hammock in the Survey's test holes is 16 feet.

The Paynes Hammock was deposited in a shallow marine environment. The increased amount of sand suggests a closer proximity to the source area than was the case with the Chickasawhay. The thin and variable strata demonstrate the frequency of minor fluctuations in sea level during this time. Basically, the depositional environments of the Chickasawhay and Paynes Hammock were similar.

The Paynes Hammock crops out along the extreme southern boundary of the Vicksburg Hills physiographic province near its contact with the Piney Woods physiographic province. Its overall effect on the topography is negligible. Many of the outcrops are in the Chickasawhay River alluvial plain. Localized sinkholes near Paynes Hammock outcrops can logically be attributed to solution cavities within the formation.

The Paynes Hammock adds its weathered material to soils of the Ruston-Falkner-Sweatman and Ruston-Sweatman associations.[133]

MIOCENE SERIES

CATAHOULA FORMATION

The term "Catahoula" was introduced by A. C. Veatch[134], in 1905, for exposures in Catahoula Parish, Louisiana. The Catahoula is recognized across the southern part of Mississippi, in Louisiana and Texas to the west, and in Alabama to the east. It is correlated with the Tampa limestone of Florida. D. H. Eargle[135] divided the Catahoula into two parts, an upper nonfossiliferous part and a lower limestone member. The lower part, which was formerly called the "*Heterostegina* Zone", was renamed the Tatum Limestone Member by Eargle. The "*Heterostegina* Zone", as stated earlier, is a marker zone in the Anahuac Formation of Texas. Eargle designated the age of the Tatum as either late Oligocene or early Miocene. The upper nonfossiliferous sands and clays were assigned to the Miocene.

No *Heterostegina* were observed in any of the samples collected during the field work phase of this report. This fossil zone was reported however, in an oil well test hole in the extreme southwestern part of the County (Plate 4). The writer feels that calcareous material taken from the test holes updip from the aforementioned oil test might indicate the feather edge of the Tatum ("*Heterostegina* Zone"). This thin zone is included in the Catahoula Formation in this report and considered Miocene in age.

The Catahoula Formation in Wayne County has a complex and varied lithology. It contains gray to brown, fine- to medium-grained sand, which is commonly indurated near the surface. The indurated ledges are lenticular and are the result of weathering. In the NE/4 of Sec. 1, T.9 N., R.9 W., large Catahoula boulders over 25 feet in diameter are exposed on a hillside (Fig. 41). The sandstone that forms these unusual boulders is hard and compact. The boulders are pitted and have a water-worn appearance. Thin deposits of pea gravel-size black chert and smokey quartz were found at the base of some of the unindurated sand units. The gravel-size particles were probably deposited in stream channels during Catahoula time. Kaolinitic, micaceous, argillaceous silts are common constituents of Catahoula sediments. Smooth-textured high-alumina clays were sampled from this formation. The clays and silts commonly have a mottled red and gray appearance when weathered. Near the contact of the Catahoula and recent terrace deposits many odd shaped ferruginous concretions were observed (Fig. 42). A characteristic of the upper contact of the Catahoula was the presence of thin, ferruginous sandstone ledges. In some test holes dark gray, carbonaceous clay containing fragments of pyritized wood was pentrated. This carbonaceous clay was also noted in several outcrops.

The updip Catahoula is composed primarily of non-marine sediments. In test holes AM-47 and AM-49 calcareous material was detected well above the stratigraphic interval for the Paynes

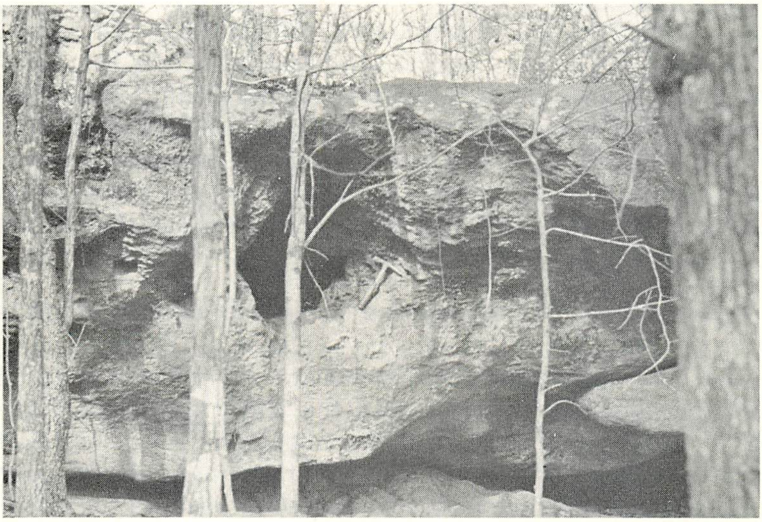


Figure 41.—Massive Catahoula sandstone boulder located in the SW/4, NE/4, NE/4 of Sec. 1, T.9 N., R.9 W. February 8, 1972.

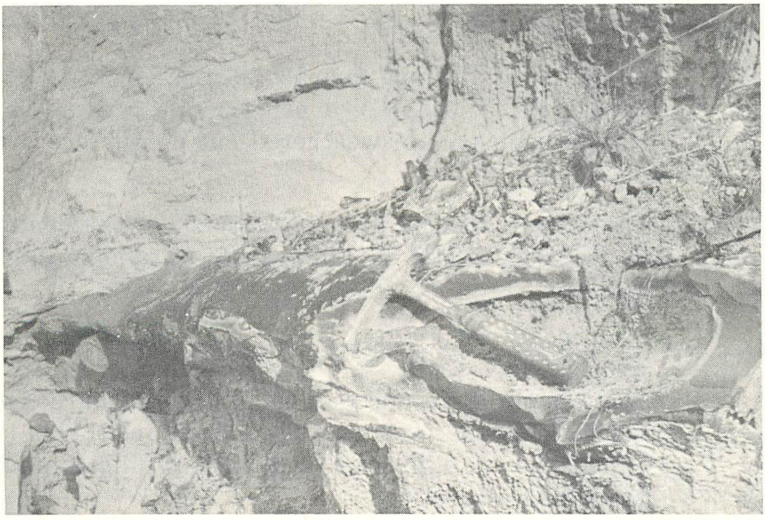


Figure 42.—Unusual ferruginous concretion near the contact of the Catahoula and the overlying terrace along Highway 84, in the NE/4, SE/4, SW/4 of Sec. 4, T.8 N., R.7 W. February 8, 1972.

Hammock. Monsour[136] stated, "The farthest updip Anahuac wedge fauna in Mississippi is recorded by H. C. Ferguson (personal communication) from a core test drilled by the Louisiana Crusader Oil Company in the southeast corner of the NE/4 of NE/4 of Section 36, T.8 N., R.10 W., Jones County, Mississippi." Ferguson found the following microfauna: *Miogypsina, Heterostegina, Elphidium,* and *Amphistegina.* This fossiliferous zone, when projected along strike into nearby Wayne County, apparently occupies the same stratigraphic interval as the calcareous zones in test holes AM-47 and 49.

Exposures of Catahoula are numerous because of its large outcrop area. Approximately 65 per cent of Wayne County is in the outcrop belt of the Catahoula. An unusual outcrop of sandstone boulders is located in the Eucutta Oil Field in the NE/4 of Sec. 1, T.9 N., R.9 W., about one mile southeast of Eucutta Creek. These boulders contain many large solution cavities, some of which may have served as shelters for primitive people.

Another outcrop of these large sandstone boulders is in the SE/4 of Sec. 2, T.9 N., R.9 W. A large tabular boulder underlain by red sand was observed in place (Fig. 43).

Catahoula outcrops can be observed at the following localities:

(1) near oil well site one quarter of a mile northwest of water tank, in the NW/4 of Sec. 6, T.9 N., R.8 W., massive boulders are weathered out on surface over a large area.

(2) in the north roadcut of asphalt road, in the center of Sec. 6, T.9 N., R.8 W., light-gray Catahoula sand is exposed.

(3) on the north road cut of U. S. 84, one mile west of the Chickasawhay River, in the SW/4 of Sec. 4, T.8 N., R.7 W., a three to four foot thick ledge of hard, ferruginous sandstone protrudes from the bank. This ledge is underlain by light-gray, argillaceous silts containing odd-shaped concretions.

(4) in the SW/4 of Sec. 17, T.8 N., R.7 W., approximately 400 yards southwest of Maynor Creek, on north side

Figure 43.—Large sandstone boulder overlying ferruginous stained sand. Located in the NW/4, SE/4 of Sec. 2, T.9 N., R.9 W. February 8, 1972.

of gravel road, ferruginous sandstone ledges are exposed.

(5) one-half mile southwest of State Highway 63 bridge over the Chickasawhay River, south of road in the NW/4 of Sec. 25, T.8 N., R.7 W., light-gray to red-purple, kaolinitic clay underlies terrace sand. Core hole AM-5 was drilled for the purpose of testing this clay.

(6) in gravel pit south of gravel road, in the NE/4 of Sec. 13, T.7 N., R.6 W., sandstone boulders similar to those in the Eucutta area can be observed. Sand and gravel are around and under the boulders. Light-gray Catahoula clay can be seen in the bottom of the gravel pit.

(7) in east road cut, approximately 0.9 miles east of the Jones-Wayne County line, in the extreme southeastern corner of Sec. 18, T.8 N., R.9 W., white, micaceous, lenticular, sandstone ledges overlie light-gray argillaceous silts.

(8) north of Highway 84, 2 miles southwest of Bucatunna Creek, in the SE/4 of Sec. 23, T.9 N., R.6 W., purple clay is overlain by red terrace sand.

The contact of the Catahoula with the underlying formations, as discussed previously, is disconformable. Test hole information indicates that the Catahoula rests on varying thicknesses of the Paynes Hammock and on erosional surfaces in the Chickasawhay. If the calcareous zone described in the downdip Catahoula in Wayne County is the feather edge of the Tatum (*Heterostegina* Zone), it is believed to interfinger with the Catahoula. Material characteristic of the Catahoula underlies the calcareous zone.

The upper contact of the Catahoula throughout most of the County is unconformable. In the northwestern part of the County, the Catahoula is overlain unconformably by the sands, gravels, and clays of the Citronelle. In the remaining outcrop area, dissected ridges of Catahoula sediments are often capped with high level terrace sands and gravels. The contact between the terrace deposits and the Catahoula is typically characterized by the presence of a thin ferruginous sandstone ledge. This ledge, which is usually about 2 inches thick, is formed where the ground water percolates between the coarser terrace material and the more argillaceous Catahoula. In the extreme southern half of Sec. 36, T.10 N., R.7 W., a reddish-purple clay was observed underlying terrace sand and gravel. The clay exposure was distinctly dome shaped with the sand and gravel draped over it. This condition was also noted in the adjoining section in a gravel pit in the SW/4 of Sec. 30, T.10 N., R.6 W.

Samples from core hole AM-48 (SE/4 of Sec. 24, T.6 N., R.8 W.) indicate the Hattiesburg-Catahoula contact to be at the base of a mottled light-brown and pale-olive clay. The underlying sand was composed of light-brown, fine- to medium-grained, subangular quartz. Due to the limited areal extent of the Hattiesburg outcrop area, the exact nature of the contact was not determined. In AM-48 the change from clay to sand was abrupt, rather than transitional.

The thickest section of Catahoula drilled was in test hole AM-47, in the SW/4 of Sec. 20, T.8 N., R.9 W. In this hole 380 feet of Catahoula sediments were sampled. This does not represent the total thickness. On the dip section (Plate 4) it can be seen that the total thickness of the Catahoula is about 600 feet in southwestern Wayne County.

The thinnest section, as approximated from the dip section, is 550 feet. The determination of thickness is difficult because of the scarcity of observable Hattiesburg-Catahoula contacts. The Hattiesburg outcrop area occupies only a small part of the County.

The sediments of the Catahoula were deposited under several different conditions. Much of the sand appears to have been deposited under fluviatile conditions. Some of the sand units display graded bedding. These units have pea-size quartz and black chert at their base. Also found in the Catahoula are lenses of carbonaceous, pyritic, micaceous clay. This clay, which is similar in appearance to the carbonaceous clay of the Bucatunna, was deposited in a swampy environment. In the SW/4 of Sec. 14, T.8 N., R.8 W., the surface Catahoula is in the form of a white, fine, unconsolidated quartz sand. This sand has the appearance of a beach or dune sand. Similar sand was observed in southern Wayne County. The occurrence of calcareous material suggests the nearness of a marine environment for deposition of the downdip Catahoula. Fluctuations in sea level occurred during Catahoula time, as indicated by the alternations of gravel, clay, and sand strata.

The Catahoula crops out in the Piney Woods physiographic province. This province occupies more area than any of the other physiographic regions in the County. The partially indurated sands of this formation are more resistant to erosion in some areas than in others. The result is a rugged topography where the only large flat areas are in the alluvial plains. Small flat areas are present where high level terraces overlie the Catahoula.

The Catahoula weathers to form soils of the Savannah-Susquehanna-Falkner association in southern Wayne County. In the central and northwestern part of the County the weathered Catahoula materials are absorbed in the Ruston-Falkner-Sweatman association.[137]

HATTIESBURG FORMATION

The original reference to the Hattiesburg was by L. C. Johnson[138] in 1893. The type locality is near Hattiesburg, in Forrest County, Mississippi.

In 1916, George Matson[139] stated, "The Hattiesburg Clay is readily recognizable from central Alabama, where it merges into the more sandy fossiliferous beds of the Alum Bluff Formation, westward to eastern Texas." Matson believed that the Hattiesburg reached a thickness of 450 feet in central and western Mississippi. He also thought that the Hattiesburg was Oligocene in age. In 1947, F. Stearns MacNeil[140] placed it in the Miocene. He stated that the exact equivalence of the Hattiesburg and Pascagoula clays with any of the named formations of Florida had not been demonstrated. He indicated that there was no definite correlation in eastern Alabama and throughout Georgia. In the present report the Hattiesburg is considered to be Miocene in age.

The unweathered Hattiesburg is composed of greenish-gray, silty to arenaceous clay. It weathers locally to a ferruginous, reddish-purple, nodular clay. The writer observed similar nodular clay in the NE/4 of Sec. 10, T.10 N., R.14 W., and at several other locations in Smith County, Mississippi. The chemical analysis of the clay from test hole AM-48 showed it to contain 61.94% silica, 14.43% alumina, 5.22% iron oxide, and minor amounts of other chemical constituents. In the SE/4 of Sec. 25, T.6 N., R.8 W., the Hattiesburg is represented, in part, by an indurated siltstone ledge which is several inches thick. The ledge is overlain by greenish-gray, smooth-textured clay. Under the ledge is a mottled red and gray silt containing indurated, reddish, ferruginous nodules very similar to those in the Hattiesburg Formation in Smith County, Mississippi. In most of the outcrops the Hattiesburg was exposed as a smooth-textured greenish-gray clay. It was differentiated from Catahoula clay by its greener color and by a higher percentage of clay size particles. Clay was tested from two different intervals in test hole AM-48. The clay from the 4- to 18-foot interval contained 69.70% silica, 13.48% alumina, and 4.79% iron oxide as its major constituents. The 18- to 32-foot interval contained 68.18% silica, 12.15% alumina and 4.79% iron oxide. Chemical analyses for the Hattiesburg in Copiah County, Mississippi, as shown by

Alvin Bicker[141], are reasonably similar to the Wayne County samples. X-ray and differential thermal analysis both indicated a high percentage of the clay mineral montmorillonite. A fine yellow residue was noted on some of the dry clay samples.

No fossils were found in the samples of Hattiesburg collected by the writer. Chemical analyses indicated a trace of lime in the clay from AM-48. The writer observed no effervescence from HCl placed on test hole or outcrop samples of the Hattiesburg during microscopic examination.

Outcrops of Hattiesburg are common in the extreme southwestern part of the County. An easily accessible area where the Hattiesburg can be observed is in the SE/4 of Sec. 24, T.6 N., R.8 W., in the road cut of State Highway 63. Test hole AM-48 is located in this area.

The Hattiesburg was studied at the following localities:

(1) 300 yards north of Wayne-Greene County line, near Smithtown community, in the S/2 of Sec. 32, T.6 N., R.7 W., greenish-gray clay is exposed in road ditch. The clay is smooth-textured with a waxy appearance.

(2) in the SE/4 of Sec. 25, T.6 N., R.8 W., about 200 yards north of intersection of State Highway 63 and gravel road, good section of greenish-gray clay overlies claystone ledge. Reddish ferruginous nodules are present here (Fig. 44).

(3) along section line road, in the extreme NW/4 of Sec. 16, T.6 N., R.9 W., greenish-gray clay is exposed along the roadside. The clay is friable and shows a fine yellow residue when dry.

(4) east of the center of Sec. 29, T.6 N., R.9 W., one half mile east of West Little Thompson Creek, argillaceous green silts can be seen along roadside.

(5) one-half mile north of the Mulberry community, in the NE/4 of Sec. 13, T.6 N., R.9 W., light-green argillaceous silt is exposed in road cut.

(6) in the NW/4 of Sec. 7, T.6 N., R.8 W., 100 yards southwest of intersection of gravel road and unimproved road, purple argillaceous silt can be observed in ditch.

Figure 44.—Partially indurated Hattiesburg along Highway 63 in the NE/4, SE/4, SE/4 of Sec. 25, T.6 N., R.8 W. March 29, 1972.

(7) in the NW/4 of Sec. 33, T.6 N., R.8 W., 300 yards southeast of Piney Woods Creek, on south side of County road, light-gray clay is overlain by red weathered clay.

(8) in road cut of County road, in S/2 of Sec. 36, T.7 N., R.9 W., three-eighths of a mile south of Hollis Creek, light-greenish-gray, silty clay was collected.

Because of the weathered condition of the outcrops and the covering of terrace deposits, the contact of the Catahoula and the Hattiesburg was not visible. As discussed previously, this contact was penetrated by test hole AM-48. The base of the Hattiesburg was picked at the top of a light-brown, fine- to medium-grained, subangular quartz sand. The abrupt change from clay to sand may indicate an unconformity.

The Hattiesburg is unconformably overlain by terrace deposit sands in some areas of the outcrop belt. The exact position of the Hattiesburg-terrace contact is usually obscured by the slumping of the terrace sands. A large terrace overlying the Hattiesburg is located near the common corners of Sec. 19, 20, 30, and 29, T.6 N., R.8 W. This terrace reaches an elevation of 367 feet. This is a relatively high surface elevation for southern Wayne County.

The full thickness of the Hattiesburg is not present in Wayne County. In the southwestern part of the County, it is about 160 feet from the top of the Catahoula to the truncated top of the Hattiesburg. In test hole AM-48 in the SE/4 of Sec. 24, T.6 N., R.8 W., 41 feet of clay was cored before the top of the Catahoula was reached.

The depositional environment of the Hattiesburg appears to have been similar to that of the Catahoula. The Catahoula generally contains more sand. The presence of carbonized wood could indicate a marginal deltaic environment for the Hattiesburg.

The Hattiesburg crops out in the Piney Woods physiographic province. The area of the Hattiesburg outcrop belt is higher topographically than the remainder of southern Wayne County. This is probably the result of the more resistant indurated layers in the Hattiesburg.

The soils that are characteristic of the Hattiesburg outcrop belt belong to the Savannah-Susquehanna- Falkner association. In the lower lying areas the soils are included in the Prentiss-Myatt association of nearly level, moderately well drained, loamy soils that have a fragipan, and poorly drained loamy soils.[142]

PLEISTOCENE SERIES

CITRONELLE FORMATION

The name Citronelle Formation was applied by Matson[143], in 1916, to sediments which he considered to be Pliocene in age. These sediments occurred near the seaward margin of the Gulf Coastal Plain and extended from a short distance east of the western boundary of Florida, westward to Texas. Matson's Citronelle was equivalent to portions of the deposits formerly classified as "Drift", "Orange Sand", and "Lafayette". Doering[144] stated that the Pliocene age of the Citronelle was questionable. He said that the plant fossil data on which the Pliocene age was based could be interpreted as readily to support a pre-Nebraska Pleistocene age for the Citronelle. In the present report the Citronelle is considered to be Pleistocene age. The type locality for the Citronelle is the exposures in the vicinity of Citronelle, Alabama. The Citronelle Formation is exposed for 3 or 4 miles along the Illinois Central Gulf railroad near there.

The problem of correlating the Citronelle across counties and states is extremely complex. Several fluviatile surfaces are apparent in southern Mississippi and the surrounding area. These surfaces were formed by a network of streams emptying into the Gulf. The deltaic material from these streams came together along the coast, resulting in widespread terrace deposits. Lowering of the sea level resulted in the development of younger terraces which were formed partly from the reworked material of the older terraces. Of this sequence of terraces the Citronelle is the oldest and topographically the highest. The problems of accurate correlation of specific age terraces are evident. In the writer's opinion, the mappability of the Citronelle as a formation requires considerably more study.

The Citronelle in Wayne County contains mostly dark yellowish-orange, fine- to coarse-grained sand. Samples from the Citronelle in test hole AM-45 contained more well-rounded quartz grains than samples from any other formation in the County. Multicolored quartz and chert gravel containing layers of varicolored clay is common. The gravel has a weathered appearance. Many marine fossil imprints are found in the chert gravel. These fossils indicate a Paleozoic source for the gravel. Banded agates and silicified wood are also found in the gravel beds. In lower "high level" terraces the above constituents are often found, but in decreased amounts. The reduction in the number of well-rounded quartz sand grains in the younger terrace sands is obvious. Most of the gravel size material is bedded or in layers. In some areas the red sand of the Citronelle contains pea-size quartz gravel scattered throughout. This would indicate a fairly high energy transportation for the material and a sudden dissipation of that energy to leave the larger material suspended in the sand. An example of this type deposit can be observed in the road cuts along the asphalt road in the S/2 of Sec. 24, T.10 N., R.8 W.

No Citronelle fossils, other than the transported Paleozoic fossils, were noted by the writer in Wayne County. In 1916, Berry[145] described numerous fossil forms of Citronelle flora.

Most of the flora that he described came from clays near Lambert or Red Bluff, Alabama. Whether or not these clays could be projected and correlated with the Citronelle Formation of this report is questionable.

The Citronelle is exposed in many areas along its outcrop belt, especially in the sides and bottoms of active gravel pits. Test hole AM-45 was drilled in the edge of a gravel pit in the SE/4 of Sec. 23, T.10 N., R.8 W., for the purpose of determining the thickness of the Citronelle in this area. It was found to be about 67 feet thick. The sands and gravels can be seen in the nearby pit.

Outcrops of Citronelle can be observed at the following localities:

(1) at intersection 300 yards south of Clarke-Wayne county line, in the NW/4 of Sec. 24, T.10 N., R.9 W., bright reddish-orange, ferruginous, massive, quartz sand can be seen in road bank. This outcrop is near the highest elevation in Wayne County (480 feet).

(2) in road cut 250 yards southwest of pumping station, in NW/4 of Sec. 35, T.10 N., R.8 W., a red ferruginous sand containing unbedded pea-size quartz gravel was sampled.

(3) one-half mile southwest of North Yellow Creek Oil Field, in the SW/4 of Sec. 24, T.10 N., R.8 W., red ferruginous sand and pea gravel is along an asphalt road. Several large active gravel pits are located in this vicinity.

(4) on hilltop 700 feet south of Eucutta Creek, in the extreme NW/4 of Sec. 29, T.10 N., R.8 W., grayish-orange sand and chert gravel overlie the Bucatunna Formation. Test hole AM-3 is located near here.

(5) in an active gravel pit, near center of Sec. 11, T.9 N., R.8 W., ferruginous sand and gravel conglomerate overlies light-gray, argillaceous, Catahoula silt (Fig. 45).

(6) in active gravel pit on the property of Mrs. West, in the NW/4 of Sec. 25, T.9 N., R.8 W., the gravel is overlain by several feet of soil.

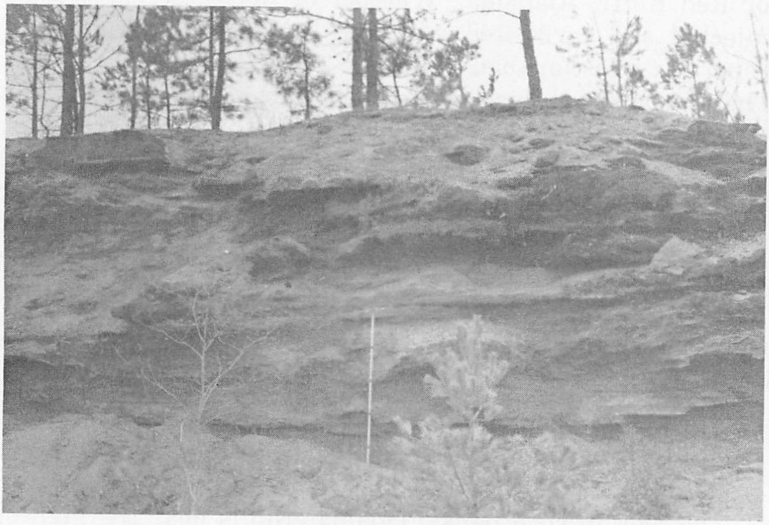


Figure 45.—Sand and gravel conglomerate of basal Citronelle in active gravel pit, near center of Sec. 11, T.9 N., R.8 W. Scale divided in feet. February 22, 1972.

The contact of the Citronelle with the underlying formations is unconformable. The sands, clays, and gravels were spread sheet-like over the older truncated formations. In test hole AM-3 the Citronelle is in contact with the Bucatunna Formation. A light-brown, coarse-grained, ferruginous sandstone separated the two units. Similar ferruginous cementation was observed in test hole AM-13. In this hole the finer-grained sediments of the Catahoula were in contact with the Citronelle. Ferruginous sandstone ledges seem to be characteristic where a porous formation overlies impervious stratum. Therefore, these ledges are not necessarily indicative of any particular formation. The Citronelle-Bucatunna contact was drilled through again in AM-45. In this test hole the pale-orange sand of the Citronelle was underlain unconformably by the pale-yellowish-brown, silty, bentonitic clay of the Bucatunna.

Surface contacts are difficult to locate because of the thick cover of vegetation and the tendency of the Citronelle to slump over the contacts. A surface contact was observed in the SE/4 of Sec. 23, T.10 N., R.8 W., where the Bucatunna appeared to be eroded and replaced with coarse, red, ferruginous sand containing abundant pea-size gravel. The contact was exposed during excavation for an oil well test.

The upper surface of the Citronelle was not overlain by any other formation in Wayne County. The Citronelle could not be recognized in the subsurface in any of the downdip test holes. The writer believes that the Citronelle, as restricted to this report, cannot be projected into the downdip subsurface of Wayne County.

The maximum thickness of the Citronelle measured in Wayne County was 100 feet. The original thickness is believed to have been much greater. Erosion has removed much of the Citronelle and redeposited the material at lower elevations. The terraces containing Citronelle material at these lower elevations are younger than the original surface designated as the Citronelle Formation and not the result of formational dip. The base of this formation in Wayne County is from 300 to 380 feet above sea level.

The different materials such as clays, sands, and gravel indicate a variety of sedimentary environments. The lack of marine fossils suggest a fluviatile origin. The size range of the rock particles indicates that they were transported by streams that were subject to variations in velocity and direction. A considerable amount of energy was required to transport the gravels. On the other hand, quiet bodies of water were needed to deposit the beds of clays (Fig. 46).

The Citronelle is in the Vicksburg Hills physiographic province near its boundary with the Piney Woods province. Topographically this area has the highest elevations in Wayne County. The hills capped by the Citronelle represent some of the steepest and roughest terrain in the County. The most rugged area is the vicinity just south of the confluence of Bogue Flower Creek and Eucutta Creek.

The Citronelle underlies the Ruston-Sweatman soil association.[146]

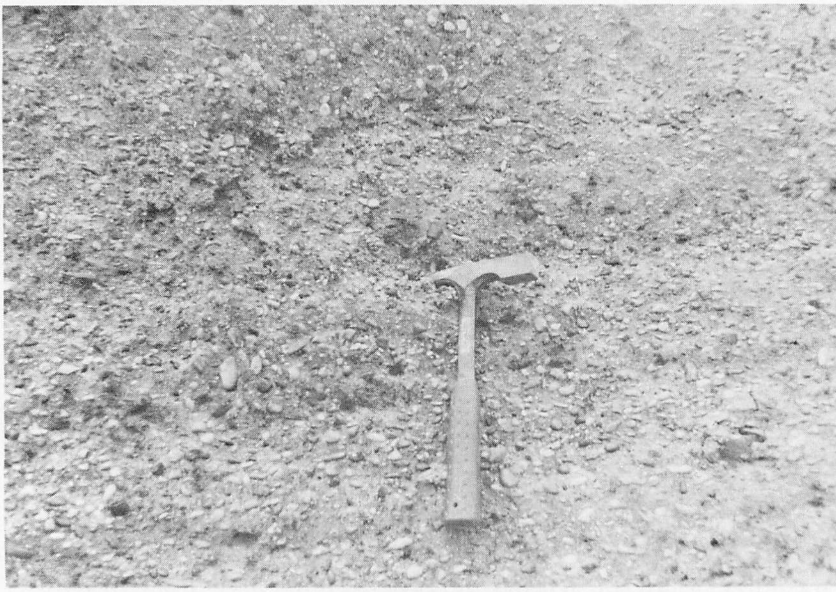


Figure 46.—Citronelle gravel located along the section line between Sections 23 and 24, T.9 N., R.8 W., a quarter of a mile southeast of Lowery Church. May 8, 1972.

TERRACE DEPOSITS

The higher ridges and hills in Wayne County, which are not capped by the Citronelle, are covered by younger Pleistocene terraces. These terraces are a series of high deltaic plains and flood plains that extend step-like up the major stream valleys. As discussed previously, these terraces are believed to be the result of fluctuations of sea level which occurred during Pleistocene glaciation.

Harold Fisk[147], in his 1944 Geological Investigation of the Alluvial Valley of the Lower Mississippi River, referred to four Pleistocene terraces which occurred in the central Gulf Coastal Plain. From oldest to youngest these were: The Williana, the Bentley, the Montgomery, and the Prairie. In a west-east section across the Mississippi alluvial valley near Forrest City, Arkansas, he indicated the comparative elevations of the four terraces. The Williana, the highest terrace, was 350 feet above the present alluvial plain. The Bentley had been uplifted 200 feet, the Montgomery more than 100 feet, and the Prairie about 40 feet above the flood plain of minor streams.

In this report the highest and oldest terrace is generally mapped as the Citronelle. The younger terraces were not differentiated. They were all mapped as Terrace deposits. Some Terrace deposits which were at the same elevations as the Citronelle, but differed lithologically, were also mapped as undifferentiated Terrace deposits. Whether these terraces are equivalent to the Citronelle, or are uplifted younger terraces, would require more detailed study. In this area the material from higher teraces was often slumped or washed down over the younger terraces. The recent streams in the area continue the process of bringing the older terraces down to the elevation of the recent flood plains. These factors make the correlation of Pleistocene terraces younger than the Citronelle impractical in the Wayne County area. In other areas of the Gulf Coastal Plain the different terraces may be distinguished more readily.

The Terrace deposits are often very similar in lithology to the Citronelle Formation. They are composed mostly of multicolored, fine- to coarse-grained, subangular to rounded, quartz sand, with some quartz and chert gravel. Local clay lenses are also present. The younger terraces contain less, and smaller sized, chert gravel than the Citronelle. A noticeable decrease in the amount of well-rounded quartz sand grains was observed in the lower teraces. The more recent terraces also contain material that has been eroded from formations that crop out in the immediate area.

Silicified logs are frequently found in the terrace material. In the SE/4 of Sec. 28, T.10 N., R.9 W., near Eucutta Creek, a log approximately three feet in diameter protrudes from an old road cut through a red sand terrace (Fig. 47).

Test hole records containing descriptions of Terrace deposits are test holes AM-4, 5, 12, 17, 21, 22, 23, 26, 27, 30, 32, 33, 35, 37, 39, 40, 46, and Griner-5 and 6.

Terrace deposits were visible in many parts of the study area. Terraces can be observed at the following localities:

(1) about one-mile southwest of Liberty Church, in the S/2 of Sec. 33, T.9 N., R.7 W., multicolored bedded sand is exposed in the roadcut.

(2) one-half mile southwest of State Highway 63 Chickasawhay River Bridge, in the NW/4 of Sec. 25, T.8 N.,

Figure 47.—End of silicified log in terrace near Eucutta Creek, in the NE/4, SE/4, SE/4 of Sec. 28, T.10 N., R.9 W. January 21, 1972.

R.7 W., multicolored, ferruginous, argillaceous sand overlies the Catahoula Formation.

(3) 250 feet east of gravel road near Alabama State Line, in the NW/4 of Sec. 3, T.10 N., R.5 W., pale yellowish-orange, ferruginous quartz sand overlies the Cocoa Sand Member of the Yazoo Formation.

(4) in road cut north of Highway 84, in the E/2 of Sec. 23, T.9 N., R.6 W., bright red terrace sand overlies purple Catahoula Clay.

(5) 400 yards south of Limestone Creek, near the center of Sec. 25, T.9 N., R.7 W., red terrace sand overlies Catahoula Clay.

The thickest Terrace deposit penetrated was in the SW/4 of Sec. 25, T.9 N., R.7 W., in test hole AM-32, where 34 feet was recorded. From field observations many of the terraces appear to be considerably thicker than the above figure.

The high level terraces were deposited as the result of Pleistocene glaciation to the north. As the glaciers accumulated ice and advanced, the subsequent lowering of the sea level resulted in entrenchment and valley cutting by the streams. When the glaciers retreated these valleys were filled with sands, clays, and gravel. Since regional uplift and seaward tilting continued throughout the Pleistocene, the younger terraces never attained the altitude of the terraces that preceded them. Therefore, the older terraces are topographically the highest and occur farther inland.

The Terrace deposits have considerable effect on the topography as almost every hill and ridge of any size in the county is capped by this material.

RECENT SERIES

Alluvium

The larger streams have deposited alluvial material in the low lying drainage courses. The area of the combined alluvial plains encompasses a considerable part of the County. The Chickasawhay River and Bucatunna Creek are the largest streams and therefore account for a majority of the Recent alluvial material. Both of these streams meander through wide flood plains. Numerous oxbow lakes suggest an old age stage in geologic development of their valleys. Entrenched meanders in the alluvial plains are evidence of rejuvenation in certain areas. Near the mouth of Bucatunna Creek on the Chickasawhay River, the alluvial plain is over three miles wide.

The materials in the alluvium are dependent to a large extent on the formations through which a particular stream is eroding in a given area. Primarily the alluvium is composed of yellowish-gray to yellowish-orange, subangular to rounded quartz sand. In some areas the alluvium contains varying amounts of quartz and chert gravel which has been eroded down from the higher terraces. The coarser material is usually at the base of the sediments. Silty dark clays with abundant organic matter are characteristic of backswamp deposits within the alluvial plains. Old meander scars are often overlain by these backswamp deposits.

The thickness of the alluvium is normally between 15 and 25 feet. The thickest section tested was in test hole AM-41 in the SW/4 of Sec. 6, T.8 N., R.7 W., where 72 feet of sands and gravel were tentatively assigned as alluvium. This unusual thickness could be the result of structural disturbance that reached the surface. The material has a Citronelle appearance, but is stratigraphically too low. The thickness of the material is greater than that usually found in terraces younger and lower than the Citronelle. Test hole AM-38 also contains material unusually thick for an alluvial deposit. Like AM-41 it contained material that was stratigraphically low. Both test holes are located along a shallow structural trend which shows up on the Glendon structural map. These unusual deposits will be discussed again under the section on Structure.

Test hole records containing information about alluvium are AM-11, 18, 28, 29, 36, 38, 41, 42, 44, and Griner-1, 2, 4, and 7.

ECONOMIC GEOLOGY

GENERAL STATEMENT

It has long been known that Wayne County is rich in academic geology. For many years students of geology have travelled here to observe the formations and collect the excellently preserved fauna. Fossils from Wayne County are found in museums throughout the Nation. The geologic formations in this area have yielded valuable information for the correlation of Tertiary stratigraphy. An important objective of the recent geological survey was to confirm and increase the academic knowledge concerning the County.

Of equal importance is the location and evaluation of all mineral resources that are potentially important economically. It was not the purpose of the Mississippi Geological Survey to conduct detailed research into any one area or any particular mineral resource. The purpose was, however, to collect representative samples from various formations throughout the County and run preliminary tests on those that appear promising. When important minerals were located, the overall geologic knowledge of the area aided in predicting other occurrences of the same mineral (Fig. 49).

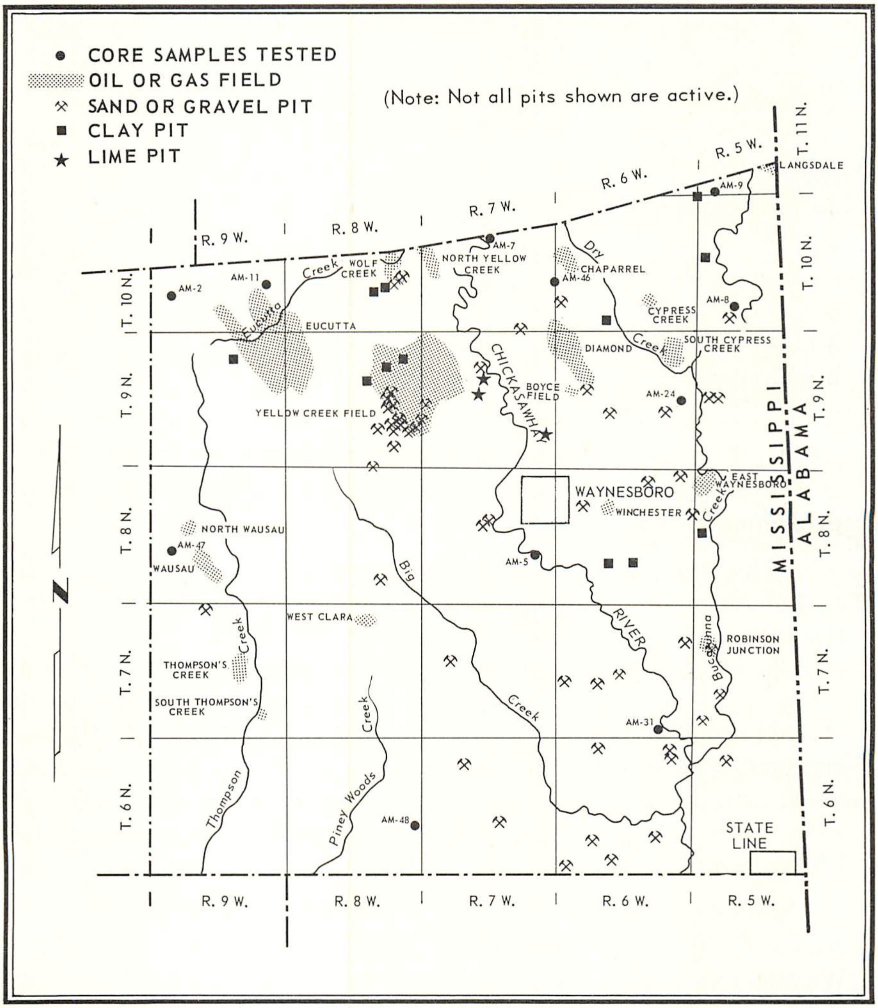


Figure 48.—Mineral resource and core sample locations.

Several mineral resources are being utilized at present. It is the hope of the Mississippi Geological Survey that with information gained through this study more of these valuable resources will be developed. This would aid in the economic growth of Wayne County and, consequently, of Mississippi.

LIMESTONE AND MARL

Valuable deposits of limestone and marl are common throughout the northern half of Wayne County. Many of these deposits were located and described in geologic literature over 100 years ago. There are several reasons why these resources have not been utilized to their fullest extent. One important reason was inadequate transportation. Navigable streams are an important method of transporting raw material. The Chickasawhay, which is the largest stream in the County, is not considered to be navigable. The County is served by a railroad, but the connections are not situated for ideal distribution of lime products. Excessive overburden was also a factor that hindered early use of this resource.

The availability of large earth-moving equipment has considerably reduced the problem of overburden. Improved roads and trucking methods have helped to solve the transportation problem.

Many of the formations in Wayne County contain calcium carbonate material. From an economic standpoint, however, the Glendon and the Marianna are the most important. This sequence of deposits is mined commercially to the west and east of Wayne County. Cement plants near Brandon, Mississippi, and north of Redwood, Mississippi, acquire their raw material from this stratigraphic interval. The Lone Star Cement Company, at its quarry near St. Stephens, Alabama, takes the majority of its raw material from the Chickasawhay, Glendon, and Marianna Formations.

An agricultural lime plant is presently in operation in the NE/4 of Sec. 16, T.9 N., R.7 W., about five miles northwest of Waynesboro (Fig. 50). The limestone is being taken from the Glendon and Marianna Formations. It is crushed on the site and then transported by spreader trucks to the surrounding lime-deficient areas, where it is applied to the soil. The plant is operated by Jim West.

Across the Chickasawhay River, and southeast from the above lime plant, is an abandoned quarry which was formerly maintained by the State Penitentiary. This site is located along the eastern edge of Sec. 26, T.9 N., R.7 W., just south of Limestone Creek. Mellen[148], in 1942, stated that a sample from this pit

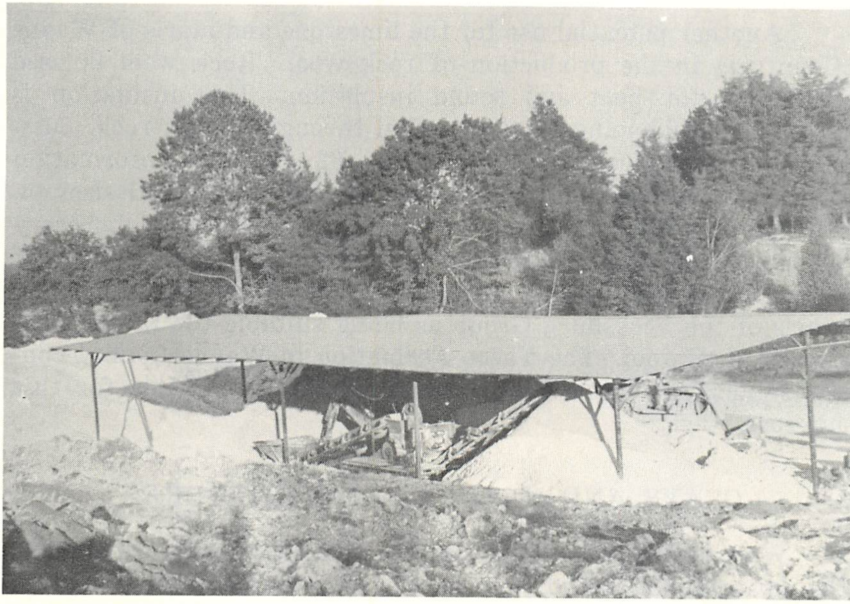


Figure 49.—Agricultural lime plant operated by Jim West. The limestone is in the Marianna Formation in the NE/4 of Sec. 16, T.9 N., R.7 W. May 1972.

analyzed 93.82 percent $CaCO_3$. Information from test hole AM-32 near the old quarry indicated 27 feet of Paynes Hammock-Chickasawhay limestone and marl, 31 feet of Bucatunna clay and 75 feet of limestone and marl making up the combined Glendon, Marianna, and Mint Spring Formations. The most massive outcrop of limestone observed by the writer is in this same area where Limestone Creek enters the Chickasawhay River.

Another large outcrop of Glendon and Marianna is located in the NE/4 of Sec. 23, T.10 N., R.8 W., about 5 miles west of Hiwannee. Mellen[149] estimated the limestone in this area to have 90 percent $CaCO_3$.

Should the need become great enough, the Red Bluff Formation and the Pachuta Marl Member of the Yazoo Formation contains considerable amounts of $CaCO_3$. These strata are also being mined at the quarry near St. Stephens, Alabama. A clay sample from test hole AM-8 near the top of the Shubuta Clay contains 40.29 percent $CaCO_3$.

Another potential use for the limestone and marls of Wayne County is in the production of rock wool. Rock wool is used primarily for heat and sound insulation. This insulation is produced by blowing a jet of steam through molten rock. Mississippi Geological Survey Bulletin 62 contains information concerning production possibilities for rock wool in Mississippi. In 1945 rock wool was produced experimentally in the laboratory of the Mississippi Geological Survey from the Selma Chalk of Lee County, Mississippi. Morse[150] discussed the limestone and marls of the Vicksburg Group as being suitable for the production of rock wool. The Yazoo Formation in Wayne County contains calcareous beds that would probably be suitable for this purpose.

CLAYS AND NATURAL CLAY MIXTURES

Wayne County's clays and clay-like mixtures are among the most abundant and least developed resources. The value of clays for use in ceramics, clarifying oils, and structural clay products has been recognized for years. Modern science has paved the way for many new applications for clays. Useful clays have a wide range of compositions and characteristics. A clay that is completely useless for some of the more familiar applications might have the exact requirements for a more specific use. Research and testing are the only way to match a unique need with the appropriate clay. Clays are used in relation to adhesives, aluminum ore, animal bedding, atomic waste disposal, cement and mortar mix, concrete additives, lightweight aggregate, pozzolanas, clarification of wines, beer, cider, etc., coating seeds, desiccants, absorbents, fabrics, fertilizers, miscellaneous fillers, floor absorbent, food, ink, leather, greases, paint, paper, plastics, pesticides, soaps, water clarification, and water impedance.[151] Although the above list is not complete it indicates the versatility of clays and clay-like mixtures.

The Glossary of Geology[152] defines the term clay from a geologic and also from an engineering standpoint. From the engineering standpoint the clay is defined as, "Plastic material consisting mainly of particles having diameters less than .074 millimeters." Geologically speaking clay is, "A rock or mineral fragment or a detrital particle of any composition (often a crystalline fragment of a clay mineral), smaller than a very fine silt grain, having a diameter less than 1/256 millimeter (4 microns)." Another geologic definition is, "A loose, earthy, extremely fine-grained, natural sediment or soft rock composed primarily of clay-size or colloidal particles and characterized by high plasticity and by containing a considerable amount of clay minerals (hydrous aluminum silicates)."

Since very few of the samples tested meet all the requirements for a clay, Moore[153] introduced the term "natural clay mixtures" for those that exhibited some of the properties of clay without having artificial materials added. In this report the writer's use of the term "clay" will very often include material that contains varying amounts of silt-sized to sand-sized particles.

Of the 49 test holes drilled by the Survey in Wayne County, 11 holes were found to contain clays exhibiting qualities which warranted preliminary testing. From the material in these eleven holes, seventeen samples were selected for testing. Seven samples were from the Catahoula Formation, two from the Bucatunna Formation, one from the Forest Hill Formation, one from the North Twistwood Creek Member of the Yazoo Formation, three from the Shubuta Member of the Yazoo Formation, and three from the Hattiesburg Formation.

The samples were sent to Mississippi State University where they were processed for testing. The tests were supervised by Dr. William B. Hall, Associate Professor, Department of Materials Engineering, Dr. Rollin C. Glenn, Head, Department of Plant and Soil Sciences, and Dr. James P. Minyard, State Chemist. The tests included: those for physical and mechanical properties (ceramics), tests for pH and $CaCO_3$ equivalents, particle size analysis, clay mineral identification by X-ray diffraction and differential thermal analysis, viscosity, and chemical analysis. Additional testing was performed by the U. S. Bureau of Mines at their research laboratory at Tuscaloosa, Alabama. Preliminary tests were run on clays thought to be suitable for lightweight aggregate material and decolorization tests on several of the Wayne County bentonitic clay samples were made.

The detailed results of all the tests are included in the section of this report entitled Wayne County Clay Tests.

Structural Clay Products

The samples from test holes AM-5, AM-31, AM-47, and AM-48 show the most promise for use in structural clay products such as: brick, sewer pipe, drain tile, building block, terra cotta, conduits, roofing tile, and quarry tile. The clay from AM-5 is the most desirable (Table 1—Clay report) and would not have to be modified by the use of additives. Most of the clay samples are montmorillonitic. The exception is AM-5, which is kaolinitic.

Drilling Muds

The most important qualification of clays for use in drilling muds is the number of barrels of mud of a given viscosity (usually 15 centipoises) obtained from a ton of clay. Figure 22 (Clay report) indicates that the clay samples from AM-2, AM-7, and AM-24 have potential for drilling muds. The writer superimposed the results of the Wayne County clay tests on a graph modified from Grim's Applied Clay Mineralogy[154] to obtain Figure 22.

Lightweight Aggregate

From the tests conducted at Mississippi State University it was determined that some of the samples were promising as lightweight aggregate material. These samples were sent to the Bureau of Mines Tuscaloosa Metallurgy Research Laboratory for preliminary bloating tests. The details of these tests are shown in Table 7 (Clay report). The Forest Hill samples from test hole AM-46 have excellent potential as raw material for lightweight aggregate.

Mineral Additives

The chemical analysis of sample AM-11 (Bucatunna) compared favorably with the analysis of a sample from the Bucatunna in Smith County, Mississippi. Clays from the Bucatunna in Smith County have been used for years in the preparation of a ferric sulfate solution used as an additive for poultry and livestock feed. The solution has also been used in the preparation of iron-rich tonics and is an excellent coagulant. The Bucatunna is mined commercially in Smith County, Mississippi, and processed by the Anvil Mineral Product Corporation and Jenkins, Thigpen, and Jenkins Corporation, both located in Bay Springs, Jasper County, Mississippi. Mineral-rich extract was also reported to have been produced from a blue clay in the NE/4 of Section 7, T.8 N., R.5 W., in Wayne County. This clay is stratigraphically higher than the Bucatunna and is probably in the Chickasawhay section.

Bleaching Clays—Bentonite

The Bureau of Mines analyzed five samples of montmorillonitic clay for their oil-bleaching capabilities. These tests are designed to determine whether or not a clay is a natural bleacher and if it can be activated. The procedure for the test is given in the Bureau of Mines Bulletin 565, entitled Syllabus of Clay Testing. The Wayne County clays tested are all capable of being activated, as shown in figures 23, 24, 25, 26, and 27 (Clay Report). The acid activated clay from Test Hole AM-24 came the closest to the desired standard in its oil-bleaching capability and is possibly a commercial prospect.

Further investigations and increasing demand for clays of varying compositions should place Wayne County in an enviable position in relation to the clay industry.

SAND AND GRAVEL

With the exception of the oil and gas industry, the sand and gravel industry is the most well-developed mineral industry in the County. Sand and gravel for the construction of county roads has been mined locally for many years. During the field work phase of this report, Highways 84 and 85 in Wayne County were in the process of being resurfaced and widened. The sand and gravel required for this project was obtained from pits within the County.

Sand and gravel is relatively abundant in Wayne County. The largest accumulation of sand and gravel is in the Citronelle Formation. Terrace deposits and alluvium contain some sand and scattered gravel deposits. From an economic standpoint the Citronelle offers the most attractive commercial prospects. Unfortunately, as seen on the Geologic Map (Plate 1), the Citronelle has a very limited areal extent. The active gravel pits which were observed by the writer were all in Citronelle deposits (Fig. 51). Many of the pits shown on the U. S. Geo-

Figure 50.—Loading Citronelle age gravel in the extreme NW/4 of Sec. 25, T.9 N., R.8 W. May 1972.

logical Survey topographic maps as gravel pits were found to contain little or no gravel. Gravel was probably present at one time in these pits, but only in small amounts.

The active gravel pits are concentrated in two areas of the County. The first area is centered around Sections 23 and 24, T.10 N., R.8 W., where sand and gravel is being mined from the Citronelle. The second area centers around Sections 14, 23, and 24, T.9 N., R.8 W. Although the gravel in this area is at a slightly lower elevation than the gravel in the first area, the writer tentatively classified it as Citronelle.

The gravel in both of the above areas appears to have undergone considerable weathering. This weathering has rendered the gravel inadequate for use in ready-mix concrete. A ready-mix concrete plant located in Waynesboro must import its gravel from other counties.

The vicinity of test hole AM-41 (Sec. 6, T.8 N., R.7 W.) bears further consideration for exploration due to the quality of gravel sampled there. The gravel from AM-41 appeared to be similar to, but much less weathered than, the gravel being mined in the pits to the north. This feature could make the gravel here more desirable for use in ready-mix concrete than any being mined in the County at the present time. More testing would be needed to determine the quality and extent of the gravels in this area. AM-41 is located on the property of Leland McMichael.

Deposits of sand are numerous throughout Wayne County. Much of this sand has been used in road construction in the past. In the area of Sec. 23, T.8 N., R.8 W., the Catahoula appears as a fine, unconsolidated quartz sand. Under microscopic examination the sand appeared to be composed almost entirely of clear quartz grains. Further exploration in this area could reveal sand suitable for commercial glass sand.

The lower terraces and alluvium are composed of sands and gravels of varying degrees of homogeneity. It should be taken into consideration that sand and gravel deposits cannot be mapped and projected with the same degree of accuracy as formations of a more continuous nature.

OIL AND GAS

The oil and gas industry is by far the most important mineral industry in Wayne County. With a total of 4,394,376 barrels of oil produced in 1972, Wayne County ranked fifth in the State in annual production. It is fourteenth in the State in annual gas production with 1,146,182,000 cubic feet for 1972. Table 2 shows the cummulative production of individual fields as of January 1, 1973.

East Eucutta Field leads the County in cummulative oil production and is second in cummulative gas production. It is located in Section 26, 35, and 36, T.10 N., R.9 W.; Sections 1, 2, 12, and 13, T.9 N., R.9 W., and Sections 6, 7, 8, 17, and 18, T.9 N., R.8 W. The zones of production are the Eutaw, Upper Tuscaloosa, Lower Cretaceous (8,052), Paluxy, Hosston, and Lower Cretaceous (10,900). The depths of the producing reservoirs range from 4,884 feet to 11,024 feet. All the producing wells, as of March 31, 1973, have to be pumped except for 17 wells that are flowing from the Paluxy horizon. The structures producing the reservoirs are faulted anticlines and domes over deep salt.

TABLE 2

Pertinent data on oil and gas fields in Wayne County, Mississippi

Field	Disc. Date	Prod. Wells	Cumulative Prod. 1-1-73 Oil Bbls.	Gas - MCF
Boyce (Boice)	3-18-73	1	1,385*	2,055*
Chaparral	4-16-52	10	3,359,437	119,913
West Clara	11,1-66	13	1,656,495	1,234,768
Cypress Creek	3-6-60	6	1,771,206	313,225
South Cypress Creek	8-30-68	9	3,867,595	1,188,883
Diamond	5-14-57	37	10,451,588	2,773,611
East Eucutta	9-3-43	89	36,552,751	2,852,128
West Eucutta	5-15-45	13	5,866,589	322,109
Langsdale	6-24-56	1**	87,301	—0—
Thompson's Creek	4-21-59	7	2,463,147	784
South Thompson's Creek	10-6-60	6	2,468,147	784
East Waynesboro	9-10-67	0	77,472	600
Wausau	8-18-53	8	3,349,066	3,372,695
North Wausau	3-1-65	0	65,058	3,276
Winchester	1-11-69	2	261,220	121,193
Wolf Creek	1-4-69	5	739,242	745,111
East Yellow Creek	8-14-58	40	6,727,049	247,704
North Yellow Creek	6-2-53	10**	1,723,712	74,925
West Yellow Creek	12-21-47	80	20,674,216	1,608,793
		337***	101,603,556	15,133,220

Source: Mississippi Oil and Gas Board
***as of January 1, 1973
**Wayne County only
*for March 1973

West Yellow Creek Field ranks second in the County in the production of oil. It is located in Sections 2, 3, 10, 11, 12, 13, 14, 15, 23, 24, and 25, T.9 N., R.8 W., and Sections 18, 19, and 30, T.9 N., R.7 W. The oil and gas producing horizons are the Eutaw, Lower Tuscaloosa, Upper-Lower Cretaceous, Middle-Lower Cretaceous, Lower-Lower Cretaceous, Upper Cotton Valley, and Lower Cotton Valley. The range of the producing depths is from 4,938 feet to 12,330 feet. The one well producing from the Lower Cotton Valley produces by gas lift and all the rest are pumped. The nature of the trap is that of a faulted domal structure overlying deep salt.

The Diamond Field is the third largest oil producer and also the third largest gas producer in the County. It is located about five miles north of Waynesboro in Section 36, T.10 N., R.7 W.; Section 1, T.9 N., R.7 W.; and Sections 3, 7, 8, 17, and 18, T.9 N., R.6 W. The producing horizons are the Glen Rose, Hosston, and the Cotton Valley (four different zones). The shallowest production is from a depth of 9,200 feet and the deepest is from 12,248 feet. The only wells that do not require pumping are two flowing wells from the 12,000 foot Cotton Valley horizon. The structures are anticlinal except for the 12,100 foot Cotton Valley horizon which is listed as a stratigraphic trap.

East Yellow Creek Field is located west of the Chickasawhay River in Section 31, T.10 N., R.7 W., and Sections 5, 6, 7, 8, and 17, T.9 N., R.7 W. In Table 2 the production from East Yellow Creek Field Unit was included in with the East Yellow Creek Field. They both produce from the Eutaw. The wells in East Yellow Creek all require pumping to remove the oil and gas. The East Yellow Creek Field Unit has no gas production. The Robert Graham #1 and the M. M. Roebuck #1-A are the only non-gas producing wells in the East Yellow Creek Field. The other wells in the field produce oil and gas. The producing depths are from 4,724 feet to 4,988 feet. The structure forming the trap is a complexly faulted dome overlying deep-seated salt.

West Eucutta Field is located in Sections 27, 28, and 34, T.10 N., R.9 W., and Sections 2, 3, and 11, T.9 N., R.9 W. Oil and gas in this field is produced from the Eutaw. Of the thirteen producing wells the Ernest Pace et al #1 is the only one that produces oil but no gas. The producing horizons are from 4,884 feet to 5,299 feet. The structure is a faulted dome overlying deep-seated salt.

South Cypress Creek Field, located in Sections 1, 2, 11, and 12, T.9 N., R.6 W., produces from the Smackover reservoir at a depth of 14,299 feet to 14,588 feet. The nine wells in the field are pumping wells. The oil and gas is taken from an anticlinal structure.

The Chaparral Field, located in Sections 12 and 13, T.10 N., R.7 W., and Sections 7, 18, and 19, T.10 N., R.6 W., produces from the Eutaw, Rodessa, Sligo, and Hosston reservoirs. The producing horizons are between 8,689 and 10,201 feet. The ten wells in the field all require pumping. Only one of the five wells pumping from the Rodessa produces gas. One of the two wells in the Sligo produces only oil. The structure is domal and is related to underlying salt.

Wausau Field, located in Sections 21 and 28, T.8 N., R.9 W., produces oil and gas from the Tuscaloosa and the Upper Paluxy reservoirs at depths of 7,431 feet to 10,930 feet. Pumping is necessary on all eight wells. Two of the wells produce only oil with the remaining six yielding oil and gas. The structures forming the traps are the result of faulting over a deep-seated dome.

North Wausau Field was abandoned in August of 1969.

Thompson's Creek Field, located in Sections 14, 15, 22, and 23, T.7 N., R.9 W., produces oil and gas from the Tuscaloosa and oil from the Washita-Fredericksburg. The zones yielding oil and gas are between 8,120 feet and 10,184 feet and were formed as the result of anticlinal structures. All wells must be pumped.

South Thompson's Creek Field, located in Sections 34 and 35, T.7 N., R.9 W., produces oil and gas from the Lower Tuscaloosa, Washita-Fredericksburg, and Paluxy zones. These zones are at depths between 8,009 feet and 11,381 feet. The six producing wells require pumping. The structure is an anticlinal closure within a graben overlying deep-seated salt.

Cypress Creek Field, located in Sections 26 and 27, T.10 N., R.6 W., produces oil from the Rodessa and oil and gas from the Smackover. The producing zones are between 8,750 feet and 12,808 feet. The nature of the trap is a faulted anticline produced by salt movement.

North Yellow Creek Field is located on the Clarke-Wayne County line. The wells in Wayne County are in Section 13, T.10 N., R.8 W., and Sections 18 and 19, T.10 N., R.7 W. The information in Table 2 pertains only to the part of the field in Wayne County. The production is from the Eutaw at a depth of 4,638 feet to 4,900 feet. The wells in this field all require pumping. The structure is a fault-line trap.

West Clara Field, located in Sections 2 and 3, T.7 N., R.8 W., produces oil and gas from the Washita-Fredericksburg, Paluxy, Rodessa, Upper Sligo, Lower Sligo, Cotton Valley, and Smackover. The Rodessa is the most prolific producing zone in the field. The depth of production is between 9,445 feet and 13,362 feet. The traps are mostly anticlinal overlying deep salt piercement.

Wolf Creek Field, located in Section 23, T.10 N., R.8 W., is a five well field that produces oil and gas from the Smackover. The depth of the producing zones is 15,250 feet to 15,600 feet. The structure is anticlinal. The wells are flowing.

Winchester Field, located in Sections 9 and 17, T.8 N., R.6 W., produces oil and gas from the Cotton Valley and the Smackover. The producing depths are 12,611 feet to 15,700 feet. The field contains only two wells and both require pumping. The structure is anticlinal.

Langsdale Field is located mostly in Clarke County, Mississippi. One well in Section 27, T.11 N., R.5 W., Wayne County, pumps oil from the Eutaw. The producing depths for the field are 3,622 feet to 3,780 feet. The production is from a fault trap structure.

The cummulative production is shown for East Waynesboro and North Wausau Fields, but they were not producing as of March 1973.

Boyce Field, located in Section 18, T.9 N., R.6 W., has one well that flows oil and gas from the Smackover. The production shown in Table 2 is only for March of 1973, which is the month this field was discovered.

The oil and gas industry, along with related industries, plays an important role in the economic development of Wayne County. Many local jobs are created during the exploration phase, development, and maintenance of an oil or gas field. Geophysical exploration and wildcat drilling are being conducted daily throughout the County. Deeper test holes made possible by advanced technology permit sampling of heretofore unexplored strata. With $233,795 returned to the County in oil and gas severance taxes for 1972 alone, the future looks promising for the oil and gas industry of Wayne County.

The sources of information on the oil and gas fields of Wayne County are the monthly production bulletins of the Mississippi State Oil and Gas Board.

BUILDING STONE

The Catahoula Formation has been quarried in Mississippi for sandstone used in construction. In Wayne County, as it is throughout the State, the variance in induration of the sandstone limits its usefulness. It is often very hard and compact near the surface, but is unindurated a few feet away in the subsurface.

The Marianna, locally called "chimney stone," has been quarried and used for the construction of chimneys. Unlike the Catahoula, this limestone is fairly homogeneous in its outcrop area. It is not hard enough, however, to be considered a good building material.

The Glendon contains hard ledges but is usually considered unsuitable as a building material.

LIGNITE

The Survey is presently conducting a State-wide investigation of lignite deposits. Mississippi lignite, which was once thought to have little value, is being given a second look due to the current energy crisis. Beds of lignite are present in the Cockfield and Forest Hill Formations in Wayne County. These beds are usually thin and restricted to areas of small areal extent. The thickest beds of lignite penetrated during this study were two 12 inch thick seams of argillaceous lignite encountered in test hole AM-17 in the NW/4 of Sec. 3, T.10 N., R.5 W., near the Alabama-Mississippi state line. The lignite beds were about 165 feet below ground surface in the Cockfield Formation. The test hole was located on a high hill at an elevation of 390 feet.

SIDERITE ($FeCO_3$)

The ferruginous nodules that characterize the Red Bluff Formation in Wayne County contain a significant amount of siderite. Siderite is a valuable iron ore. Much of the siderite contained in the Red Bluff outcrops is weathered to limonite. More detailed drilling in the Red Bluff outcrop area, along with chemical analyses, would determine the feasibility of utilizing this material.

The largest accumulation of sideritic nodules observed by the writer was in the SE/4 of Sec. 24, T.10 N., R.7 W. Information from nearby test hole AM-46 indicates that the strata containing the sideritic nodules is overlain by the Forest Hill Formation. The clay in the Forest Hill in this area was tested favorably (in preliminary tests) as lightweight aggregate material.

GEOTHERMAL ENERGY

Because of the worldwide energy crisis, geothermal energy is being considered as a means to supplement the more conventional forms of energy. Geothermal energy is useful energy that can be extracted from naturally occurring heat from the Earth's interior.

The Mississippi Geological Survey is currently planning a research project to study geothermal areas in Mississippi.

Geopressured zones commonly are penetrated during the exploration for oil and gas in Mississippi. Geopressures occur where the fluid pressure exceeds the normal hydrostatic pressure of 0.465 pound per square inch per foot of depth. In geopressured deposits, the geothermal gradients are higher than the approximate average for the Earth's crust of 25° C/km.

According to Calvin A. Parker[155], "the highest pressure gradients in Mississippi are 1.03 psi/ft in the Buckner and 1.06 psi/ft in the Smackover, both of which were found in salt water flows from Shell-Murphy USA 22-7, a 23, 455-ft wildcat in Sec. 22, T.6 N., R.8 W., Wayne County. The Buckner geopressure shook the rig during drilling at 19,904 ft and a bottom-hole pressure of 20,500 psi was calculated."

These geopressured areas represent an energy source that could possibly be developed in the future. Thermal waters of the correct temperature, pressure, and salinity could be used to produce steam for electric power generation.

STRUCTURE

The geology of Wayne County is influenced by several major structural features. The County is located along the east side of the synclinal structure known as the Mississippi Embayment. The Embayment is a part of the much larger Gulf Coast Geosyncline. The regional dip of the near-surface strata is about 38 feet per mile toward the southwest (determined from dip section, Plate 4). The Embayment plunges to the south with the axis located just east of the Mississippi River.

The electrical logs used in preparing the Dip Section, A-A′ on Plate 4 are: 1-Humble, John Blodgett #8-A; 2-Sohio Petroleum Company, Wayne #134-A; 3-Sohio Petroleum Company, Wayne #106-A; 4-Sohio Petroleum Company, Wayne #108-A; 5-Sohio Petroleum Company, Wayne #120-A; 6-Griner Drilling Company, Town of Waynesboro, Test Hole #3; 7-Sohio Petroleum Company, Wayne #130-B; 8-Sohio Petroleum Company, Wayne #116-A; 9-Mississippi Geological Survey, Test Hole AM-19; and 10-Mississippi Geological Survey, Test Hole AM-17.

The electrical logs used in preparing the Strike Section, B-B′ on Plate 4 are: 1-Sohio Petroleum Company, Wayne #99-A; 2-R. Merrill, G. S. Stanley #1; 3-Sohio Petroleum Company, Wayne #109-A; 4-Sohio Petroleum Company, Wayne #145-B; 5-Sohio Petroleum Company, Wayne #119-A; 6-Griner Drilling Company, Town of Waynesboro, Test Hole #9; 7-Sohio Petroleum Company, Wayne #197-B; 8-Sohio Petroleum Company, Wayne #140-B; 9-Sohio Petroleum Company, Wayne #123-B; and 10-Sohio Petroleum Company, Wayne #216-B.

A fault system is recognized downdip of the Pickens-Gilbertown zone in the central and eastern Mississippi counties. The faults in this system have a more northerly and irregular trend than those in the Pickens-Gilbertown system.

The above fault zone appears to be closely associated with salt. Wayne County is located near the updip limit of the Louann salt on the northeast margin of the Interior Salt Basin of Mississippi (Fig. 51). Many deep-seated structural swells are located near the northern edge of the salt basin. Large north to northwestward-trending salt ridges are often associated with the faulting. The deep-seated salt domes are very important structural features in the production of oil and gas. The majority of the oil fields in Wayne County are underlain by deep salt features. For example, both Eucutta and Yellow Creek Fields are graben structures overlying deep-seated salt domes. Many of the fault planes have angles of approximately 45°. The displacement of beds increases with depth from a few hundred feet or less near the surface, to one thousand feet or more on the deeper horizons.

The northwestern part of the Hatchetigbee Anticline is located along the Mississippi-Alabama line adjacent to the northeast corner of Wayne County.

In an effort to determine what effect structural features might have on near surface strata, the writer constructed struc-

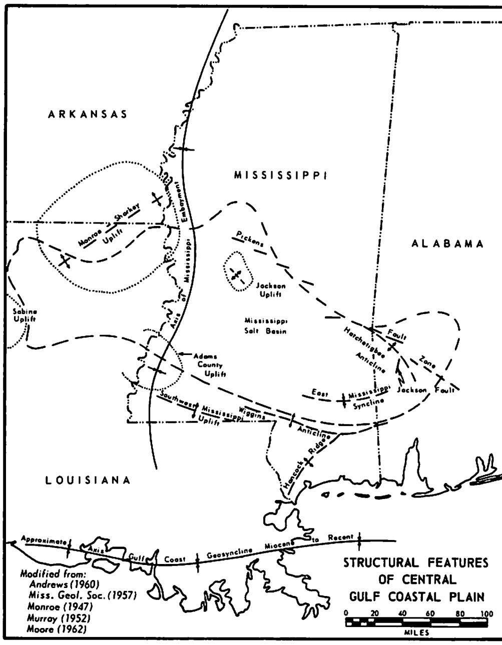


Figure 51.—Structural features of central Gulf Coastal Plain.

tural contour maps of two shallow horizons. The datum planes chosen were the tops of the Glendon Formation and Moodys Branch Formation. Both formations were easily mappable and were readily distinguishable on electrical logs. The information for these structure maps was obtained from Survey test holes, water well tests, oil well tests, and surface outcrops. Microscopic examination of samples aided in the correlation of datum points on the electrical logs.

Plate 2 in this report is a structural contour map using as datum the top of the uppermost limestone ledge in the Glendon Formation. The contour interval is 20 feet. As determined from the strike section on Plate 4 the regional strike of the Glendon is approximately north 70° west. In an area slightly northeast of Waynesboro the strike is almost due east and west. Near the center of the County the strike is about north 85° west and in the southwest corner of the County the strike is north 55° west. Locally the strike is very irregular, especially in the area of some of the oil fields. As observed from the dip section on Plate 4, the regional dip of the Glendon is approximately 38 feet per mile.

Some of the deep structure underlying Wayne County apparently showed up on the Glendon structure map as anomalous nosings and deviations from normal dip. Strong nosings are evident in the area to the southwest of West Eucutta Oil Field in the northern part of T.9 N., R.9W. Anomalies are very evident in the areas of Eucutta, Yellow Creek, and Thompson's Creek Oil Fields. A strong northeasterly trending anomaly is located in the northwest corner of T.8 N., R.5 W., three miles north of Denham. Another strong anomalous structure is evident in T.6 N., R.7 W., where an apparent structural high with a southwest trend is located. A deviation from normal dip is evident two miles east of the Clara community. A line drawn between test holes AM-41 (Sec. 6, T.8 N., R.7 W.) and AM-38 (Sec. 29, T.9 N., R.7 W.) parallels a structural low as seen on the Glendon structure map. Cuttings examined from these test holes confirm a small displacement in strata in this area. A southward nosing just west of State Line is probably the result of the salt dome located just below the Wayne-Greene County line in Greene County (County Line Dome). Minor deflections are apparent in the Buckatunna area.

The top of the Moodys Branch Formation was used as the datum for a second and deeper structural contour map. As discussed previously, the Moodys Branch is a widespread and often used mapping horizon due to the ease with which it is recognized on electrical logs. It can be seen on Plate 3 that the regional strike for the Moodys Branch, like that of the Glendon, is approximately north 70° west. The regional dip averages about 38 feet per mile to the southwest. Anomalies revealed on the top of the Moodys Branch are in basically the same areas as those shown on the Glendon map. On the Moodys Branch map the nosings are more clearly defined and may be shifted slightly. The shifting is probably due to the position at which the fault planes cut through formations at varying depths. As stated earlier, the fault planes normally have angles of 45° and displacement of beds increases with depth. In constructing these two maps the writer contoured around probable faults where this was possible. At two localities on the Moodys Branch map the displacement was such that it was not feasible to contour around the suspected faults. Southwest of West Eucutta Oil Field, a fault trending north 40° west, and down-thrown to the northeast, is shown on the Moodys Branch datum. Slightly to the northeast of East Yellow Creek Field, a fault trending north 48° west, and down-thrown to the southwest, is shown.

A nosing trend on the Moodys Branch datum (the Glendon is eroded away in this area) is located in T.9 N., R.6 W., in the area of Cypress Creek Field. A weak structural trend is indicated in the Boice area about four miles north of Waynesboro. An unusually steep dip along a nosing in the area of Sec. 28 and 33, T.8 N., R.9 W., may be a reflection of the structure that produces in the Wausau Field.

On the geologic map of Wayne County (Plate 2) the writer shows the approximate locations of the surface expression of six shallow faults. The writer indicated only the faults that were revealed through evidence gained during the current survey. The displacement along these faults is not great on the surface, but probably increases with depth. The faults shown are along the Chickasawhay River and Bucatunna Creek.

The northernmost fault shown on the Chickasawhay River begins in the southwest corner of Sec. 4, T.9 N., R.7 W., and extends north 50° east toward the northeast corner of Sec. 26, T.10 N., R.7 W. The reasons for placing the approximate location of a fault in the above area were as follows: the lineation observed from a right angle bend in the Chickasawhay River, up Carson Sand Creek and continuing up Sand Branch into Chaparral Field; and two hills parallel to Carson Sand Creek that are capped by Marianna Limestone that appears to dip toward the southeast. Another fault is shown extending from Sec. 9, T.9 N., R.7 W., south 18° east toward the mouth of Yellow Creek. The criteria for placing the fault as shown were: the change in direction of flow from east to south of Yellow Creek at West King; and the anomalous nosing as indicated on the Glendon structural contour map. A fault is suspected to extend from the southeast corner of Sec. 22, T.9 N., R.7 W., south 65° east and into Sec. 25, T.9 N., R.7 W. The criteria for the location of this fault were: the abrupt change in direction of the Chickasawhay River; the unusual warped and fractured appearance of the Glendon near this abrupt change; and the fact that AM-32 in Sec. 25, T.9 N., R.7 W., contained 27 feet of Glendon while AM-16, located across the suspected fault in Sec. 13, T.9 N., R.7 W., contained no Glendon.

Along Bucatunna Creek beginning in Sec. 18, T.9 N., R.5 W., and trending north 50° west along Dry Creek is another suspected fault. The criteria for the location of this fault were: abrupt changes in direction of Bucatunna Creek; the fact that the line of hills paralleling Dry Creek are capped with Marianna, but are not following regional strike as would be expected; an increase in dip in this area as shown by the dip section on Plate 4; and the fact that the Bucatunna section thins and its sediments become more diversified southwest of this area. A second fault along Bucatunna Creek is shown extending from a sharp bend located in Sec. 6, T.8 N., R.5 W., north toward right angle deflections in Bucatunna Creek in Sec. 19, T.9 N., R.5 W. The fault located to the southwest of the above fault is believed to help form a graben-like structure. This structure is visible on the Glendon structural contour map. The Glendon in test hole AM-28 in the NW/4 of Sec. 32, T.9 N., R.5 W., is 50 feet lower than in AM-26 in the NW/4 of Sec. 25, T.9 N., R.6 W. The two holes are approximately along regional strike and less than two miles apart.

Test Hole and Core Hole Records

The following are descriptions of cuttings and cores from test holes drilled and/or cored during the geologic and mineralogic study of Wayne County. The test holes preceded by the prefix AM were drilled or cored by the Mississippi Geological Survey. The prefix AM is a code designation reserved for samples from Wayne County. All the following described samples are cataloged and stored in the Survey's Sample Library, where they are available for public observation. The samples were washed prior to microscopic examination.

The test holes not preceded by the prefix AM were drilled by Griner Drilling Service in a series of water well tests for the City of Waynesboro. The writer was present during most of the drilling. The Survey ran electrical logs on these wells and has the samples on file.

The test hole locations were determined from 7.5 minute topographic maps. In areas where these maps were not available larger scale maps and aerial photos were used. Elevations shown were obtained from topographic maps or from a Paulin altimeter and represent ground level elevations at the drill sites.

The purpose for drilling each test hole is stated in the heading along with other appropriate remarks. The quality of the samples is very good due to precautions such as proper drilling fluid consistency and the correct rate of penetration. Driller's logs from the Survey driller, Randal Warren, were incorporated in the field notes of the writer at each location.

All thicknesses and depths are expressed in feet.

AM-1

Location: 50 feet east of asphalt road, on property of Pete Reynolds, in NE/4, NW/4, SE/4, SW/4, Sec. 6, T.9 N., R.8 W.

Elevation: 345 feet (Topographic map) Date: June 12, 1972

Purpose: Drilled 163 feet for stratigraphic information. Cored to 18 feet to obtain clay for testing. Descriptions from cores and cuttings. Electrical log to 162 feet.

Depth	Thickness	Description
		Catahoula Formation
10	10	Sand, light-gray and light-red, fine- to medium- grained, subangular quartz, kaolinitic, ferruginous.
40	30	Sand, very pale-orange, medium- to coarse-grained, mostly subangular quartz, ferruginous, argillaceous, micaceous.
58	18	Sand, very pale-orange and light-red, fine- to medium-grained, subangular quartz, micaceous, rare glauconite, clay streaks.
75	17	Clay, dark-greenish-gray, fine-textured, blocky, pyritic.
		Paynes Hammock Formation
84	9	Sand, light-gray, medium-grained, subangular quartz, argillaceous, ferruginous.
88	4	Marl, grayish-yellow, medium-grained quartz, fossiliferous, indurated.
90	2	Clay, light-gray, fine-textured, blocky, calcareous.
96	6	Sand, light-gray, fine- to medium-grained, subangular quartz, glauconitic, argillaceous.
		Chickasawhay Formation
111	15	Clay, olive-gray, fine-textured, arenaceous in lower part, glauconitic, fossiliferous.
113	2	Limestone, light-olive-gray, fine- to medium-textured, fossiliferous, glauconitic, arenaceous; fossil imprints.
114	1	Clay, medium-dark-gray, calcareous, glauconitic, arenaceous.
118	4	Limestone, light-gray, fine- to medium-textured, glauconitic, arenaceous; soft marly clay streaks.
124	6	Clay, dark-gray, arenaceous, carbonaceous, fossiliferous.
		Vicksburg Group (Bucatunna Formation)
146	22	Clay, dark-gray, lignitic, arenaceous (medium-grained, subangular quartz), pyritic, fossiliferous.
147.5	1.5	Limestone, light-olive-gray, fine-textured, fossiliferous, pyritic.
156	8.5	Clay, dark-gray, silty, carbonaceous, fossiliferous, pyritic.
		Vicksburg Group (Byram Formation)
159	3	Marl, medium-dark-gray, medium-grained quartz, glauconitic, pyritic, very fossiliferous.
		Vicksburg Group (Glendon Formation)
162	3+	Limestone, light-olive-gray, fine-textured, hard, fossiliferous.

AM-2

Location: Approximately 30 feet west of unimproved road on Masonite property, in NE/4, NE/4, SE/4, NE/4, Sec. 30, T.10 N., R.9 W.

Elevation: 365 feet (Topographic map) Date: June 13, 1972

Purpose: Drilled 157 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 156 feet. Cored to 20 feet to obtain clay samples for testing.

Depth	Thickness	Description
		Soil
1	1	Sand, light-brown, medium-grained, subangular quartz, ferruginous.
		Catahoula Formation
4	3	Clay, mottled light-brown and yellowish-gray, smooth- to silty-textured, fissile.
13	9	Clay, brownish-gray, smooth-textured, ferruginous.
14	1	Sand, light-greenish-gray, very fine-grained, argillaceous, micaceous.
20	6	Clay, greenish-gray, silty, micaceous.
25	5	Sand, light-greenish-gray, very fine-grained, argillaceous, micaceous.
42	17	Silt, light-gray, argillaceous, micaceous.
53	11	Clay, greenish-gray, fine-textured, fissile.
68	15	Sand, medium-gray, fine-textured, ferruginous, carbonaceous; indurated ledge near top.
		Paynes Hammock Formation
80	12	Clay, white, fine-textured, homogeneous, very calcareous, rare fossils; partially indurated.
		Chickasawhay Formation
95	15	Marl, olive-gray, very fossiliferous, glauconitic, partially indurated, argillaceous.
97	2	Limestone, light-olive-gray, arenaceous, fossiliferous.
98	1	Marl, dark-gray, fossiliferous, argillaceous.
100	2	Limestone, light-olive-gray, arenaceous, fossiliferous.
101	1	Marl, dark-gray, fossiliferous, argillaceous.
103	2	Limestone, light-olive-gray, arenaceous, fossiliferous.
108	5	Marl, medium-gray, very fossiliferous (coquina).
		Vicksburg Group (Bucatunna Formation)
144	36	Clay, olive-black, silty, carbonaceous, micaceous, fossiliferous, fissile.
		Vicksburg Group (Byram Formation)
152	8	Marl, olive-gray, fossiliferous, glauconitic.
		Vicksburg Group (Glendon Formation)
156	4+	Limestone, light-gray, fossiliferous, hard; marl streak.

AM-3

Location: On hilltop, 700 feet south of Eucutta Creek, in NW/4, NW/4, NW/4, Sec. 29, T.10 N., R.8 W.

Elevation: 360 feet (Topographic map) Date: June 15, 1972

Purpose: Drilled 78 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 55 feet.

Depth	Thickness	Description
		Citronelle Formation
17	17	Sand, grayish-orange, medium- to very coarse-grained, subrounded to rounded quartz; chert gravel with fossil imprints.
17.5	.5	Sandstone, light-brown, coarse-grained, ferruginous.
		Vicksburg Group (Bucatunna Formation)
26	8.5	Clay, multicolored, silty, friable.
42	16	Sand, grayish-orange, fine-grained, subangular to subrounded quartz, ferruginous; clay streak.
63	21	Clay, light-brown changing to brownish black, silty, carbonaceous, pyritic, montmorillonitic, blocky.
		Vicksburg Group (Byram Formation)
70	7	Marl, light- to moderate-brown, fossiliferous, ferruginous.
		Vicksburg Group (Glendon Formation)
78	8+	Limestone, white, soft, badly weathered, fossiliferous. Note: Lost circulation here.

AM-4

Location: 250 feet south of gravel road, in NE/4, NW/4, NW/4, NW/4, Sec. 21, T.10 N., R.8 W.

Elevation: 295 feet (Topographic map) Date: June 19, 1972

Purpose: Cored and drilled to 62 feet for stratigraphic information. Descriptions from cuttings and cores. No electrical log due to loss of circulation.

Depth	Thickness	Description
		Terrace deposit
13	13	Sand, reddish-brown, medium-grained, argillaceous; pea gravel in lower part.
27	14	Sand, yellowish-orange to white, coarse-grained, subangular quartz.
		Vicksburg Group (Marianna Formation)
29	2	Clay, pale-yellowish-brown, silty, bentonitic.
37	8	No recovery.
42	5	Limestone, yellowish-gray, soft, very fossiliferous (many **Lepidocyclina** noted.)
		Forest Hill Formation
62	20+	Clay, dark-gray, silty, carbonaceous.

AM-5

Location: One-half mile southwest of State Highway 63 Chickasawhay River Bridge, in NW/4, NW/4, NW/4, Sec. 25, T.8 N., R.7 W.

Elevation: 255 feet (Topographic map) Date: June 20, 1972

Purpose: Cored 42 feet to obtain samples of clay for testing. Descriptions from cores. Electrical log not available.

Depth	Thickness	Description
		Terrace deposit
21	21	Sand, multicolored, medium- to coarse-grained, subangular quartz, ferruginous; argillaceous streaks; bedding planes.
		Catahoula Formation
28	7	Clay, multicolored to light-gray, smooth-textured, waxy appearance.
32	4	Clay, light-gray to pale-red-purple, very smooth, kaolinitic.
42	10+	Sand, grayish-orange, medium- to coarse-grained, subangular quartz, ferruginous.

AM-6

Location: 400 feet northeast of Little Rock Church, at intersection of county road with State Route 63, in NW/4, NE/4, SW/4, Sec. 26, T.8 N., R.7 W.

Elevation: 290 feet (Topographic map) Date: June 20, 1972

Purpose: Cored 22 feet to obtain clay samples for testing. Descriptions from core. No electrical log.

Depth	Thickness	Description
		Catahoula Formation
5	5	Clay, light-gray, silty, ferruginous.
10	5	Sand, pale-yellowish-orange, fine- to medium-grained, subangular quartz, ferruginous, argillaceous.
14	4	Sand, white, fine- to medium-grained, subangular quartz; sugar-like appearance.
22	8+	Sand, multicolored, medium- to coarse-grained, subangular quartz, ferruginous.

AM-7 and AM-14

Location: On the Daniel property, about 50 feet west of U. S. Route 45, in SE/4, SW/4, SW/4, Sec. 10, T.10 N., R.7 W.

Elevation: 260 feet (Topographic map) Date: June 21, 1972
July 10, 1972

Purpose: Cored 61 feet in AM-7 to obtain clay samples for testing and to describe contact of lower Red Bluff and Shubuta. Drilled 299 feet at same location for stratigraphic correlation and ground-water information. Electrical log to total depth.

Depth	Thickness	Description
		Soil
.5	.5	Soil, light-gray, silty.
		Red Bluff Formation
4	3.5	Clay, mottled-light-gray and light-brown, silty, calcareous.
4.5	.5	Clay, light-brown, fossiliferous; partially indurated.
7	2.5	Clay, olive-gray, very fossiliferous.
7.5	.5	Clay, light-brown, fossiliferous; partially indurated.
		Yazoo Formation (Shubuta Clay)
35	27.5	Clay, mottled light-gray and light brown, silty, calcareous, gypsiferous, blocky.
80	45	Clay, light-olive-gray, silty; fossiliferous (numerous **Flabellum** imprints at 58 feet).
92	12	Clay, brownish-gray, silty; fossiliferous (mostly microfossils).

		Yazoo Formation (Pachuta Marl)
102	10	Marl, light-olive-gray, arenaceous, fossiliferous, glauconitic; partially indurated.
		Yazoo Formation (Cocoa Sand)
130	28	Sand, light-gray, fine-grained, subangular quartz, fossiliferous, partially indurated; more argillaceous in lower part.
		Yazoo Formation (North Twistwood Creek Clay)
188	58	Clay, olive-gray, silty, fossiliferous, fissile, micaceous; glauconitic in lower part.
		Moodys Branch Formation
196	8	Marl, dark-olive-gray, arenaceous, glauconitic, fossiliferous; partially indurated.
		Cockfield Formation
206	10	Clay, dark-gray, lignitic, arenaceous, fossiliferous.
232	26	Sand, light-olive-gray, fine- to medium-grained, subangular quartz, glauconitic, pyritic, fossiliferous, micaceous.
240	8	Clay, dark-gray, silty to arenaceous, lignitic, fossiliferous.
247	7	Sand, medium-dark-gray, medium-grained, subangular quartz, fossiliferous.
252	5	Clay, grayish-black, silty, lignitic.
270	18	Sand, dark-gray, fine- to medium-grained, subangular quartz, pyritic, argillaceous.
284	14	Sand, light-gray, fine- to medium-grained, angular to subangular quartz, glauconitic, fossiliferous, argillaceous.
		Cook Mountain Formation
300	16+	Clay, dark-gray, silty, lignitic, fissile.

AM-8

Location: Approximately 75 feet northwest of gravel road, on hillside, in NE/4, NE/4, NW/4, NE/4, Sec. 32, T.10 N., R.5 W.

Elevation: 250 feet (Topographic map) Date: June 21, 1972

Purpose: Cored 30 feet to obtain clay with a bentonitic appearance. Descriptions from cores. No electrical log.

Depth	Thickness	Description
		Soil
.5	.5	Soil, grayish-orange, silty.
		Yazoo Formation (Shubuta Clay)
14	13.5	Clay, grayish-yellow, silty, lime nodules, fossiliferous.
22	8	Clay, greenish-gray to yellowish-gray, smooth-textured, brown specks, calcareous.
30	8	Clay, yellowish-gray, silty to arenaceous, fossiliferous, marly in part.

AM-9

Location: In flat, 200 feet south of gravel road in, NW/4, NW/4, NE/4, NE/4, Sec. 6, T.10 N., R.5 W.

Elevation: 275 feet (Topographic map) Date: June 22, 1972

Purpose: Cored 32 feet to obtain samples of a clay reported to be a sub-bentonite in Mississippi Geological Survey Bulletin 29. Descriptions from cores. No electrical log.

.4	.4	Soil, grayish-brown, silty.
		Yazoo Formation (North Twistwood Creek Clay)
2	1.6	Clay, mottled yellowish-gray and light-brown, silty, lime nodules, blocky.
6	4	Clay, grayish-yellow, smooth-textured, blocky, fossil imprints.
8	2	Clay, grayish-yellow, smooth-textured, weathered light-brown in spots, ferruginous.
29	21	Clay, grayish-yellow, smooth-textured, fossiliferous, lime nodules.
		Moodys Branch Formation
32	3+	Marl, olive-gray, arenaceous, fossiliferous, glauconitic, weathered brown in part; indurated last few inches.

AM-10

Location: On hillside, 25 feet northwest of gravel road, in SW/4, NE/4, NW/4, Sec. 3, T.10 N., R.5 W.

Elevation: 340 feet (Altimeter) Date: June 22, 1972

Purpose: Cored to 40 feet to obtain clay for testing and to correlate information from AM-9. Descriptions from cores. No electrical log.

Depth	Thickness	Description
		Yazoo Formation (North Twistwood Creek Clay)
4	4	Clay, mottled yellowish-gray and light-brown, smooth-textured, bentonitic, lime nodules.
6	2	Clay, yellowish-gray, smooth-textured, fossiliferous (fragile fragments).
9	3	Clay, yellowish-gray, bentonitic, smooth-textured, blocky; fossil imprints and fragile parts.
18	9	Clay, greenish-gray, bentonitic, blocky, fossiliferous.
20	2	Clay, greenish-gray, silty, calcareous, fissile.
28	8	Clay, greenish-gray, smooth-textured, blocky, calcareous; numerous
		Flabellum (cuneiformes?).
38	10	Clay, greenish-gray, smooth-textured, very fossilerous.
		Moodys Branch Formation
40	2+	Marl, olive-gray, fossiliferous, glauconitic, indurated in lower part.

AM-11

Location: In Sugar Hill Creek valley, 40 feet southeast of gravel road, in NW/4, SW/4, SW/4, Sec. 24, T.10 N., R.9 W.

Elevation: 295 feet (Topographic map) Date: July 5, 1972

Purpose: Cored 34 feet to obtain clay sample for testing. Descriptions from cores. No electrical log due to loss of circulation.

Depth	Thickness	Description
		Soil
.5	.5	Soil, dark-gray, humus.
		Alluvium
22	21.5	Sand, dark-yellowish-orange, medium- to coarse-grained, subrounded to rounded quartz, some pea gravel.
		Vicksburg Group (Bucatunna Formation)
24	2	Clay, brownish-black, silty, carbonaceous.
		Vicksburg Group (Byram Formation)
28	4	Marl, yellowish-gray, argillaceous, soft, fossiliferous.
		Vicksburg Group (Glendon Formation)
29.5	1.5	Limestone, light-olive-gray, fine-textured, very hard, fossiliferous.
34	4.5+	Marl, olive-gray, silty, fossiliferous.

AM-12

Location: On hillside. 40 feet southeast of gravel road, in NW/4, NW/4, NE/4, NE/4, Sec. 26, T.10 N., R.9 W.

Elevation: 310 feet (Topographic map) Date: July 5, 1972

Purpose: Drilled 200 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 199 feet.

Depth	Thickness	Description
		Chickasawhay Formation (badly weathered)
10	10	Clay, light-brown to dark-yellowish-orange, arenaceous (subangular to rounded, coarse-grained quartz), glauconitic, pyritic; rare fossil fragments.
		Vicksburg Group (Bucatunna Formation)
45	35	Clay, dark-gray, silty, carbonaceous, micaceous, fissile, fossiliferous.
		Vicksburg Group (Byram Formation)
51	6	Clay, dark-gray, silty; becoming more fossiliferous.
		Vicksburg Group (Glendon Formation)
53	2	Limestone, light-olive-gray, fine-textured, hard, fossiliferous.
54	1	Marl, light-gray, partially indurated, fossiliferous.
55	1	Limestone, light-gray, fossiliferous, pyritic.
60	5	Marl, light-gray, partially indurated, fossiliferous.
74	14	Limestone, light-gray, fine-textured, fossiliferous, pyritic, soft marl streaks, argillaceous.
		Vicksburg Group (Marianna Formation)
80	6	Limestone, medium-dark-gray, fine-textured marl streaks; softer than limestone above.
83	3	Marl, light-gray, fossiliferous, argillaceous.
84	1	Limestone, light-gray, fine-textured, soft, fossiliferous.
87	3	Marl, light-gray, fossiliferous, argillaceous, pyritic.
91	4	Limestone, light-gray, fine-textured, fossiliferous, pyritic.

94	3	Marl, light-gray, fossiliferous, argillaceous, pyritic, glauconitic.
97	3	Limestone, light-gray, fine-textured, fossiliferous.
99	2	Marl, medium-dark-gray, fossiliferous, pyritic, glauconitic, argillaceous.
100	1	Limestone, medium-dark-gray, fine-textured, fossiliferous.
102	2	Marl, light-olive-gray, fossiliferous, argillaceous.
107	5	Limestone, light-olive-gray, fossiliferous, glauconitic.
109	2	Marl, light-gray, fossiliferous, glauconitic, argillaceous.
121	12	Limestone, light-olive-gray, fossiliferous, glauconitic; marl streak.
		Vicksburg Group (Mint Spring Formation)
127	6	Marl, dark-gray, arenaceous, very fossiliferous, glauconitic.
		Forest Hill Formation
172	45	Clay, dark-gray, silty, fossiliferous, carbonaceous, pyritic.
		Red Bluff Formation
179	7	Marl, dark-gray and light-brown, fossiliferous, ferruginous; partially indurated.
187	8	Limestone, light-gray, fine-textured, very fossiliferous, pyritic.
		Yazoo Formation (Shubuta Clay)
198	11+	Clay, dark-gray, silty, marl streak, fossiliferous.

AM-13

Location: Approximately one mile northeast of Bethlehem Church and 200 feet north of gravel road, in NW/4, NW/4, SE/4, Sec. 34, T.10 N., R.8 W.

Elevation: 390 feet (Topographic map) Date: July 6, 1972

Purpose: Drilled to 163 feet for stratigraphic information and to correlate available electrical logs in the area. Electrical log to 162 feet.

Depth	Thickness	Description
		Citronelle Formation
40	40	Sand, very pale-orange, medium- to coarse-grained quartz.
		Catahoula Formation
88	48	Sand, very pale-orange to moderate pink, medium- to very coarse-grained, subrounded to rounded quartz; some ferruginous cementation.
100	12	Clay, moderate-reddish-brown and moderate-yellow, micaceous, silty.
		Chickasawhay Formation
108	8	Clay, medium-dark-gray, fissile, fossiliferous, silty.
110	2	Limestone, light-gray, fine-grained, fossiliferous.
115	5	Marl, dark-gray, silty, very fossiliferous.
		Vicksburg Group (Bucatunna Formation)
149	34	Clay, dark-gray, silty, lignitic, fossiliferous, pyritic, micaceous.
		Vicksburg Group (Byram Formation)
152	3	Marl, medium-dark-gray, fossiliferous.
		Vicksburg Group (Glendon Formation)
162	10+	Limestone, light-olive-gray, fine-grained, very fossiliferous; very hard ledges with marl streaks.

AM-15

Location: On hillside 25 feet southeast of gravel road, in SW/4, SE/4, SW/4, SE/4, Sec. 24, T.10 N., R.7 W.

Elevation: 325 feet (Topographic map) Date: July 11, 1972

Purpose: Drilled 100 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 95 feet.

Depth	Thickness	Description
		Vicksburg Group (Marianna Formation)
11	11	Limestone, white, soft; fossils include **Bryozoa, Pecten** and **Lepidocyclina.**
		Vicksburg Group (Mint Spring Formation)
16	5	Sand, brown, medium- to coarse-grained, rounded to subangular quartz, glauconitic; brown clay particles.
		Forest Hill Formation
53	37	Clay, dark-gray, silty, micaceous, calcareous, carbonaceous, pyritic.
55	2	Claystone, dark-gray, fine-textured, calcareous.
84	29	Clay, medium-dark-gray, fine-textured, fossiliferous, carbonaceous, pyritic, blocky.
100	16+	Clay, medium-dark-gray, arenaceous (glauconite and quartz); more fossiliferous in lower portion.

AM-16

Location: On the property of George H. Rainwater, approximately 1,000 feet east of U. S. Route 45, in NE/4, SW/4, SE/4, SW/4, Sec. 13, T.9 N., R.7 W.

Elevation: 260 feet (Topographic map) Date: July 12, 1972

Purpose: To examine prospective commercial lime plant location and to obtain other stratigraphic information. Drilled to 170 feet and logged to 169 feet.

Depth	Thickness	Description
		Chickasawhay Formation
12	12	Clay (weathered marl), dusky-yellow and light-brown, fine-textured, silty, bentonitic, fossiliferous (macrofossils and microfossils).
14	2	Limestone, yellowish-gray, fine-grained, fossiliferous.
		Vicksburg Group (Bucatunna Formation)
20	6	Silt, light- to dark-gray, fossiliferous; under thin ferruginous sandstone conglomerate ledge.
36	16	Clay, yellowish-gray, very bentonitic, silty, calcareous.
40	4	Claystone, light-brown to dark-gray, calcareous.
50	10	Clay, yellowish-gray, silty, fissile, bentonitic.
58	8	Sand, yellowish-gray, fine- to medium-grained, argillaceous, calcareous, fossiliferous.
72	14	Sand, yellowish-gray, fine- to medium-grained, mostly subangular quartz, glauconitic, fossiliferous, pyritic, micaceous.
		Vicksburg Group (Marianna Formation)
95	23	Limestone, yellowish-gray, soft, fine-textured, fossiliferous (macrofossils and microfossils).
98	3	Limestone, light-olive-gray, indurated, fossiliferous.

		Vicksburg Group (Mint Spring Formation)
115	17	Sand, light-gray, fine- to medium-grained, subangular to subrounded quartz, very fossiliferous, glauconitic, pyritic, micaceous; clay streak.
		Forest Hill Formation
170	55	Clay, dark-gray, silty, micaceous, carbonaceous, fissile, fossiliferous.

AM-17

Location: 250 feet east of gravel road near Alabama state line, in NE/4, SE/4, NW/4, of Sec. 3, T.10 N., R.5 W.

Elevation: Approximately 390 feet (Topographic map) Date: July 18,1972

Purpose: To check displacement and to obtain other stratigraphic information. Electrical log to 199 feet.

Depth	Thickness	Description
		Terrace Deposit
10	10	Sand, pale-yellowish-orange, medium- to very coarse-grained, abundant angular quartz grains, some rounded quartz grains, ferruginous.
16	6	Clay, mottled light-brown and yellowish-brown, bentonitic, silty, ferruginous.
		Yazoo Formation (Cocoa Sand)
20	4	Sand, yellowish-gray, medium-grained, subangular, fossiliferous (macrofossils and microfossils), ferruginous, micaceous.
45	25	Sand, light-gray, fine- to medium-grained, subangular, very argillaceous, micaceous, fossiliferous.
		Yazoo Formation (North Twistwood Creek Clay)
89	44	Clay, light-gray to pale-olive, silty, micaceous, fossiliferous, fissile, bentonitic, calcareous.
		Moodys Branch Formation
102.5	13.5	Marl, grayish-olive, medium-grained glauconite, very fossiliferous; abundant ostracodes; partially indurated.
104	1.5	Siltstone ledge, light-brown, arenaceous, glauconitic.
		Cockfield Formation
125	21	Sand, dark-gray, medium-grained, subangular glauconitic; many well preserved macrofossils.
156	31	Sand, dark-gray, fine- to medium-grained, angular quartz, argillaceous, lignitic, micaceous, fossiliferous.
163	7	Clay, dark-gray, silty, micaceous, lignitic fissile.
169	6	Clay, dark-gray, silty, micaceous; several one foot thick beds of lignite.
176	7	Clay, light-olive-gray, silty, micaceous, lignitic, fissile.
184	8	Clay, medium-dark-gray, silty, micaceous; indurated fine-grained sandstone ledge.
		Cook Mountain Formation
199	16+	Clay, olive-gray, silty, micaceous, lignitic, fossiliferous.

AM-18

Location: In Dry Creek valley, 20 feet west of gravel road, in NW/4, NE/4, SW/4, Sec. 12, T.9 N., R.6 W.

Elevation: 191 feet (Topographic map) Date: July 19, 1972

Purpose: Drilled 290 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 289 feet.

Depth	Thickness	Description
		Alluvium
14	14	Sand, yellowish-orange, medium- to very coarse-grained, subangular to rounded, ferruginous, argillaceous; more coarse in lower part.
		Forest Hill Formation
25	11	Clay, dark-gray, silty, carbonaceous, pyritic, fissile, micaceous.
68	43	Clay, light-olive-gray, blocky, carbonaceous, calcareous.
77	9	Clay, light-olive-gray, silty, very fossiliferous.
		Red Bluff Formation
79	2	Limestone, light-brown, fine-textured, fossiliferous.
94	15	Marl, light-olive-gray, fossiliferous, argillaceous; indurated ledges.
		Yazoo Formation (Shubuta Clay)
133	39	Clay, light-gray, silty, fossiliferous, fissile; abundant ostracodes and foraminifera.
		Yazoo Formation (Pachuta Marl)
151	18	Marl, light-olive-gray, medium-textured, fossiliferous (numerous microfossils), glauconitic; indurated ledges.
153	2	Limestone, light-gray, arenaceous, fossiliferous.
		Yazoo Formation (Cocoa Sand)
170	17	Sand, light-gray, fine- to medium-grained, subangular quartz; argillaceous in lower part.
178	8	Silt, light-gray, arenaceous, fossiliferous; indurated calcareous ledge at bottom.
196	18	Sand, light-gray, fine- to medium-grained, subangular quartz, indurated streaks, fossiliferous.
		Yazoo Formation (North Twistwood Creek Clay)
254	58	Clay, grayish-olive, silty, fossiliferous, pyritic, fissile; glauconitic in lower part.
		Moodys Branch Formation
258	4	Marl, pale-olive, indurated, fossiliferous, glauconitic, pyritic.
272	14	Sand, olive-gray speckled, fine- to medium-grained, angular to subangular quartz, glauconitic, fossiliferous (macrofossils and microfossils).
		Cockfield Formation
286	14	Clay, dark-gray, silty to arenaceous, carbonaceous.
289	3+	Sand, dark-gray, medium-grained, subangular quartz, very fossiliferous.

AM-19

Location: On hillside, 30 feet northeast of gravel road and 200 feet southeast of Shiloh Creek, in SE/4, SW/4, SW/4, Sec. 18, T.10 N., R.5 W.

Elevation: 250 feet (Topographic map) Date: July 20, 1972

Purpose: Drilled 150 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 149 feet.

Depth	Thickness	Description
		Yazoo Formation (Cocoa Sand)
5	5	Sand, yellowish-gray, medium-grained, angular to subangular quartz, calcareous, glauconitic; one foot thick fossiliferous sandstone ledge two feet below surface.
31	26	Sand, light-gray, medium-grained, angular to subangular quartz, fossiliferous, micaceous.
33	2	Clay, yellowish-gray, silty, calcareous.
40	7	Sand, yellowish-gray, fine-grained, angular to subangular quartz, argillaceous.
		Yazoo Formation (North Twistwood Creek Clay)
88	48	Clay, greenish-gray, silty, fossiliferous, fissile to blocky, micaceous.
		Moodys Branch Formation
90	2	Marl, light-olive-gray, glauconitic (weathered olive-brown), fossiliferous, indurated.
95	5	Marl, greenish-gray, glauconitic, fossiliferous.
		Cockfield Formation
97	2	Clay, olive-gray, silty.
110	13	Sand, olive-gray, (50% quartz sand particles and 50% fossil fragments), fine- to coarse-grained, angular to rounded quartz, glauconitic.
122	12	Clay, grayish-black, silty, lignitic, fossiliferous, fissile.
134	12	Sand, dark-gray, fine- to medium-grained, glauconitic.
142	8	Fossil zone: numerous well preserved fossils including **Turritella, Dentalium** and **Endopachys.**
150	8+	Clay, grayish-black, silty, carbonaceous, fissile.

AM-20

Location: In flat, 20 feet northeast of gravel road, in NW/4, NW/4, SE/4, Sec. 22 T.10 N., R.6 W.

Elevation: 275 feet (Topographic map) Date: July 24, 1972

Purpose: Drilled 241 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 240 feet.

Depth	Thickness	Description
		Red Bluff Formation
6	6	Clay, light-brown to yellowish-orange, silty, fossiliferous; ferruginous pebbles and granules.
		Yazoo Formation (Shubuta Clay)
33	27	Clay, very pale-orange, silty, fossiliferous (numerous microfossils); white lime nodules.
42	9	Clay, grayish-green, silty, fossiliferous.

		Yazoo Formation (Pachuta Marl)
58	16	Marl, yellowish-gray, argillaceous, partially indurated, fossiliferous (phosphatized bone fragments and shark teeth).
		Yazoo Formation (Cocoa Sand)
72	14	Sand, light-gray, fine- to medium-grained, angular quartz, scattered mica flakes.
78	6	Clay, light-gray, silty, micaceous, fissile.
80	2	Sandstone, light-gray, medium-grained, calcareous, fossiliferous (many echinoid fragments).
115	35	Sand, light-gray, fine-grained, angular quartz, micaceous, fossiliferous, argillaceous.
		Yazoo Formation (North Twistwood Creek Clay)
120	5	Silt, light-gray, argillaceous, fossiliferous, micaceous.
156	36	Clay, pale olive, silty, fossiliferous, fissile.
		Moodys Branch Formation
171	15	Marl, yellowish-gray, fossiliferous, lignitic clay streak, glauconitic (glauconite weathered to a light brown color); partially indurated.
		Cockfield Formation
189	18	Clay, dark-gray to light-brown, arenaceous streaks, fossiliferous (weathered fragments), ferruginous, lignitic.
205	16	Marl, dark-gray, arenaceous (subangular quartz and brown and green glauconite), fossiliferous (many weathered fragments), lignitic.
230	25	Sand, grayish-brown, medium-grained angular to subangular quartz, fossiliferous, glauconitic, lignitic.
241	11+	Clay, dark-gray, silty to arenaceous, micaceous, carbonaceous; calcareous in part.

AM-21

Location: On hilltop 10 feet northeast of gravel road, in NE/4, NW/4, SE/4, Sec. 34, T.10 N., R.6 W.

Elevation: 327 feet (Topographic map) Date: July 25, 1972

Purpose: Cored 42 feet to obtain samples from Marianna and Forest Hill contact. Descriptions from cores. No electrical log.

Depth	Thickness	Description
		Terrace Deposit
3	3	Sand, light-brown, fine- to medium-grained, ferruginous.
6	3	Clay, mottled yellowish-gray and light-brown, smooth-textured, fossiliferous; some silt.
		Vicksburg Group (Marianna Formation)
8	2	Clay, mottled yellowish-gray to light-brown, manganiferous? (black residue along fractures).
12	4	Limestone, grayish-yellow, uniform texture, fossiliferous, soft.
14	2	Marl, light-brown, black nodules (manganese?).
16	2	Marl, moderate-yellow, weathered glauconite, fossiliferous (**Pecten** sp., **Lepidocyclina** sp. and **Bryozoa**).
22	6	Marl, light-brown, fossiliferous, ferruginous, medium-grained glauconite.
25	3	Marl, dark-olive-gray, glauconitic, fossiliferous; indurated in part.

		Vicksburg Group (Mint Spring Formation)
29.5	4.5	Marl, olive-gray, very arenaceous, fossiliferous, glauconitic, pyritic.
		Forest Hill Formation
30	.5	Clay, olive-gray, silty, micaceous, pyritic, indurated.
42	12+	Clay, olive-gray, silty, micaceous, pyritic, indurated.

AM-22

Location: On hillside, 50 feet northeast of asphalt road at intersection with unimproved dirt road, in SW/4, SW/4, NE/4, Sec. 31, T.10 N., R.6 W.

Elevation: 345 feet (Topographic map) Date: July 26, 1972

Purpose: Drilled 90 feet for stratigraphic information. Descriptions from cuttings. Electrical log from 38 feet to 89 feet.

Depth	Thickness	Description
		Terrace deposit
18	18	Sand, light-brown, fine- to medium-grained, subangular quartz, scattered pea gravel, ferruginous.
18.2	.2	Sandstone, moderate-reddish-brown, medium-grained, ferruginous.
		Vicksburg Group (Bucatunna Formation)
39	20.8	Sand, light-brown, fine- to medium-grained, subangular quartz, micaceous, clay streaks.
		Vicksburg Group (Marianna Formation)
42	3	Clay, dark-brown, smooth-textured; probably weathered limestone.
83	41	Limestone, white, very fossiliferous (numerous **Lepidocyclina** and **Bryozoa**), marl streaks.
		Forest Hill Formation
90	7+	Clay, dark-gray, silty.

AM-23 and 24

Location: On hillside, approximately 40 feet north of U. S. Highway 84, in SW/4, NE/4, NW/4, Sec. 24, T.9 N., R.6 W.

Elevation: 250 feet (Topographic map) Date: July 27, 1972

Purpose: Drilled 265 feet to check for displacement of beds along Bucatunna Creek. Moved several feet and cored 32 feet to sample bentonite. Electrical log to 266 feet.

Depth	Thickness	Description
		Terrace deposit
5	5	Sand, light-brown, medium- to coarse-grained, subangular to subrounded quartz, ferruginous; rare black chert grains.
7	2	Clay, light-gray, silty, fissile.
11	4	Sand, light-brown, medium-grained, subangular quartz, ferruginous.
		Vicksburg Group (Bucatunna Formation)
30	19	Clay (bentonite), light-yellowish-gray, fine-textured, ferruginous.
37	7	Clay, reddish-brown, silty, calcareous; weathered limestone particles.

		Vicksburg Group (Marianna Formation)
39	2	Limestone, light-yellowish-gray, fossiliferous (many **Pecten**).
69	30	Marl, yellowish-gray, fine-textured, calcareous, fossiliferous; partially indurated.
		Forest Hill Formation
154	85	Clay, dark-gray, silty, lignitic, calcareous, micaceous, blocky.
191	37	Clay, dark-gray (partially weathered to light-red), silty, fossiliferous, micaceous; partially indurated.
		Red Bluff Formation
202	11	Marl, medium-dark-gray, fossiliferous (**Spondylus dumosus** in the interval from 190 to 200 feet); partially indurated.
		Yazoo Formation (Shubuta Clay)
236	34	Clay, light-olive-gray, silty, fossiliferous (microfossils and macrofossils), ferruginous, carbonaceous, pyritic, blocky to fissile.
		Yazoo Formation (Pachuta Marl)
265	29+	Marl, yellowish-gray, silty, fossiliferous; partially indurated; bottomed out on hard ledge.

AM-25

Location: On hillside, 40 feet northwest of U. S. Route 84, in SW/4, NW/4, SE/4, Sec. 18, T.9 N., R.5 W.

Elevation: 190 feet (Topographic map) Date: July 31, 1972

Purpose: Drilled 330 feet to check possible displacement of strata across Bucatunna Creek valley.

Depth	Thickness	Description
		Forest Hill Formation
15	15	Clay, light-gray and light-brown mottled, silty; round ferruginous granules.
16	1	Claystone, medium-gray, calcareous.
70	54	Clay, dark- to olive-gray, silty, carbonaceous, fissile, fossiliferous, micaceous, pyritic; uniform texture.
104	34	Clay, olive-gray, silty, lignitic, fossiliferous; ferruginous streak; very uniform texture.
		Red Bluff Formation
115	11	Marl, olive-gray to light-brown, very fossiliferous (**Dentalium** at 110 feet); indurated ferruginous claystone ledges.
		Yazoo Formation (Shubuta Clay)
159	44	Clay, light-olive-gray, silty, fossiliferous, blocky.
		Yazoo Formation (Pachuta Marl)
174	15	Marl, light-gray, fossiliferous (many foraminifera), glauconitic (weathered olive-black), indurated ledges.
		Yazoo Formation (Cocoa Sand)
202	28	Sand, light-gray, fine- to medium-grained, angular to subangular quartz, clean, well sorted, clay streaks; weathered fossil fragments.

216	14	Sand, light-gray, fine- to medium-grained, angular to subangular quartz, fossiliferous; indurated sandstone ledges; ferruginous clay.
236	20	Sand, light-gray, fine-grained, subangular quartz, micaceous, fossiliferous; dark-gray clay streaks.
		Yazoo Formation (North Twistwood Creek Clay)
293	57	Clay, light-olive-gray, silty, fossiliferous, pyritic, fissile to blocky.
		Moodys Branch Formation
296	3	Marl, light-brown, fossiliferous, glauconitic (weathered light-brown).
310	14	Marl, medium-gray, argillaceous, fossiliferous.
		Cockfield Formation
314	4	Clay, dark-gray, silty, lignitic, micaceous.
324	10	Sand, medium-gray, fine-grained, angular, fossiliferous, micaceous.
330	6+	Clay, dark-yellowish-brown, silty.

AM-26

Location: On hillside 50 feet west of gravel road, in NE/4, SE/4, NW/4, Sec. 25, T.9 N., R.6 W.

Elevation: 250 feet (Topographic map) Date: August 1, 1972

Purpose: Cored interval from 12 to 30 feet to obtain bentonitic clay for testing. Drilled 190 feet for stratigraphic information. Electrical log to 189 feet.

Depth	Thickness	Description
		Terrace deposit
2	2	Sand, yellowish-gray, fine- to medium-grained, subangular quartz, fossiliferous.
		Chickasawhay Formation
4	2	Limestone, yellowish-gray, arenaceous, fossiliferous.
6	2	Marl, yellowish-gray, silty, fossiliferous.
12	6	Limestone, yellowish-gray, arenaceous, fossiliferous; marl in lower part.
		Vicksburg Group (Bucatunna Formation)
41	29	Clay, grayish-brown to dark-gray, silty, laminated, carbonaceous, montmorillonitic, fossiliferous.
		Vicksburg Group (Byram Formation)
45	4	Marl, medium-dark-gray; many weathered fossil fragments.
		Vicksburg Group (Glendon Formation)
51	6	Limestone, light-olive-gray, fine-textured, hard, fossiliferous; argillaceous streak.
55	4	Marl, olive-gray, silty, fossiliferous.
60	5	Limestone, light-olive-gray, fine-textured, hard, fossiliferous, pyritic.
		Vicksburg Group (Marianna Formation)
95	35	Limestone, light-gray, silty, fossiliferous, argillaceous streaks; not as hard as above limestone.
		Forest Hill Formation
108	13	Clay, dark-gray, silty, calcareous, blocky.
110	2	Marl, olive-gray, silty, fossiliferous, glauconitic.
190	80+	Clay, dark-gray, silty, pyritic, carbonaceous, fissile to blocky, fossiliferous (**Dentalium** noted at 140 to 150 foot interval).

AM-27

Location: On hilltop 250 feet north of asphalt road, on property of Decil Dyess, in SW/4, NW/4, SW/4, Sec. 6, T.8 N., R.5 W.

Elevation: 280 feet (Topographic map) Date: August 2, 1972

Purpose: Drilled 169 feet to sample reported bentonite and to obtain other stratigraphic information. Electrical log to 168 feet.

Depth	Thickness	Description
		Terrace deposit
17	17	Sand, dark-yellowish-orange, medium- to coarse-grained, subangular quartz, argillaceous.
30	13	Sand, pale-yellowish-orange, coarse-grained, subangular quartz; scattered dark mineral grains.
		Catahoula Formation
60	30	Sand, very light-gray, fine- to medium-grained, subangular quartz, silty, micaceous; scattered dark mineral grains.
63	3	Clay, greenish-gray, silty; overlain by 2 inch ferruginous sandstone ledge.
82	19	Sand, olive-gray, medium-grained, subangular quartz, argillaceous.
90	8	Silt, greenish-gray, arenaceous, argillaceous.
		Chickasawhay Formation
92	2	Limestone, pale-olive, arenaceous, fossiliferous.
100	8	Marl, grayish-yellow-green, silty, argillaceous, calcareous; partially indurated.
102	2	Limestone, pale-olive, arenaceous, fossiliferous.
109	7	Marl, olive-gray, silty, fossiliferous (saddle shaped **Lepidocyclina**).
111	2	Limestone, pale-olive, silty, fossiliferous.
		Vicksburg Group (Bucatunna Formation)
158	47	Clay, dark-gray, silty, laminated, pyritic, fissile.
		Vicksburg Group (Byram Formation)
163	5	Marl, olive-gray, fossiliferous, argillaceous.
		Vicksburg Group (Glendon Formation)
166	3	Limestone, light-gray, medium-textured, hard, very fossiliferous.
168	2	Marl, olive-gray, argillaceous, fossiliferous.
169	1+	Limestone, light-gray, medium-textured, very hard, fossiliferous.

AM-28

Location: In flat, approximately 1,900 feet west of Pleasant Grove Church, on Walker property, in SE/4, NE/4, NW/4, Sec. 32, T.9 N., R.5 W.

Elevation: 197 feet (Topographic map) Date: August 8, 1972

Purpose: Drilled 50 feet to verify reported bentonite. Descriptions from cuttings. Electrical log to 49 feet.

Depth	Thickness	Description
		Alluvium
8	8	Sand, pale-orange, medium- to coarse-grained, subangular quartz; poorly sorted.

14	6	Clay, light-gray, silty, feruginous.
18	4	Sand, yellowish-orange, very coarse-grained, subangular quartz; scattered black grains; some gravel size quartz.
		Vicksburg Group (Bucatunna Formation)
36	18	Clay, medium dark-gray, silty.
		Vicksburg Group (Byram Formation)
40	4	Marl, yellowish-gray, pyritic; composed mostly of foraminifers and rounded fossil fragments.
		Vicksburg Group (Glendon Formation)
50	10+	Limestone, yellowish-gray, fossiliferous; ledges with marl streaks.

AM-29

Location: In Bucatunna Creek Valley, 800 feet north of Denham Bridge and 150 feet east of Bucatunna Creek, in NW/4, SE/4, SE/4, Sec. 18, T.8 N., R.5 W.

Elevation: 160 feet (Topographic map) Date: August 8, 1972

Purpose: Drilled 190 feet for stratigraphic information. Description from cuttings. Electrical log to 189 feet.

Depth	Thickness	Description
		Alluvium
12	12	Sand, dark-yellowish-orange, fine- to medium-grained, subangular quartz, ferruginous.
17	5	Sand, pale-yellowish-orange, medium- to coarse-grained, subangular quartz; scattered black grains.
24	7	Sand, yellowish-gray, medium-grained, subangular; scattered black grains.
		Chickasawhay Formation
35	11	Clay, greenish-gray, silty, glauconitic, pyritic.
44	9	Marl, greenish-gray, arenaceous, calcareous.
47	3	Limestone, light-olive-gray, arenaceous, fossiliferous.
50	3	Clay, greenish-gray, fine-textured, blocky, pyritic.
52	2	Limestone, light-gray, arenaceous, fossiliferous.
		Vicksburg Group (Bucatunna Formation)
107	55	Clay, dark-gray, silty, carbonaceous, fissile, fossiliferous.
		Vicksburg Group (Glendon Formation)
112	5	Limestone, light-gray, fine-textured, hard, fossiliferous.
114	2	Marl, olive-gray, silty, argillaceous, fossiliferous.
124	10	Limestone, light-gray, fine-textured, hard, fossiliferous; marl streaks.
		Vicksburg Group (Marianna Formation)
163	39	Limestone, yellowish-gray, silty, softer than above limestone, fossiliferous, marl streaks.
		Vicksburg Group (Mint Spring Formation)
166	3	Marl, dark-gray, arenaceous, glauconitic, fossiliferous.
		Forest Hill Formation
190	24+	Clay, dark-gray, silty, lignitic, fossiliferous, pyritic.

AM-30

Location: On hillside, 150 feet west of Langs Creek and 25 feet north of unimproved dirt road, in NW/4, SE/4, NW/4, Sec. 16, T.8 N., R.6 W.

Elevation: 210 feet (Topographic map) Date: August 8, 1972

Purpose: Drilled 251 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 251 feet.

Depth	Thickness	Description
		Terrace deposit
10	10	Sand, pale-yellowish-orange, medium- to very coarse-grained, mostly subangular quartz; some pea gravel; scattered black grains.
17	7	Sand, very-pale-orange, fine-grained, subangular quartz; indurated ferruginous ledge at base.
		Catahoula Formation
27	10	Clay, medium bluish-gray, silty to arenaceous, pyritic.
36	9	Sand, light-olive-gray, medium-grained, subangular to subrounded quartz, well sorted.
57	21	Clay, greenish-gray, fine-textured, pyritic.
		Paynes Hammock Formation
66	9	Clay, dark-greenish-gray, silty, pyritic, fossiliferous.
68	2	Limestone, yellowish-gray, arenaceous.
72	4	Marl, medium-dark-gray, arenaceous, fossiliferous, pyritic.
74	2	Limestone, yellowish-gray, arenaceous, fossiliferous.
78	4	Clay, bluish-gray, silty, fossiliferous (many echinoid spines).
80	2	Limestone, light-gray, arenaceous, fossiliferous.
		Chickasawhay Formation
92	12	Clay, greenish-gray to medium-dark-gray, silty, calcareous.
102	10	Marl, greenish-gray, argillaceous, fossiliferous; indurated ledges.
105	3	Limestone, light-gray, arenaceous, fossiliferous.
113	8	Marl, light-olive-gray, fossiliferous; indurated ledges.
		Vicksburg Group (Bucatunna Formation)
174	61	Clay, grayish-black to olive-gray, silty, lignitic, fissile, calcareous.
		Vicksburg Group (Glendon Formation)
176	2	Limestone, light-gray, fine-textured, hard, fossiliferous.
180	4	Marl, medium-dark-gray, fossiliferous; partially indurated.
183	3	Limestone, light-gray, fine-textured, hard, fossiliferous, pyritic.
187	4	Marl, olive-gray, fossiliferous; partially indurated.
194	7	Limestone, light-gray, fine-textured, hard, fossiliferous; marl streaks.
		Vicksburg Group (Marianna Formation)
232	38	Limestone, yellowish-gray, silty, fossiliferous (numerous **Lepidocyclina** and **Bryozoa**); softer than limestone above; marl streaks.
		Forest Hill Formation
251	19+	Clay, dark-gray, silty, calcareous, lignitic, pyritic.

AM-31

Location: On property of Frank Powe, 20 feet east of gravel road, in NE/4, NE/4, SW/4, Sec. 35, T.7 N., R.6 W.

Elevation: 245 feet (Topographic map) Date: August 9, 1972

Purpose: Cored 32 feet to obtain clay for testing. Descriptions from cores. No electrical log.

Depth	Thickness	Description
		Catahoula Formation
6	6	Sand, very pale-orange, fine- to medium-grained, subangular to angular quartz, ferruginous.
9	3	Sand, light-gray, fine-grained, subangular quartz, clean.
16	7	Clay, light-gray, smooth-textured, dense; some ferruginous staining.
18	2	Clay, mottled light-gray and light-brown, arenaceous, ferruginous.
32	14+	Sand, mottled light-brown and moderate-red, fine- to medium-grained, argillaceous.

AM-32

Location: On hilltop, approximately 1,700 feet east of Chickasawhay River and 2000 feet south of Limestone Creek, in SW/4, NW/4, SW/4, Sec. 25, T.9 N., R.7 W.

Elevation: 285 feet (Topographic map) Date: August 14, 1972

Purpose: Drilled 211 feet to determine thickness of limestone and to obtain other stratigraphic information. Electrical log to 210 feet.

Depth	Thickness	Description
		Terrace deposit
20	20	Sand, light-brown, medium- to coarse-grained, mostly subangular quartz, rare rounded quartz, ferruginous, argillaceous, rare black chert grains; indurated ferruginous steaks.
34	14	Sand, grayish-orange, medium-grained, micaceous, subangular to well-rounded quartz, some subrounded black chert; gravel in lower part.
		Catahoula Formation
50	16	Clay, dark-yellowish-orange to medium dark-gray, silty, arenaceous (medium-grained, subangular quartz).
60	10	Clay, light-red and pale-brown, fine-textured; ferruginous indurated sand streaks (subangular to subrounded quartz grains).
		Paynes Hammock Formation
67	7	Clay, dark-gray, silty, glauconitic.
71	4	Limestone, yellowish-gray, fine-grained, fossiliferous, glauconitic.
		Chickasawhay Formation
87	16	Limestone, yellowish-gray, fine- to medium-grained, many fossil imprints, glauconitic; soft streaks.
		Vicksburg Group (Bucatunna Formation)
118	31	Clay, dark-gray, silty, carbonaceous, fissile, calcareous.
		Vicksburg Group (Glendon Formation)
122	4	Limestone, light-olive-gray, fine-grained, fossiliferous (**Lepidocyclina** sp. noted).

141	19	Marl, light-gray, fossiliferous; indurated ledges.
145	4	Limestone, light-olive-gray, fine-grained, hard, fossiliferous.
		Vicksburg Group (Marianna Formation)
150	5	Limestone, light-olive-gray, fine-grained, fossiliferous; softer than limestone above.
182	32	Limestone, light-gray, fine- to medium-textured, fossiliferous, soft.
184	2	Limestone, light-gray, fine-textured, fossiliferous, hard.
186	2	Marl, dark-gray, silty, calcareous, pyritic.
		Vicksburg Group (Mint Spring Formation)
193	7	Marl, light-gray, arenaceous, glauconitic, fossiliferous.
		Forest Hill Formation
211	18+	Clay, dark-gray, silty, fissile, slightly calcareous.

AM-33

Location: On hillside, 400 feet northeast of unimproved dirt road, in NW/4, NW/4, SE/4, Sec. 36, T.10 N., R.7 W.

Elevation: 375 feet (Topographic map) Date: August 15, 1972

Purpose: Drilled 87 feet for stratigraphic information. Descriptions from cuttings. No electrical log due to loss of circulation.

Depth	Thickness	Description
		Terrace deposit
7	7	Sand, dark-yellowish-orange, medium- to coarse-grained, subrounded quartz, some gravel, scattered fossil fragments, ferruginous.
8	1	Sandstone, light-brown, medium-grained, ferruginous.
		Catahoula Formation
28	20	Clay, light-gray, silty, ferruginous.
87	59+	Sand, light-brown, fine- to medium-grained, subrounded quartz, ferruginous, micaceous, scattered dark grains; clay streaks.

AM-34

Location: On hillside, 300 feet southwest of Bucatunna Creek, in NE/4, SE/4, NW/4, Sec. 6, T.8 N., R.5 E.

Elevation: 240 feet (Topographic map) Date: August 8, 1972

Purpose: Cored 29 feet in the vicinity of the type locality of the Bucatunna Clay to obtain stratigraphic information. Descriptions from cores. No electrical log.

Depth	Thickness	Description
		Catahoula Formation
11	11	Clay, mottled light-gray and light-brown, arenaceous, bentonitic.
		Paynes Hammock Formation
12	1	Clay, greenish-gray, silty, fossiliferous.
16	4	Marl, olive-gray, very fossiliferous (echinoid spines); partially indurated.

		Chickasawhay Formation
20	4	Marl, bluish-gray, silty, fossiliferous, indurated streaks.
28	8	Marl, bluish-gray, argillaceous, very fossiliferous (molds and original shell material).
29	1+	Limestone, olive-gray, fossiliferous, hard.

AM-35

Location: On hillside, 175 feet southeast of asphalt road and 1600 feet southwest of Dyess Bridge, in SW/4, SW/4, NE/4, Sec. 6, T.8 N., R.5 W.

Elevation: 235 feet (Topographic map) Date: August 16, 1972

Purpose: Drilled 120 feet for stratigraphic information. Description from cuttings. Electrical log to 119 feet.

Depth	Thickness	Description
		Terarce deposit
12	12	Sand, pale-yellowish-orange, medium- to very coarse-grained, subangular quartz, ferruginous, rare black mineral grains; very coarse-grained in lower part.
		Paynes Hammock Formation
31	19	Clay, greenish-gray, silty, calcareous and fossiliferous in lower part.
34	3	Limestone, light-olive-gray, arenaceous, fossiliferous, glauconitic.
		Chickasawhay Formation
38	4	Marl, olive-gray, silty, fossiliferous.
47	9	Limestone, light-olive-gray, arenaceous, fossiliferous, argillaceous streaks.
51	4	Marl, light-olive-gray, silty, fossiliferous.
54	3	Limestone, olive-gray, arenaceous, fossiliferous.
		Vicksburg Group (Bucatunna Formation)
105	51	Clay, dark-gray, silty, lignitic, fossiliferous, glauconitic, pyritic.
		Vicksburg Group (Byram Formation)
108	3	Marl, olive-gray, fossiliferous; partially indurated.
		Vicksburg Group (Glendon Formation)
110	2	Limestone, light-gray, fine-textured, hard, fossiliferous.
114	4	Marl, olive-gray, silty, fossiliferous, argillaceous.
120	6+	Limestone, light-gray, fine-textured, hard, fossiliferous.

AM-36

Location: On south bank of Bucatunna Creek, about 450 yards west of Dyess Bridge, in NW/4, SW/4, NE/4, Sec. 6, T.8 N., R.5 W.

Elevation: 200 feet (Topographic map) Date: August 17, 1972

Purpose: Cored 56.9 feet to obtain samples of Bucatunna clay from the area of the type locality. No electrical log available.

Depth	Thickness	Description
		Alluvium
4	4	Sand, light-brown, fine- to medium-grained, argillaceous.

Vicksburg Group (Bucatunna Formation)

6	2	Clay, mottled red, brown and black, smooth-textured; possibly weathered limestone.
11.2	5.2	Clay, light-brown and light-gray mottled, smooth-textured, bentonitic, arenaceous.
15.0	3.8	Clay, olive-black, smooth-textured, fossiliferous sand laminae, gypsiferous, lignitic.
39	24	Clay, olive-gray to light-olive-gray, micaceous, lignitic; silty to finely arenaceous laminae; very uniform.
53	14	Clay, olive-gray to light-olive-gray, micaceous, lignitic, pyritic; silty to finely arenaceous laminae; macrofossils more numerous.
53.1	.1	Clay, light-gray, silty, micaceous.

Vicksburg Group (Byram Formation)

55.5	2.4	Marl, olive-gray, numerous foraminifera; weathered fossil fragments; argillaceous laminae.
56.9	1.4+	Marl, light-olive-gray, very fossiliferous; indurated in lower part.

AM-37

Location: On hillside, 1,400 feet west of Chickasawhay River, on the property of Bob Joiner, in NE/4, NW/4, SW/4, Sec. 15, T.8 N., R.7 W.

Elevation: 175 feet (Topographic map) Date: August 21, 1972

Purpose: Drilled 450 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 446 feet.

Depth	Thickness	Description
		Terrace deposit
12	12	Sand, very pale-orange, medium- to coarse-grained, subangular quartz, ferruginous; streaks of moderate red, silty, clay.
22	10	Sand, clear to light-brown, medium-grained, scattered pea gravel size quartz, subangular quartz, ferruginous; scattered black chert grains.
		Catahoula Formation
38	16	Clay, greenish-gray, silty, fissile, pyritic.
50	12	Sand, yellowish-gray, fine- to medium-grained, subangular quartz, pyritic; medium-light-gray clay streaks.
62	12	Clay, light-greenish-gray, silty, fissile, arenaceous.
72	10	Clay, dark-gray, silty, carbonaceous, fissile.
		Paynes Hammock Formation
86	14	Limestone, greenish-gray, arenaceous, fossiliferous; marl streaks.
		Chickasawhay Formation
98	12	Clay, olive-gray, silty, calcareous, fissile.
102	4	Limestone, olive-gray, arenaceous, hard, fossiliferous; marl streak.
106	4	Clay, dark-greenish-gray, silty, calcareous, fissile.
117	11	Limestone, light-gray, glauconitic, fossiliferous; soft marl streaks.
123	6	Clay, dark-greenish-gray, silty, calcareous.
		Vicksburg Group (Bucatunna Formation)
130	7	Sand, yellowish-gray, medium-grained, subangular quartz; many well preserved fossils (bryozoa, **Pecten** sp., and sharks teeth).
182	52	Clay, yellowish-gray to dark-gray, silty, lignitic, laminated.

		Vicksburg Group (Byram Formation)
189	7	Marl, olive-gray, silty, fossiliferous, argillaceous.
		Vicksburg Group (Glendon Formation)
191	2	Limestone, yellowish-gray, fine-textured, very hard, fossiliferous.
192	1	Marl, olive-gray, silty, fossiliferous, argillaceous.
193	1	Limestone, yellowish-gray, fine- to medium-textured, hard, fossiliferous.
196	3	Marl, olive-gray, silty, fossiliferous, argillaceous.
198	2	Limestone, light-olive-gray, fine-textured.
200	2	Marl, light-gray, silty, fossiliferous.
212	12	Limestone, yellowish-gray, fine-textured, fossiliferous; hard ledges with inter-bedded marls.
		Vicksburg Group (Marianna Formation)
249	37	Limestone, light-yellowish-gray, silty, fossiliferous; more homogeneous and softer than limestone above; marl streaks.
		Forest Hill Formation
268	19	Clay, dark-gray, silty, pyritic, fossiliferous, fissile.
272.5	4.5	Sand, yellowish-gray, medium-grained, subangular quartz, glauconitic, very fossiliferous, pyritic.
322	49.5	Clay, olive-gray to greenish-gray, silty to arenaceous, lignitic, pyritic, fissile.
		Red Bluff Formation
330	8	Marl, olive-gray to moderate-yellowish-brown, fossiliferous, glauconitic; indurated ferruginous ledges.
		Yazoo Formation (Shubuta Clay)
354	24	Clay, light-olive-gray, silty, calcareous, blocky, carbonaceous.
422	68	Clay and sand streaks, olive-gray, silty, very fossiliferous, blocky, glauconitic, pyritic.
		Yazoo Formation (Pachuta Marl)
450	28+	Marl, olive-gray, fossiliferous; partially indurated.

AM-38

Location: Near stream channel, 400 feet northeast of asphalt road and 1,000 feet northwest of Antioch Church, in NE/4, SW/4, NE/4, Sec. 29, T.9 N., R.7 W.

Elevation: 245 feet (Topographic map) Date: August 24, 1972

Purpose: Drilled 132 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 130 feet.

Depth	Thickness	Description
		Alluvium (Reworked material)
12	12	Sand, light-brown and pale-yellowish-brown, fine- to medium-grained, angular to subrounded quartz, ferruginous, fossiliferous, pyritic, glauconitic, argillaceous, micaceous.
26	14	Clay, multicolored, silty, arenaceous, pyritic, fossiliferous, ferruginous.
58	32	Sand, multicolored, fine- to medium-grained, subangular to subrounded, ferruginous, pyritic, fossiliferous; clay streaks.
71	13	Sand, reddish-orange, fine- to medium-grained, subangular to subrounded; yellowish-gray clay streaks.

		Paynes Hammock Formation
80	9	Clay, dark-greenish-gray, silty, pyritic, glauconitic; indurated ledge in top part..
87	7	Limestone, light-gray, medium-textured, glauconitic; fossils and fossil imprints.
		Chickasawhay Formation
93	6	Clay, dark-gray, silty, fossiliferous, fissile.
101	8	Limestone, light-gray, fine- to medium-textured, fossiliferous; soft marl streak.
		Vicksburg Group (Bucatunna Formation)
130	29	Clay, dark-gray, silty, lignitic, calcareous, fissile, pyritic.
		Vicksburg Group (Glendon Formation)
132	2+	Limestone, light-gray, fine-textured, very hard; fossiliferous (**Pecten** sp. and **Lepidocyclina** sp. noted).

AM-39

Location: On hillside, 30 feet north of U. S. Route 84 and 50 feet west of Chickasawhay River Bridge, in NW/4, NE/4, NW/4, Sec. 10, T.8 N., R.7 W.

Elevation: 170 feet (Topographic map) Date: August 28, 1972

Purpose: Cored 55 feet to obtain samples of Chickasawhay from the type locality. Electrical log available.

Depth	Thickness	Description
		Terrace deposit
10	10	Sand, grayish-orange, coarse-grained, subangular quartz, ferruginous.
		Catahoula Formation
13	3	Clay, dark-greenish-gray, pyritic, blocky; fine sand laminae.
		Paynes Hammock Formation
16	3	Sand, light-olive-gray, medium-grained, subangular quartz; grading to light-gray calcareous sand.
16.5	.5	Sandstone, light-gray, fine-textured, hard, ferruginous, borings filled with calcareous sand.
17.5	1	Sand, olive-gray, medium-grained, subangular quartz, argillaceous, calcareous.
20	2.5	Marl, medium-gray to very light-gray, fossiliferous, argillaceous.
22	2	Sandstone, very light-gray, fine- to medium-textured, fossiliferous. Excellent ostracod fauna. Balanus (barnacle) is common.
25	3	Marl, greenish-gray, argillaceous; very fossiliferous (oyster fragments noted).
26	1	Sandstone, yellowish-gray, fine-textured, calcareous.
27	1	Marl, light-olive-gray, very fossiliferous, argillaceous.
32	5	No recovery. (Electrical log indicates another indurated ledge then back into clay at 31 feet).
		Chickasawhay Formation
37	5	Clay, dark-greenish-gray, very fossiliferous, glauconitic, silt laminae; marly in lower part.
40	3	Limestone, light-olive-gray, arenaceous, many fossil imprints; soft streak.

45	5	No recovery. (Driller's log and electrical log indicate limestone with marl streaks.)
49	4	Limestone, yellowish-gray, arenaceous, fossil imprints; soft streak.
52	3+	Marl, dark-gray, silty, fossiliferous (coquina), pyritic; indurated in lower part.

AM-40

Location: On hilltop, 20 feet north of unimproved dirt road, near its intersection with gravel road, in SE/4, NW/4, SW/4, Sec. 26, T.9 N., R.9 W.

Elevation: 355 feet (Topographic map) Date: August 29, 1972

Purpose: Drilled to 276 feet for stratigraphic information. Description from cuttings. Electrical log to 276 feet.

Depth	Thickness	Description
		Terrace deposit
26	26	Sand, yellowish-orange, fine- to medium-grained, subangular quartz, ferruginous, argillaceous; scattered black grains and well-rounded quartz.
		Catahoula Formation
32	6	Clay, multicolored, silty, carbonaceous.
36	4	Sand, grayish-orange, coarse-grained, subrounded quartz.
64	28	Clay, light-brown to light-gray, fine-textured, ferruginous, blocky; arenaceous streak.
72	8	Clay, light-brown, arenaceous, ferruginous.
90	18	Clay, grayish-yellow, arenaceous; indurated ferruginous ledge at top.
94	4	Sand, light-gray, fine-grained, subangular quartz, argillaceous, ferruginius; partially indurated.
150	56	Clay, light-yellowish-gray, silty, ferruginous; arenaceous streaks.
180	30	Sand, grayish-orange, medium- to coarse-grained, subangular quartz.
200	20	Sand, pale-orange, very-coarse; pea gravel in lower part, black chert, silicified wood.
208	8	Clay, dark-gray, silty; pyritized wood fragments.
212	4	Sand, very pale-orange, medium-grained, subangular quartz, argillaceous.
246	34	Clay, greenish-gray, silty, lignitic, pyritic.
		Paynes Hammock Formation
252	6	Sand, light-gray, fine- to medium-grained, argillaceous.
260	8	Limestone, light-gray, arenaceous, indurated ledges, marl streaks; fossiliferous (echinoid spines).
		Chickasawhay Formation
275	15	Clay, dark-gray, silty, fossiliferous.
276	1+	Limestone, light-gray, arenaceous, fossiliferous.

AM-41

Location: In stream channel, 700 feet west of gravel road, on property of Leland McMichael, in NE/4, SE/4, SW/4, Sec. 6, T.8 N., R.7 W.

Elevation: 295 feet (Topographic map) Date: August 30, 1972

Purpose: Drilled 131 feet to obtain gravel for testing. Descriptions from samples. Electrical log to 128 feet.

Depth	Thickness	Description
		Alluvium (Reworked material)
16	16	Sand and gravel, pale yellowish-orange, (sand medium- to coarse-grained, rounded quartz); (gravel, up to one-half inch in diameter, rounded quartz); ferruginous gravel size sandstones.
20	4	Clay, moderate-yellow, silty, friable.
35	15	Gravel, pale-orange, quartz and chert, banded quartz pebbles, flat chert pebbles, arenaceous.
72	37	Gravel, varicolored pebbles, chert with fossil imprints, opalized pebbles, arenaceous.
		Catahoula Formation
86	14	Sand, pale-orange, medium- to coarse-grained, rounded quartz, argillaceous (dark-gray clay with black specks).
131	45	Sand and pea gravel, pale-orange, medium- to coarse-grained sand; mostly rounded grains, but percent of subangular grains increasing.

AM-42

Location: In Maynor Creek valley, 40 feet north of gravel road and 35 feet east of the creek, in SE/4, SW/4, SE/4, Sec. 20, T.8 N., R.7 W.

Elevation: 225 feet (Topographic map) Date: August 31, 1972

Purpose: Drilled 332 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 330 feet.

Depth	Thickness	Description
		Alluvium
10	10	Sand, very pale-orange, fine- to coarse-grained, subangular to rounded quartz, argillaceous, ferruginous.
12	2	Sand and gravel, varicolored, coarse sand and pea-size gravel, quartz and chert, (noted chert replacement of oolitic limestone nodule).
		Catahoula Formation
18	6	Sandstone, light-gray, medium-textured, arenaceous (subrounded quartz); rare dark mineral grains.
20	2	Clay, dark-gray, arenaceous, kaolinitic.
23	3	Sandstone, light-gray, fine- to medium-textured, very hard.
55	32	Sand, light-gray, fine- to medium-grained, subrounded quartz; argillaceous.
56	1	Sandstone, dark-gray, medium-textured, pyritic.
128	72	Sand, light- to medium-dark-gray, fine- to medium-grained, subrounded to subangular quartz; argillaceous streaks (light-brown clay); scattered dark grains.
140	12	Sand, light-gray, medium-grained, subangular to subrounded quartz, black chert nodules (pyrite crystals on chert), lignitic.
182	42	Clay, pale-olive to dark-gray, silty, pyritic, blocky.
		Paynes Hammock Formation
184	2	Limestone, olive-gray, arenaceous, fossiliferous (oyster fragments).
186	2	Marl, dark-olive-gray, argillaceous, fossiliferous.
188	2	Limestone, olive-gray, arenaceous, fossiliferous.
190	2	Marl, dark-olive-gray, argillaceous, fossiliferous.
192	2	Limestone, olive-gray, silty to arenaceous, fossiliferous, glauconitic.
		Chickasawhay Formation
209	17	Clay, grayish-olive, silty, fossiliferous (numerous microfossils).

212	3	Limestone, pale-olive, arenaceous, fossiliferous (many fossil imprints); phosphatized bone fragments.
218	6	Marl, olive-gray, argillaceous, fossiliferous, partially indurated, glauconitic.
222	4	Limestone, light-olive-gray, arenaceous, fossiliferous.
		Vicksburg Group (Bucatunna Formation)
240	18	Clay, dark-gray, silty, lignitic, fissile.
311	71	Clay, greenish-gray, arenaceous to silty, fossiliferous.
		Vicksburg Group (Byram Formation)
320	9	Marl, greenish-gray, fossiliferous, silty, pyritic.
		Vicksburg Group (Glendon Formation)
332	12+	Limestone, light-gray, medium-grained, hard, fossiliferous, glauconitic; marl streaks.

AM-43

Location: In valley flat, 600 feet southwest of Illinois Central Gulf Railroad at intersection of two gravel roads, in NW/4, SW/4, NW/4, Sec. 11, T.7 N., R.6 W.

Elevation: 165 feet (Topographic map) Date: September 6, 1972

Purpose: Cored to 23 feet to obtain sample of clay for testing. Descriptions from cores. No electrical log.

Depth	Thickness	Description
		Soil
.5	.5	Soil, light-brown, silty.
		Terrace deposit
1	.5	Silt, light-brown, ferruginous; with brown and black rounded granules.
3	2	Sand, mottled light-gray and light-red, medium-grained, argillaceous, ferruginous.
8	5	Clay, mottled light-gray and light-red, smooth-textured, ferruginous.
10	2	Sand, white, fine- to medium-grained, subangular quartz; unconsolidated.
12	2	Sand, yellowish-orange and light-brown, fine-grained, subangular quartz.
23	11	Sand, dark-yellowish-orange, coarse-grained, subangular quartz.

AM-44

Location: In creek valley, 40 feet southwest of gravel road, in NW/4, NW/4, NW/4, Sec. 16, T.7 N., R.5 W.

Elevation: 180 feet (Topographic map) Date: September 6, 1972

Purpose: Drilled 339 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 338 feet.

Depth	Thickness	Description
		Alluvium
10	10	Sand, yellowish-gray, fine- to medium-grained, subangular quartz, kaolinitic.
		Catahoula Formation
18	8	Sand, pale yellowish-orange, medium-grained, subangular quartz, ferruginous; indurated ledges at 15 and 18 feet; scattered black grains.

24	6	Clay, dark-gray, carbonaceous, silty, fissile.
30	6	Sand, grayish-orange, medium-grained, subrounded quartz; ferruginous.
36	6	Clay, white, arenaceous, kaolinitic.
80	44	Silt, light-gray, arenaceous, kaolinitic, argillaceous.
126	46	Sand, very pale-orange, coarse-grained, subangular to subrounded quartz, scattered dark chert grains; argillaceous streaks.
150	24	Sand, pale-orange, medium- to very coarse-grained, subangular to subrounded quartz, black chert grains and granules, pyritic; pebble size black chert and quartz in bottom part.
198	48	Clay, yellowish- to bluish-gray, silty to arenaceous, micaceous, fissile.
250	52	Sand, light-olive-gray, fine- to medium-grained, subangular to rounded quartz, micaceous, scattered dark mineral grains; dark-gray clay streak in bottom part.
		Chickasawhay Formation
252.5	2.5	Limestone, light-olive-gray, arenaceous, glauconitic; fossil imprints.
255	2.5	Marl, olive-gray, silty, fossiliferous, argillaceous.
256.5	1.5	Limestone, olive-gray, arenaceous, fossiliferous.
258	1.5	Marl, dark-olive-gray, silty, fossiliferous.
260	2	Limestone, olive-gray, arenaceous, fossiliferous.
		Vicksburg Group (Bucatunna Formation)
305	45	Clay, dark-gray, silty, carbonaceous, fissile; fine sand streaks.
307	2	Siltstone, olive-gray, fine-textured, calcareous, hard.
336	29	Clay, dark-gray, silty, carbonaceous, fossiliferous, fissile.
		Vicksburg Group (Glendon Formation)
338	2+	Limestone, light-olive-gray, fine-textured, hard, fossiliferous.

AM-45

Location: On hillside, 75 feet north of asphalt road, near edge of gravel pit, in SW/4, NE/4, SE/4, Sec. 23, T.10 N., R.8 W.

Elevation: 375 feet (Topographic map) Date: September 11, 1972

Purpose: Drilled 84 feet to determine thickness of Citronelle. Descriptions from cuttings. No electrical log (lost circulation).

Depth	Thickness	Description
		Citronelle Formation
12	12	Sand, dark-yellowish-orange, ferruginous, predominantly coarse-grained, well-rounded quartz; some gravel-size agate and chert, scattered dark grains.
20	8	Sand, pale-orange, coarse-grained, well rounded quartz; abundant pea gravel.
42	22	Sand, pale-orange, fine- to medium-grained, mostly subangular quartz, scattered muscovite flakes, argillaceous streaks.
		Vicksburg Group (Bucatunna Formation)
44	2	Clay, pale-yellowish-brown, silty; bentonitic in appearance.
65	21	Clay, dark-gray, silty, lignitic, fissile; slightly calcareous.
70	5	Clay, yellowish-gray, fine-textured; bentonitic in character.
		Vicksburg Group (Glendon Formation)
84	14	Limestone, yellowish-orange, medium-textured; very fossiliferous (numerous **Pecten**.

AM-46

Location: On hillside, 60 feet southeast of gravel road, on property of James Chapman, in SE/4, SE/4, SE/4, Sec. 24, T.10 N., R.7 W.

Elevation: 320 feet (Topographic map) Date: September 12, 1972

Purpose: Cored 115 feet for samples of Red Bluff. Descriptions from cores. Electrical log to 114 feet.

Depth	Thickness	Description
		Terrace deposit
13	13	Sand, light-brown, medium-grained, subangular quartz, ferruginous.
16.5	3.5	Clay, mottled (light-brown, light-gray, and black), smooth-textured, ferruginous.
		Forest Hill Formation
38	21.5	Clay, olive-gray, fine sand laminae, carbonaceous, micaceous; fragile fossils.
43	5	Sand, light-olive-gray, fine-grained, micaceous, calcareous, laminated, argillaceous.
64	21	Clay, olive-gray, tough, blocky, fossiliferous in part, fine sand laminae; fragments of carbonized wood.
64.5	.5	Marl, yellowish-gray, fossiliferous.
88	23.5	Clay, olive-gray, tough, blocky, fossiliferous, pyritic, carbonaceous; some fine sand laminae.
88.5	.5	Claystone, yellowish-gray, fossiliferous.
96	7.5	Clay, olive-gray, tough, blocky, homogeneous, fossiliferous, pyritic.
96.3	.3	Claystone, yellowish-gray, calcareous.
104	7.7	Clay, olive-gray, tough, blocky, homogeneous, fossiliferous; pyritic nodules.
		Red Bluff Formation
108	4	Marl, olive-gray, glauconitic, fossiliferous; indurated ferruginous ledges.
111	3	Clay, olive-gray, tough, blocky, fossiliferous.
115	4+	Marl, olive-gray, glauconitic, fossiliferous; very hard ferruginous claystone ledges.

AM-47

Location: In valley, 35 feet southwest of gravel road, in NW/4, SW/4, SW/4, Sec. 20, T.8 N., R.9 W.

Elevation: 260 feet (Topographic map) Date: September 18, 1972

Purpose: Drilled 475 feet for stratigraphic information and cored top 20 feet for clay samples. Electrical log to 474 feet.

Depth	Thickness	Description
		Catahoula Formation
14	14	Sand, pale-orange and light-gray, fine- to very fine-grained, micaceous, argillaceous, ferruginous.
23	9	Clay, light-gray and moderate-red, silty; indurated ferruginous particles.
36	13	Sand, light-gray and moderate-red, fine-grained, subangular quartz, argillaceous.
64	28	Clay, yellowish-gray to moderate-reddish-brown, silty, micaceous, ferruginous.
69	5	Sand, greenish-yellow, fine- to medium-grained, subangular quartz; very argillaceous.

77	8	Clay, yellowish-gray, silty, argillaceous.
104	27	Clay, yellowish-orange, arenaceous; ferruginous particles.
114	10	Sand, grayish-orange, medium- to coarse-grained, subangular quartz, argillaceous.
156	42	Clay, yellowish-gray, silty, kaolinitic.
220	64	Sand, yellowish-gray, fine- to coarse-grained, subangular quartz, clean; scattered black mineral grains.
226	6	Clay, grayish-black, silty, very lignitic, pyritic.
272	46	Sand, yellowish-gray, medium-grained to pebble size, subangular to subrounded; black chert and smokey quartz pebbles; argillaceous streaks.
300	28	Clay, greenish-gray, silty, blocky, pyritic, calcareous; calcareous material could correlate with **Heterostegina** zone.
308	8	Sand, greenish-gray, fine-grained, very argillaceous.
380	72	Clay, greenish-gray to medium-dark-gray, silty to arenaceous, pyritic, blocky.
		Chickasawhay Formation
388	8	Clay, dark greenish-gray, silty, blocky.
398	10	Sandstone, olive-gray, fine-grained, calcareous, glauconitic; hard ledges with clay streaks.
		Vicksburg Group (Bucatunna Formation)
472	74	Clay, medium- to dark-gray, silty, lignitic, micaceous, glauconitic, fossiliferous in lower part.
		Vicksburg Group (Glendon Formation)
474	2+	Limestone, light-olive-gray, fine-textured, fossiliferous.

AM-48

Location: On hilltop, 25 feet west of U. S. Route 63 and 1,000 feet southwest of Piney Woods Lookout Tower, in NE/4, SW/4, SE/4, Sec. 24, T.6 N., R.8 W.

Elevation: 350 feet (Topographic map) Date: September 25, 1972

Purpose: Cored to 46 feet to obtain samples of Hattiesburg Clay for testing. Description from cores. No electrical log.

Depth	Thickness	Description
		Soil
1	1	Soil, light-brown, silty to arenaceous.
		Hattiesburg Formation
2	1	Clay, mottled light-gray and olive-brown, ferruginous; some silt.
6	4	Clay, mottled greenish-gray and olive-brown, smooth-textured.
12	6	Clay, olive-brown with some light-gray, some black material, smooth-textured, low density.
18	6	Clay, mottled (brown and light-gray), laminated to blocky.
20	2	Clay, pale-olive, smooth-textured.
22	2	Clay, pale-olive; bright yellow residue on exposed surfaces.
26	4	No recovery.
42	16	Clay, mottled (light-brown, pale-olive and moderate-yellow), smooth-textured.
		Catahoula Formation
46	4+	Sand, light-brown, fine- to medium-grained, subangular quartz, ferruginous.

AM-49

Location: In Dry Creek valley, 150 feet north of asphalt road and 900 feet east of Dry Creek Bridge, in SW/4, SW/4, SE/4, Sec. 14, T.7 N., R.7 W.

Elevation: 207 feet (Topographic map) Date: September 25, 1972

Purpose: Drilled 447 feet for stratigraphic information. Descriptions from cuttings. Electrical log to 446 feet.

Depth	Thickness	Description
		Catahoula Formation
20	20	Clay, light-gray and light-brown mottled, fine-textured, ferruginous; silty to arenaceous streaks.
33	13	Clay, medium-light-gray, silty, smooth.
50	17	Clay, pale-yellowish-brown, silty to arenaceous.
62	12	Sand, light-gray, fine-grained, subangular quartz, clean.
68	6	Clay, dark-gray, silty, lignitic, pyritic.
88	20	Sand, yellowish-gray, fine-grained, subangular quartz, scattered dark grains; argillaceous streaks.
98	10	Clay, light-gray, silty to arenaceous.
104	6	Sand, light-gray, fine-grained, subangular quartz, argillaceous.
110	6	Clay, light-gray, silty to arenaceous.
156	46	Sand, light-gray, coarse- to very coarse-grained, subangular quartz; pea-gravel size milk quartz, rose quartz, and black chert in lower part.
186	30	Clay, greenish-gray to light-gray, silty, pyritic; ferruginous sand streaks; echinoid spines noted.
191	5	Sand, medium-gray, medium-grained, subangular quartz, argillaceous, carbonaceous.
196	5	Clay, dark gray, silty.
200	4	Sand, medium-gray, coarse-grained, subangular quartz.
242	42	Clay, light-brown to light-gray, silty; sand streaks (fine-grained, subangular, micaceous).
264	22	Clay, light- to dark-gray, silty to arenaceous; calcareous nodules noted.
300	36	Sand, light-gray, fine-grained, lignitic, micaceous; many argillaceous streaks.
326	26	Sand, light-olive-gray, coarse-grained, subangular quartz; many dark grains.
		Chickasawhay Formation
330	4	Clay, medium-gray, silty.
333	3	Siltstone, light-gray, calcareous, arenaceous.
337	4	Clay, light-gray, silty, calcareous; echinoid spines.
340	3	Siltstone, light-gray, arenaceous, fossiliferous; very hard.
		Vicksburg Group (Bucatunna Formation)
371	31	Clay, dark-gray, silty, carbonaceous, fissile, white precipitate on dry surface; streaks of light bentonitic clay.
375	4	Sand, gray, medium-grained, subangular to subrounded quartz, scattered dark grains.
418	43	Clay, dark-gray, silty, lignitic, fissile.
422	4	Sand, medium-gray, coarse-grained, subrounded quartz, fossiliferous.
442	20	Clay, dark-gray, silty, lignitic, arenaceous, fossiliferous.
		Vicksburg Group (Byram Formation)
445	3	Marl, very fossiliferous (numerous foraminifera); coquina like.
		Vicksburg Group (Glendon Formation)
447	2+	Limestone, light-gray, fine-textured, fossiliferous, hard.

Grifier T. H. #1

Location: Industrial park in SW/4, NE/4, NW/4, Sec. 19, T.8 N., R.6 W.

Elevation: 165 feet (Topographic map) Date: April 5, 1972

Purpose: Water well test. Electrical log to 613 feet.

Depth	Thickness	Description
		Alluvium
22	22	Sand, yellowish-gray, medium- to coarse-grained, angular to rounded quartz; clay streaks.
		Catahoula Formation
46	24	Clay, dark-gray, silty to arenaceous.
		Paynes Hammock Formation
48	2	Limestone, light-gray, arenaceous, fossiliferous.
58	10	Marl, greenish-gray, fossiliferous, arenaceous(medium-grained angular quartz), pyritic.
		Chickasawhay Formation
72	14	Clay, greenish-gray, silty to arenaceous, fossiliferous.
100	28	Limestone, yellowish-gray, arenaceous, fossiliferous; includes greenish-gray marl streaks.
		Vicksburg Group (Bucatunna Formation)
118	18	Sand, yellowish-gray, fine- to medium-grained, subangular quartz, pyritic; scattered black chert grains.
168	50	Clay, dark-olive-gray, silty, calcareous, lignitic, fissile; marly in lower part.
		Vicksburg Group (Glendon Formation)
172	4	Limestone, yellowish-gray, fine-textured, hard, fossiliferous.
176	4	Marl, olive-gray, silty, fossiliferous (**Pecten** sp. and **Lepedocyclina** noted).
180	4	Limestone, yellowish-gray, fine-textured, hard, fossiliferous, pyritic.
185	5	Marl, olive-gray, silty, fossiliferous, argillaceous.
187	2	Limestone, yellowish-gray, fine-textured, hard, fossiliferous, pyritic.
		Vicksburg Group (Marianna Formation)
233	46	Limestone, light-gray, fossiliferous; softer than above limestone; soft marl streaks.
		Forest Hill Formation
288	55	Clay, olive-gray, silty, calcareous, lignitic.
300	12	Marl, yellowish-gray to olive gray, silty, fossiliferous; indurated ferruginous ledges.
330	30	Clay, olive-gray, silty, fissile, fossiliferous.
		Red Bluff Formation
344	14	Marl, yellowish-gray to olive-gray, silty, fossiliferous; partially indurated.
		Yazoo Formation (Shubuta Clay)
392	58	Clay, olive-gray, silty, fossiliferous, fissile.
		Yazoo Formation (Pachuta Marl)
417	25	Clay, light-olive-gray, silty, very fossiliferous, fissile.

420	3	Limestone, yellowish-gray, arenaceous, fossiliferous.
		Yazoo Formation (Cocoa Sand)
440	20	Sand, light-gray, fine-grained, angular quartz, fossiliferous.
468	28	Silt, olive-gray, arenaceous, argillaceous, lignitic, fossiliferous, fissile.
		Yazoo Formation (North Twistwood Creek Clay)
512	44	Clay, greenish-gray, silty, montmorillonitic, calcareous, blocky.
		Moodys Branch Formation
515	3	Limestone, olive-gray, hard, glauconitic, fossiliferous.
525	10	Sand, greenish-gray, fossiliferous, medium- to coarse-grained, mostly subangular quartz, some green and brown glauconite.
		Cockfield Formation
542	17	Sand, medium-grained, subangular quartz, glauconitic (dark grains), fossiliferous; greenish-gray and dark-gray clay streaks.
560	18	Clay, dark-gray, silty, lignitic.
588	28	Sand, olive-gray, fine- to medium-grained, subangular quartz, glauconitic, fossiliferous; lignitic clay streaks.
599	11	Sand, olive-gray, medium-grained, subangular quartz, glauconitic, extremely fossiliferous.
613	14+	Clay, dark-gray, silty, lignitic, fossiliferous sand streaks.

Griner, T. H. #2

Location: 1,500 feet east of sewage disposal pond, in NE/4, SE/4, NE/4, NW/4, Sec. 13, T.8 N., R.7 W.

Elevation: 170 feet (Topographic map) Date: April 11, 1972

Purpose: Water well test. Descriptions from cuttings. Electrical log to 612 feet.

Depth	Thickness	Description
		Alluvium
15	15	Sand, grayish-orange, fine- to medium-grained, subangular to rounded quartz, argillaceous, micaceous.
		Paynes Hammock Formation
18	3	Limestone, light-olive-gray, arenaceous, pyritic, fossiliferous.
36	18	Sand, olive-gray, argillaceous, fossiliferous.
		Chickasawhay Formation
46	10	Clay, olive-gray, silty, fossiliferous.
74	28	Limestone, light-olive-gray, arenaceous, fossiliferous; soft marly streaks.
		Vicksburg Group (Bucatunna Formation)
133	59	Sand, yellowish-gray, fine- to medium-grained, subangular quartz, pyritic, argillaceous.
145	12	Clay, dark-gray, silty, carbonaceous, fissile, pyritic.
		Vicksburg Group (Glendon Formation)
168	23	Limestone, yellowish-gray, fine-textured, hard, fossiliferous, pyritic; marl streaks.
		Vicksburg Group (Marianna Formation)
201	33	Limestone, light-yellowish-gray, fossiliferous; softer than limestone above; soft marl streaks.

		Forest Hill Formation
306	105	Clay, dark-gray, silty to arenaceous, calcareous, fissile, carbonaceous.
		Red Bluff Formation
318	12	Marl, olive-gray to light-brown, silty to arenaceous; ferruginous indurated ledges.
		Yazoo Formation (Shubuta Clay)
376	58	Clay, light-olive-gray, silty, calcareous, friable.
		Yazoo Formation (Pachuta Marl)
394	18	Marl, olive-gray, silty to arenaceous, glauconitic, fossiliferous, argillaceous.
397	3	Limestone, olive-gray, arenaceous, glauconitic, fossiliferous.
		Yazoo Formation (Cocoa Sand)
428	31	Sand, light-gray, fine- to medium-grained, angular to subangular quartz, fossiliferous, glauconitic; scattered dark mineral grains.
		Yazoo Formation (North Twistwood Creek Clay)
484	56	Clay, olive-gray, silty, calcareous, fissile to blocky; glauconite in lower part.
		Moodys Branch Formation
498	14	Marl, dark-greenish-gray, arenaceous (medium-grained quartz and glauconite), fossiliferous; partially indurated.
		Cockfield Formation
534	36	Clay, dark-gray, silty, lignitic, fossiliferous; sand streaks.
544	10	Fossil zone or coquina zone; composed almost entirely of well preserved macrofossils with some showing abrasion and glauconitic replacement.
612	68+	Clay, dark-gray, silty to arenaceous, lignitic, fossiliferous; numerous sand streaks.

Griner T. H. #4

Location: 50 west of Jones Branch, in NE/4, NE/4, SE/4, Sec. 11, T.8 N., R.7 W.

Elevation: 180 feet (Topographic map) Date: April 25, 1972

Purpose: Water well test. Descriptions from cuttings. Electrical log to 304 feet.

Depth	Thickness	Description
		Alluvium
18	18	Sand, yellowish-gray, medium- to very coarse-grained, angular to well-rounded quartz, rare glauconite; scattered black chert and pea-gravel.
		Chickasawhay Formation
20	2	Clay, blue-gray, fine-textured, clacareous.
40	20	Limestone, light-olive-gray, medium-grained texture, arenaceous (mostly subangular quartz), glauconitic, fossiliferous, scattered black chert grains; clay streaks.
56	16	Limestone and marl streaks, light-olive-gray, fossiliferous, glauconitic.
		Vicksburg Group (Bucatunna Formation)
96	40	Sand, multicolored, fine- to coarse-grained, subangular to rounded quartz, fossiliferous, glauconitic; clay streaks.

104	8	Clay, dark-gray, silty, lignitic, pyritic, fissile.
		Vicksburg Group (Glendon Formation)
128	24	Limestone, light-olive-gray, fine-textured, fossiliferous, marly, pyritic, glauconitic.
		Vicksburg Group (Marianna Formation)
164	36	Limestone, light-yellowish-gray, fossiliferous, arenaceous; softer than limestone above, marl streaks.
		Forest Hill Formation
292	128	Clay, dark-gray, silty, carbonaceous, pyritic, fissile, calcareous.
		Red Bluff Formation
304	12+	Marl, medium-dark to light-olive-gray, fossiliferous, argillaceous; partially indurated; some light-brown indurated particles.

Griner T. H. #5

Location: NW/4, NE/4, NE/4, NE/4, Sec. 12, T.8 N., R.7 W.

Elevation: 190 feet (Topographic map) Date: April 27, 1972

Purpose: Water well test. Descriptions from cuttings. Electrical log to 305 feet.

Depth	Thickness	Description
		Terrace deposit
18	18	Sand, yellowish-gray, medium- to very coarse-grained, subangular to well-rounded quartz.
22	4	Clay, dark-gray, silty, lignitic, fissile.
		Chickasawhay Formation
26	4	Clay, greenish-gray, silty, fissile.
30	4	Limestone, light-olive-gray, arenaceous, fossiliferous.
39	9	Marl, medium-dark-gray, arenaceous (medium-grained, subangular quartz), glauconitic.
41	2	Limestone, light-olive-gray, arenaceous, fossiliferous.
		Vicksburg Group (Bucatunna Formation)
47	6	Sand, light-gray, coarse-grained, subrounded.
70	23	Sand and clay, dark-gray, silty, very fossiliferous; partially indurated.
95	25	Clay, dark-gray, silty, carbonaceous, fissile, pyritic, calcareous.
		Vicksburg Group (Glendon Formation)
120	25	Limestone, light-olive-gray, very hard, fine-textured, fossiliferous; soft marl streaks.
		Vicksburg Group (Marianna Limestone)
156	36	Limestone, yellowish-gray, fossiliferous; (softer than limestone above) soft marl streaks.
		Forest Hill Formation
274	118	Clay, dark-gray, silty, carbonaceous, micaceous, pyritic, fissile, calcareous.
		Red Bluff Formation
306	32	Marl, dark-gray to moderate yellowish-brown, silty, fossiliferous, partially indurated.

Griner T. H. #6

Location: 50 feet south of gravel road, in NE/4, NW/4, SW/4, SW/4, Sec. 1, T.8 N., R.7 W.

Elevation: 190 feet (Topographic map) Date: April 27, 1972

Purpose: Water well test hole. Descriptions from cuttings. Electrical log to 305 feet.

Depth	Thickness	Description
		Terrace deposit
17	17	Sand, grayish-orange, fine- to medium-grained, angular to rounded quartz, glauconitic, ferruginous.
		Chickasawhay Formation
34	17	Limestone, light-olive-gray, hard, arenaceous, fossiliferous; soft marl streaks.
40	6	Clay, dark-gray, silty, calcareous.
		Vickburg Group (Bucatunna Formation)
74	34	Sand, light-olive-gray, medium-grained, subangular to subrounded quartz, glauconitic, scattered black chert grains; clay streaks.
86	12	Clay, dark-gray, silty, carbonaceous, micaceous, fissile; fossiliferous toward lower part.
		Vicksburg Group (Glendon Formation)
122	36	Limestone, yellowish-gray, fine-textured, pyritic, fossiliferous; hard ledges with soft marl streaks.
		Vicksburg Group (Marianna Limestone)
162	40	Limestone, yellowish-gray, fossiliferous; softer than limestone above, marl streaks.
		Vicksburg Group (Mint Spring Formation)
170	8	Marl, medium-dark-gray, arenaceous, fossiliferous, argillaceous, glauconitic.
		Forest Hill Formation
294	124	Clay, dark-gray, silty, carbonaceous, fossiliferous, homogeneous.
		Red Bluff Formation
306	12+	Marl, dark-gray to grayish-orange, fossiliferous, glauconitic, ferruginous; partially indurated.

Griner T. H. #7

Location: 1,000 feet south of gravel road, in NE/4, SE/4, SW/4, SW/4, Sec. 13, T.8 N., R.7 W.

Elevation: 155 feet (Topographic map) Date: May 2, 1972

Purpose: Water well test hole. Descriptions from cuttings. Electrical log to 306 feet.

Depth	Thickness	Description
		Alluvium
18	18	Sand, grayish-orange, medium- to coarse-grained, angular to rounded quartz, ferruginous; scattered gravel.

		Paynes Hammock Formation
38	20	Sand, grayish-yellow-green, argillaceous, calcareous, carbonaceous.
		Chickasawhay Formation
53	15	Clay, grayish-yellow-green, silty, calcareous, pyritic.
57	4	Limestone, light-olive-gray, arenaceous, fossiliferous.
65	8	Marl, olive-gray, silty, argillaceous, calcareous.
69	4	Limestone, light-olive-gray, arenaceous, fossiliferous.
		Vicksburg Group (Bucatunna Formation)
100	31	Sand, yellowish-gray, medium-grained, subangular quartz, fossiliferous; clay streaks.
150	50	Sand, light-gray and black-speckled, fine- to medium-grained, subangular quartz, scattered black grains; rare fossils.
158	8	Clay, dark-gray, silty, lignitic, fissile, pyritic.
		Vicksburg Group (Glendon Formation)
184	26	Limestone, yellowish-gray, fine-textured, hard, fossiliferous, glauconitic; marl streaks.
		Vicksburg Group (Marianna Formation)
214	30	Limestone, light-yellowish-gray, glauconitic; softer than above limestone.
		Forest Hill Formation
306	92+	Clay, dark-gray, silty, fossiliferous, lignitic, pyritic; indurated ferruginous claystone at 240'.

Griner T. H. #9

Location: NE/4, SE/4, SW/4, SW/4, Sec. 12, T.8 N., R.7 W.

Elevation: 165 feet (Topographic map) Date: July 12, 1972

Purpose: Water well test. Descriptions from cuttings. Electrical log to 305 feet.

Depth	Thickness	Description
		Alluvium
18	18	Sand, yellowish-gray, medium- to very coarse-grained, angular to well-rounded quartz.
		Paynes Hammock Formation
27	9	Limestone, light-olive-gray, arenaceous, fossiliferous; marl streaks.
34	7	Clay, medium-dark-gray, silty, fissile, calcareous.
40	6	Limestone, light-olive-gray, fossiliferous, indurated; soft marl streak.
		Chickasawhay Formation
46	6	Clay, light-gray, silty, fissile.
55	9	Sand, light-olive-gray, medium- to coarse-grained, subangular to rounded, fossiliferous, argillaceous, rare grains of black chert.
78	23	Limestone and marl, light-olive-gray, arenaceous, fossiliferous, argillaceous.
		Vicksburg Group (Bucatunna Formation)
88	10	Clay, yellowish-gray, silty.
91	3	Sand, yellowish-gray, medium-grained, mostly subangular quartz; some black chert grains.
100	9	Clay, yellowish-gray, silty, bentonitic.

120	20	Sand, light-gray, fine- to medium-grained, mostly subangular quartz, scattered black chert grains.
126	6	Clay, dark-gray, silty, micaceous, lignitic, pyritic, fissile.
		Vicksburg Group (Glendon Formation)
148	22	Limestone, light-olive-gray, fine-textured, hard, glauconitic; marl streak.
		Vicksburg Group (Marianna Formation)
180	32	Limestone, light-olive-gray, fossiliferous; softer than limestone above.
		Forest Hill Formation
200	20	Clay, dark-gray, silty to arenaceous, fossiliferous.
204	4	Sand, light-olive-gray, medium-grained, subangular quartz, glauconitic, fossiliferous.
222	18	Clay, dark-gray, silty, calcareous, fissile, arenaceous in part.
302	80	Clay, dark-gray, silty, carbonaceous, fossiliferous, fissile, micaceous, pyritic.
		Red Bluff Formation
306	4+	Marl, medium-dark-gray, silty, fossiliferous, carbonaceous.

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WAYNE COUNTY CLAY TESTS

by

Dr. William B. Hall and Dr. Rollin C. Glenn

(Includes test results from Bureau of Mines and chemical analyses supervised by Dr. James P. Minyard)

ABSTRACT AND INTRODUCTION

Seventeen clay samples collected by the Mississippi Geological Survey in Wayne County, Mississippi, were sent to Mississippi State University for testing. The tests were conducted under the supervision of Dr. William B. Hall, Associate Professor, Department of Materials Engineering, Dr. Rollin C. Glenn, Head, Department of Plant and Soil Sciences, and Dr. James P. Minyard, State Chemist.

The tests included: those for physical and mechanical properties related to ceramics (Table 1); tests for pH and $CaCO_3$ equivalents (Table 2); particle size analysis (Table 3); clay mineral identification by X-ray diffraction (Table 4); clay mineral identification by differential thermal analysis (Table 5); viscosity (Figure 22); and chemical analysis (Table 6). Preliminary lightweight aggregate test (Table 7) and decolorization tests (Figures 23-27) were conducted by the U. S. Bureau of Mines at its Tuscaloosa Metallurgy Research Laboratory.

Seven of the samples were from the Catahoula Formation, three were from the Shubuta Member of the Yazoo Formation, one was from the North Twistwood Creek Member of the Yazoo Formation, two were from the Bucatunna Formation, one was from the Forest Hill Formation, and three were from the Hattiesburg Formation.

The economic possibilities of these clays are discussed under the section entitled, "Economic Geology."

MATERIALS AND METHODS

The clay samples, which were received from the Mississippi Geological Survey, were classified according to their natural color. Each sample was completely dried and crushed, then ground and mixed by a muller for 30 minutes, and then screened. The part of the clay samples which passed a U. S. standard sieve number 3.5 was tempered with water by a trial-and-error method, with the amount of water being recorded as the water of plasticy. The clay was then extruded using a Fate-Root-Heath Laboratory extruder, Model CH-TK.

The specimen used in the physical testing was a rectangular bar with dimensions about 5″ x 1″ x 0.5″, and was formed by the extrusion machine with the size of die 1″ x 0.5″ and under a vacuum of 21 inches of Mercury (Hg).

The Physical and Mechanical Properties Measurements

(1) The percent of Water of Plasticity: The water of plasticity was calculated as a percentage of the weight of the dry clay bar by the following formula:

$$T = \frac{W_p - W_d}{W_d} \times 100$$

in which T was percent water of plasticity

W_p was weight of plastic test piece

W_d was weight of dry test piece

Plastic Weight: The edges and corners of the test piece were rubbed lightly with the finger to prevent loss in handling and it was weighed on a balance to an accuracy of 0.1 grams.

Drying: The test piece was dried at 64°C for 5 hours and at 110°C until approximately constant in weight. The results of these measurements were tabulated in Table 1.

(2) Linear Drying Shrinkage: The shrinkage marks on each test piece were initially 3 inches apart. The per cent on linear drying shrinkage was calculated from the following formula:

$$a_p = \frac{l_p - l_d}{l_p} \times 100$$

in which a_p was per cent of linear drying shrinkage

l_p was plastic length (3 inches)

l_d was dry length

Three test pieces were selected in these measurements. The dry lengths were determind after the test pieces were completely dry. The drying was performed at 64°C for 5 hours and 110°C for 10 hours. The accuracy of these measurements were 0.001 inches, and the results were tabulated in Table 1.

Firing Shrinkage: The test pieces were fired to the required temperatures and maintained for 30 minutes. The fired lengths were determined after the test pieces were allowed to cool slowly down to room temperature, and the accuracy of these measurements was 0.001 inch. The formula of these measurements was as follows:

$$b_p = \frac{1_p - 1_f}{1_p} \times 100$$

where b_p was percent of total shrinkage

1_p was plastic length or original length (3 inches)

1_f was fire length

Three test pieces were prepared for each measurement, and the results were tabulated in Table 1.

(3) Modulus of Rupture: Dry strengths were determined when the test pieces were dried at 64°C for 5 hours and at 110°C until approximately constant weight and were cooled in a desiccator. The testing machine used in this measurement was similar to the one described in the report by the American Ceramic Society Committee on Standards. The formula commonly employed to determine the dry strength for bars of rectangular cross section was as follows:

$$M = \frac{3PL}{2bd^2} (X)$$

where M was modulus of rupture in psi

P was breaking load in pounds

L was distance between knife edges in inches

b was breadth of bar in inches

d was depth of bar in inches

X was multiplying factor of this machine which is 4

Three bars, processed under the same parameters, were broken and the results were tabulated in Table 1.

(4) Apparent Porosity: The apparent porosity was calculated by means of the following formula:

$$P = \frac{S_f - W_f}{V_f} \times 100$$

where P was the percent apparent porosity

S_f was weight of the saturated fired test piece in gms.

W_f was weight of the fired test piece in gms.

V_f was volume of the fired test piece in cc.

The test pieces were placed in distilled water in a suitable vessel, in which they were not allowed to make contact with the heated bottom of the container, were boiled for two hours, and then were allowed to cool to room temperature while they were still immersed in water. Suspended weights and saturated weights were determined with an accuracy of 0.1 grams. Fired volumes were determined from the following formula:

$$V_f = \frac{W_f - W_s}{S}$$

where V_f was volume of the fired test piece in cc.

W_f was weight of the fired test piece in gms.

W_s was weight suspended in water in gms.

S was the specific gravity of distilled water which in this case was approximately 1.

Three test pieces were measured and the results were tabulated in Table 1.

(5) Water Absorption: The precentages of water absorption were calculated from the following formula:

$$c = \frac{S_f - W_f}{W_f} \times 100$$

where c was the percent of water apsorption

S_f was weight saturated with water

W_f was weight of the fired test piece

Three test pieces of each sample were measured and the results were tabulated in Table 1.

The firing temperatures in Table 1 are given in °F while the temperatures in the test procedures are given in °C. The oven in the testing lab is calibrated in °F.

Clay Mineral Identification

Mineralogical identifications were made by X-ray diffraction and differential thermal analysis techniques. X-ray analyses were made on the clay-size fraction of each core sample. The clay (less than 2 micron size) was separated from silt and sand by centrifugation after free iron oxide removal and dispersion in dilute sodium carbonate solution.

Duplicate clay specimens of 50 milligrams size were prepared for the X-ray analysis. One specimen was exchanged saturated with magnesium (Mg) ions and then solvated in a 10 percent glycerin in ethyl alcohol solution for 6 hours. It was then centrifuged from suspension and redispersed in water and poured onto a 3.5 X 3.5 cm, glass slide and allowed to air dry for X-raying. The duplicate specimen was exchanged saturated with potassium (K) ions, glycerated, and likewise poured onto a 3.5 X 3.5 cm. glass slide and air dried. Both specimens were X-rayed after drying at room temperature. The K saturated speciman was then heated at 550°C for 5 hours and X-rayed again. Magnesium saturation was used to test for montmorillonite, which expands to 18A in the presence of glycerin. Potassium saturation was used to test for vermiculite and chlorite. Vermiculite will collapse from 14A to 10A when K-saturated, whereas, chlorite will not. Heating at 550°C destroys the kaolinite structure but does not affect chlorite; thus, the 7.1A line of kaolinite can be distinguished from the second order 7.1A line of chlorite when the two minerals occur together.

The X-ray analyses were run on a Norelco diffractometer equipped with a copper target tube and nickel filter. X-rays were generated at 35Kv and 18Ma. The recorder speed was 2 degrees 2θ per minute, and the full scale chart deflection was 5000cps.

The differential thermal analysis (DTA) was done on a four channel Delta Therm instrument manufactured by the

Technical Equipment Company, Denver, Colorado. The instrument was operated from 25 to 1050°C at a heating rate of 10° per minute.

Core samples were prepared for DTA by crushing to a powder and screening at 300-mesh (50 microns). The fine powder was then brought to an atmospheric equilibrium of 50 percent relative humidity over a saturated solution of magnesium nitrate prior to analysis. The inert standard for the analysis was ignited aluminum oxide.

Table 1. Summary of the Physical and Mechanical Properties Measurements

Core No.	Working Ability	% Water of Plasticity	Drying or Firing (°F)	% Shrinkage	% Porosity	% Water Absorption	Modulus of Rupture (psi)	Color
AM-2 2'-12'	Excellent	30.2	198	6.67	-	-	517	Tan
			1800					
			1900		Carbonaceous Material Present			
			2000					
AM-2 12'-17'	Fair	35.4	198	5.0	-	-	700	Grey
			1800	5.1	38.4	15.5	827	L. Red
			1900	5.1	44.4	17.4	828	Red
			2000	8.0	42.4	16.5	1109	Red
AM-5 22'-26'	Excellent	25.0	198	3.3	-	-	360	L. Brown
			1800	4.3	47.5	17.4	1568	Pink
			1900	6.3	25.0	9.4	2290	Pink
			2000	8.0	2.9	10.0	3760	Cream
AM-5 26'-32'	Excellent	25.0	198	1.6	-	-	316	White
			1800	3.3	40.0	14.9	1970	White
			1900	5.6	37.0	13.6	2450	White
			2000	5.6	38.0	14.3	3502	White
AM-7 4'-28'	Fair	35.2	198	6.6	-	-	1250	Olive
			1800					
			1900		Gaseous Material Present			
			2000					

Table 1. (continued)

Core No.	Working Ability	% Water of Plasticity	Drying or Firing (°F)	% Shrinkage	% Porosity	% Water Absorption	Modulus of Rupture (psi)	Color
AM-7	Excellent	35.0	198	6.6	-	-	640	Black
30'-60'			1800					
			1900		Bloating Occurred			
			2000					
AM-8	Excellent	36.6	198	5.0	-	-	675	Tan
6'-26'			1800					
			1900		Bloating Occurred			
			2000					
AM-9	Excellent	56.0	198	11.3	-	-	739	Olive
4'-28'			1800					
			1900		Bloating Occurred			
			2000					
AM-11	Good	35.8	198	3.3	-	-	-	Black
20'-24'			1800					
			1900		Bloating Occurred			
			2000					
AM-24	Excellent	53.2	198	8.0	-	-	-	Brown
12'-26'			1800					
			1900		Gaseous Material Present			
			2000					
AM-31	Poor	28.3	198	4.0	-	-	1480	Buff
10'-18'			1800	-	12.8	5.25	-	Buff
			1900	6.3	23.0	8.9	3740	Orange
			2000	7.3	15.4	6.1	3500	Red

Table 1. (continued)

Core No.	Working Ability	% Water of Plasticity	Drying or Firing (^{o}F)	% Shrinkage	% Porosity	% Water Absorption	Modulus of Rupture (psi)	Color
AM-46 42'-104'	Excellent	34.4	198	4.0	-	-	283	Black
			1800					
			1900		Bloating Occurred			
			2000					
AM-47 10'-14'	Fair	20.8	198	3.6	-	-	935	Brown
			1800	5.3	27.0	5.65	1640	Red
			1900	5.6	51.1	10.9	1650	Red
			2000	5.6	21.9	8.5	2500	Red
AM-47 14'-20'	Excellent	18.6	198	2.6	-	-	756	Buff
			1800	3.0	25.6	9.95	1980	Cream
			1900	3.1	26.0	10.30	2010	Cream
			2000	3.2	29.4	11.2	2340	Cream
AM-48 4'-18'	Excellent	19.4	198	3.3	-	-	1333	Tan
			1800	6.6	17.4	7.05	3340	Red
			1900	8.0	15.4	6.05	4320	Red
			2000	8.0	9.4	3.9	3160	Red
AM-48 18'-32'	Good	27.4	198	3.28	-	-	1240	Tan
			1800					
			1900		Gaseous Material Present			
			2000					
AM-48 32'-42'	Excellent	27.2	198	3.3	-	-	1000	Tan
			1800	7.6	24.4	1.1	2910	Red
			1900	8.3	18.7	.8	4060	D. Red
			2000	8.4	4.5	2.0	-	D. Red

TABLE 2. Clay Mineral Identification by X-ray Diffraction Analysis

Core No.	"d" Spacing (A)	Crystal Face	Clay Mineral	Relative Abundance
AM-2 (2'-12')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Medium
	7.1	001	Kaolinite	Low
AM-2 (12'-17')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Medium
	7.1	001	Kaolinite	Low
AM-5 (22'-26')	14.0	001	Vermiculite-Chlorite	Low
	10.0	001	Mica	Low
	7.1	001	Kaolinite	High
	4.25, 3.34	100, 101	Quartz	Medium
AM-5 (26'-32')	14.0	001	Vermiculite-Chlorite	Low
	10.0	001	Mica	Low
	7.1	001	Kaolinite	High
	4.26, 3.34	100, 101	Quartz	Medium
AM-7 (4'-28')	18.0	001	Montmorillonite	High
	14.0	001	Chlorite	Low
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Low
	4.26, 3.45	100, 101	Quartz	Low
AM-7 (30'-60')	18.0	001	Montmorillonite	High
	14.0	001	Chlorite	Low
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Low
	4.26, 3.34	100, 101	Quartz	Low
AM-8 (6'-26')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Low
AM-9 (4'-28')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Low

Table 2 (continued)

Core No.	"d" Spacing (A)	Crystal Face	Clay Mineral	Relative Abundance
AM-11 (20'-24')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Low
AM-24 (12'-26')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Low
AM-31 (10'-18')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Low
	4.26, 3.34	100, 101	Quartz	Low
AM-46 (42'-104')	18.0	001	Montmorillonite	High
	14.0	001	Vermiculite-Chlorite	Low
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Medium
AM-47 (10'-14')	18.0	001	Montmorillonite*	High
	14.0	001	Chlorite	Low
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Medium
AM-47 (14'-20')	18.0	001	Montmorillonite*	High
	14.0	001	Chlorite	Low
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Medium
AM-48 (4'-18')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Low
AM-48 (18'-32')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Low
AM-48 (32'-42')	18.0	001	Montmorillonite	High
	10.0	001	Mica	Low
	7.1	001	Kaolinite	Low
	4.26, 3.34	100, 101	Quartz	Low

* Poorly crystalline, almost X-amorphous

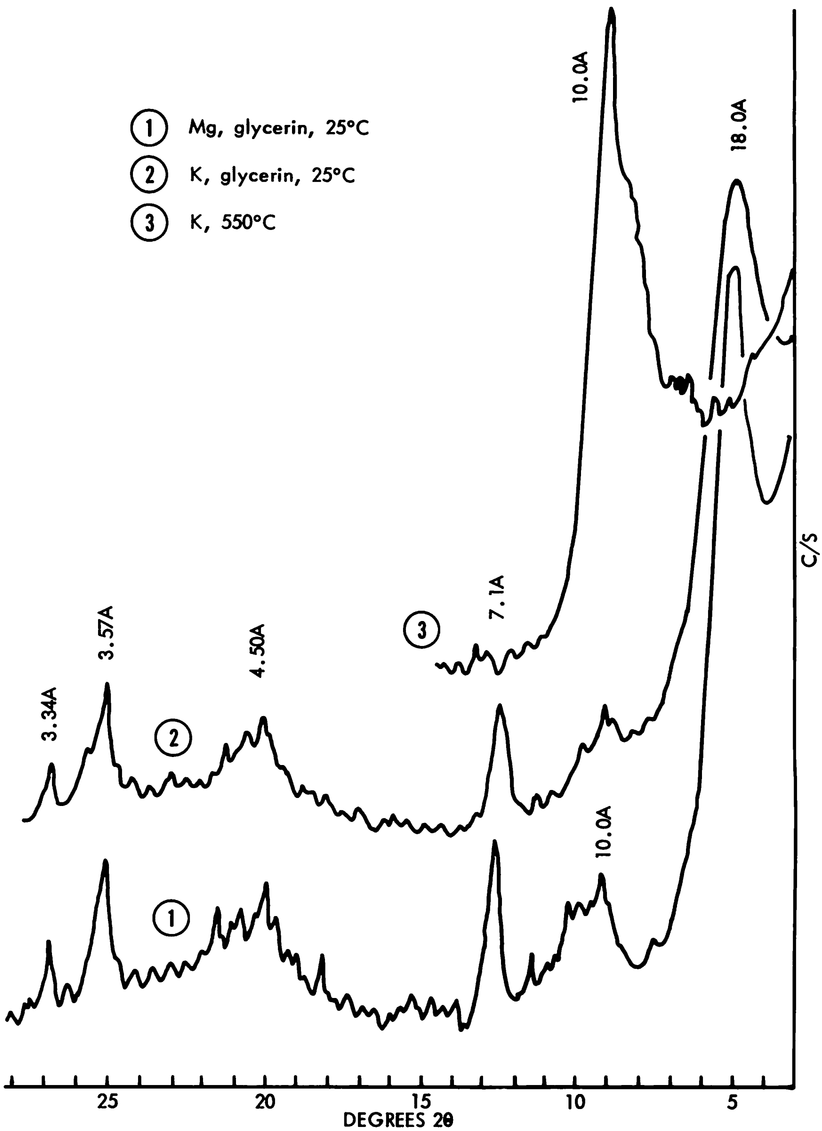


Figure 1—X-ray Diffractograms of < 2μ Clay Core No. AM-2(2'12')

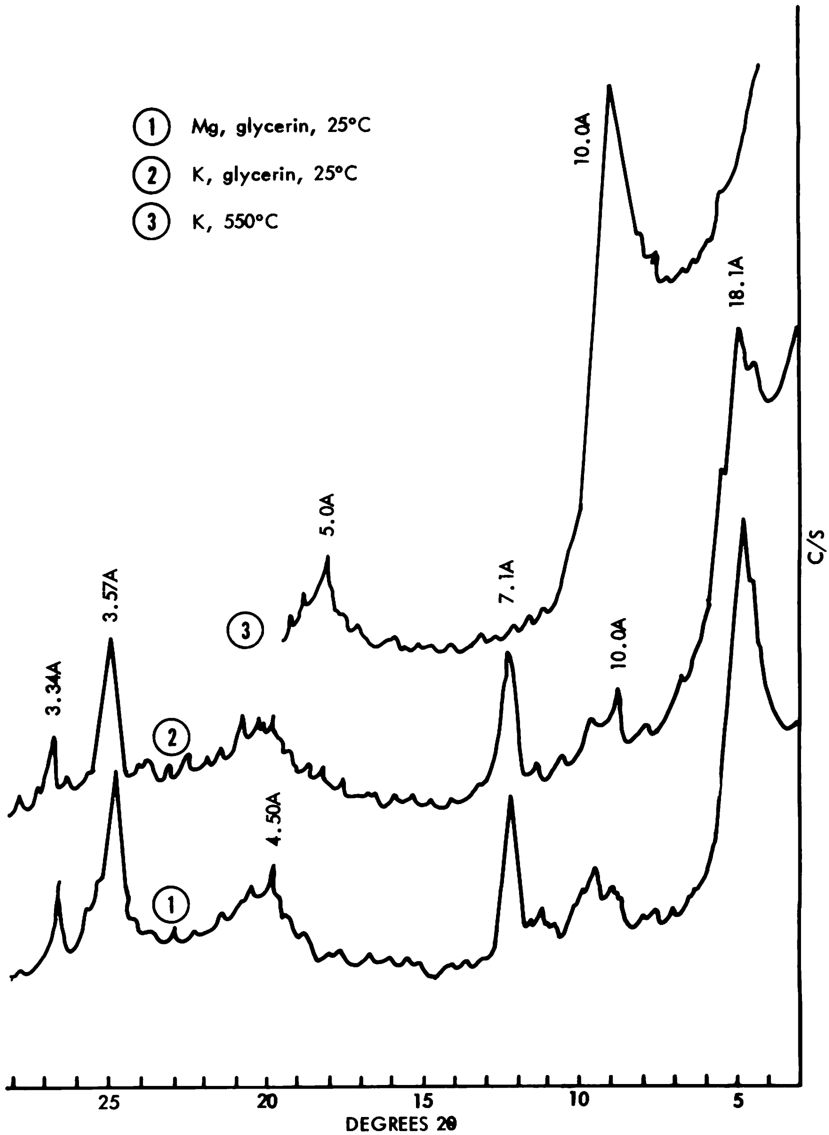


Figure 2—X-ray Diffractograms of $< 2\mu$ Clay Core No. AM-2(12′-17′)

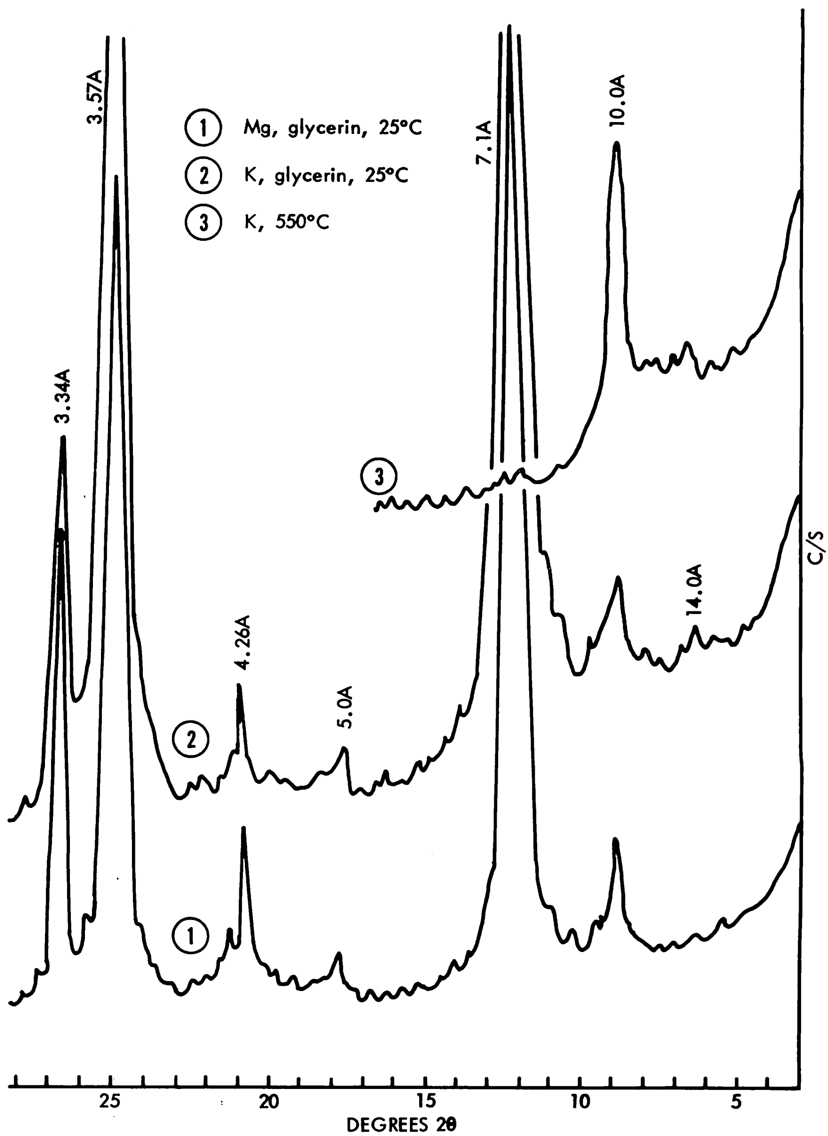


Figure 3—X-ray Diffractograms of < 2μ Clay Core No. AM-5(22′-26′)

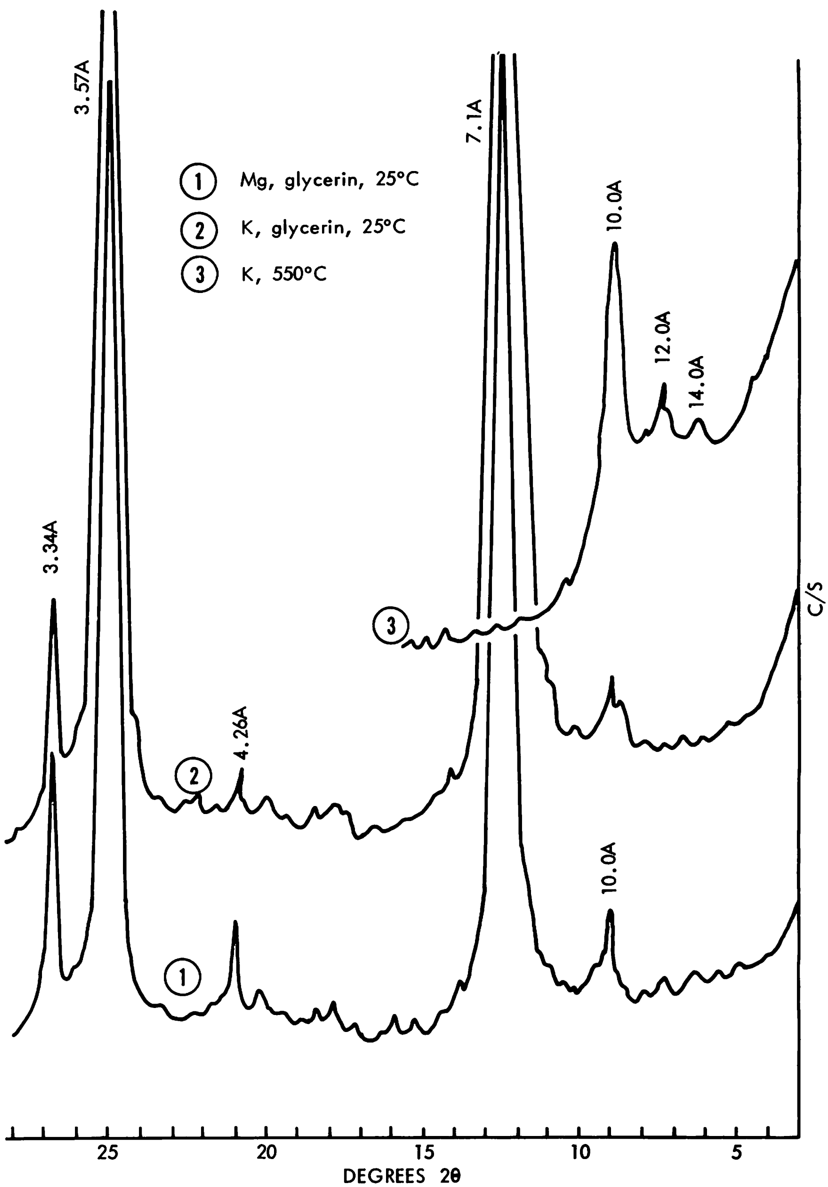


Figure 4—X-ray Diffractograms of < 2μ Clay Core No. AM-5(26′-32′)

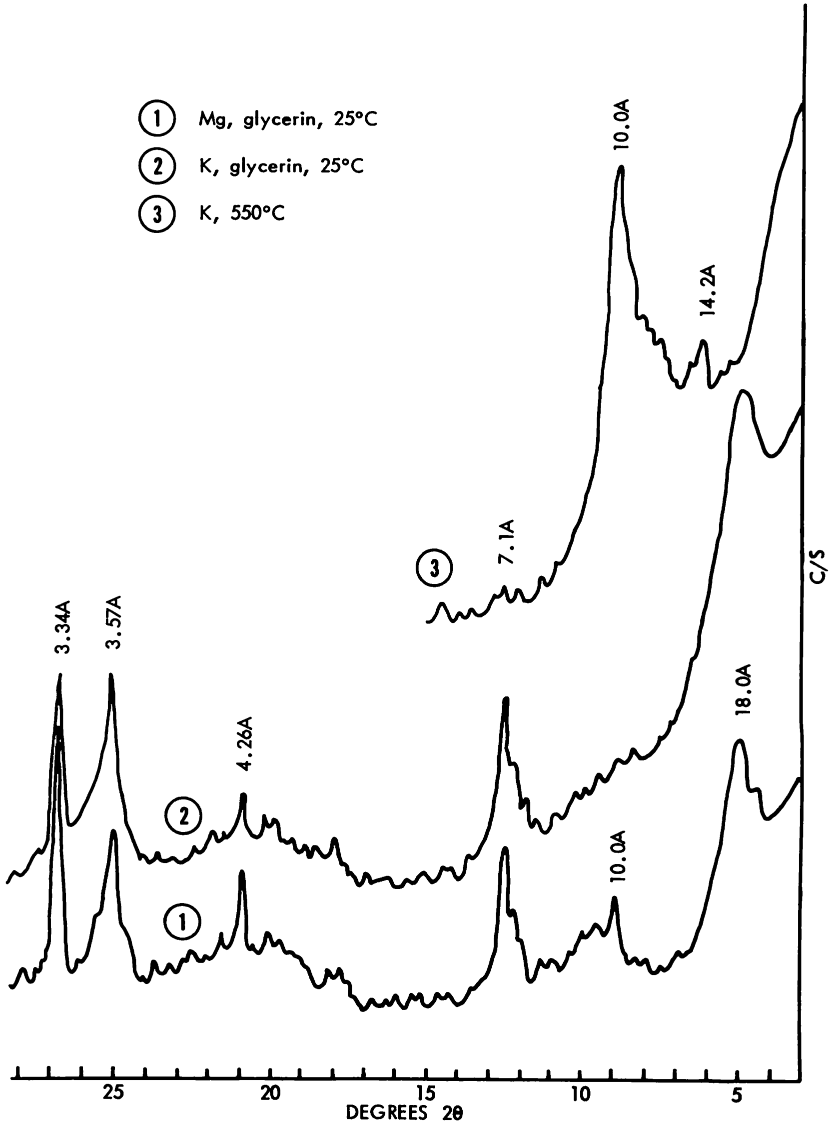


Figure 5—X-ray Diffractograms of < 2μ Clay Core No. AM-7(4'-28')

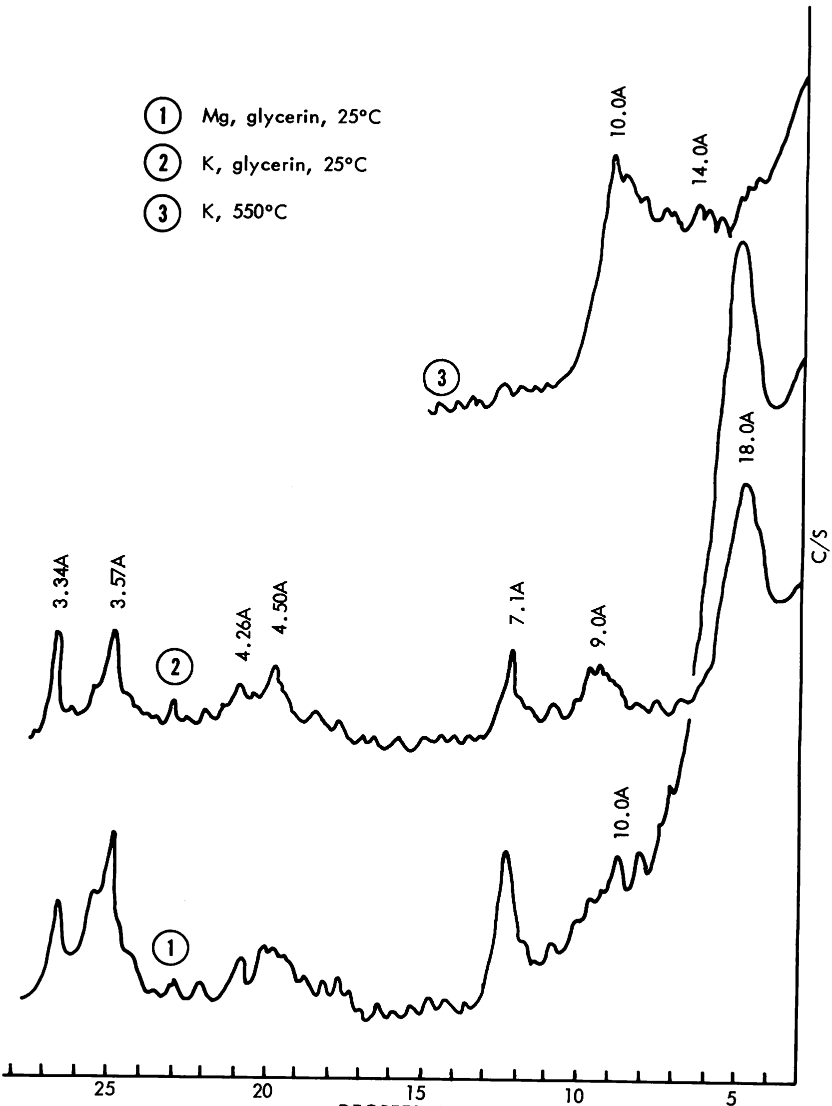


Figure 6—X-ray Diffractograms of < 2μ Clay Core No. AM-7(30′-60′)

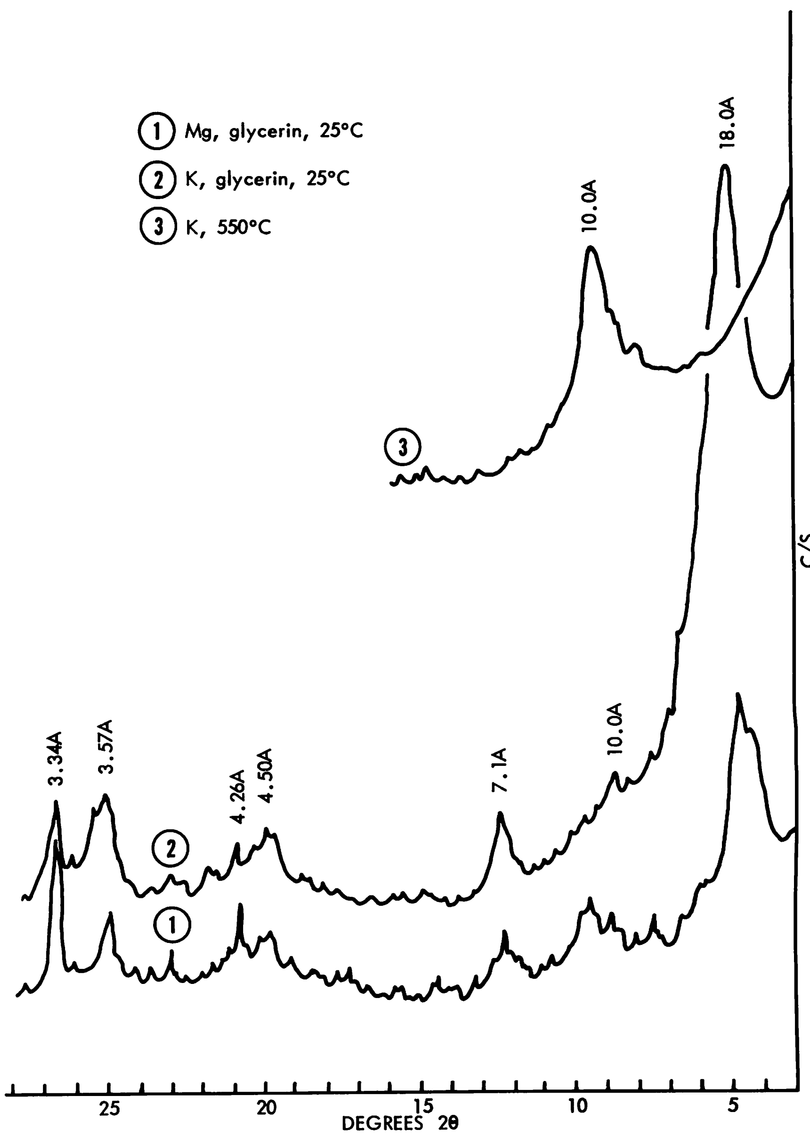


Figure 7—X-ray Diffractograms of < 2μ Clay Core No. AM-8(6′-26′)

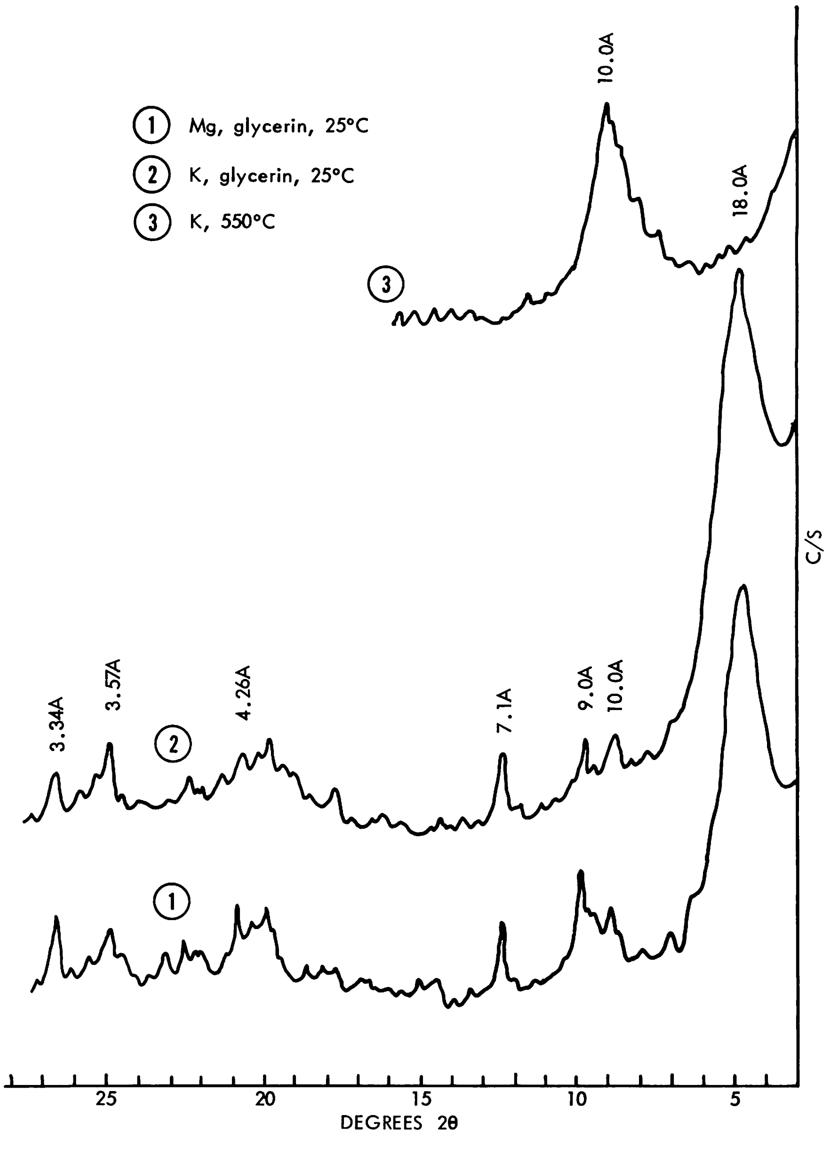


Figure 8—X-ray Diffractograms of < 2μ Clay Core No. AM-9(4′-28′)

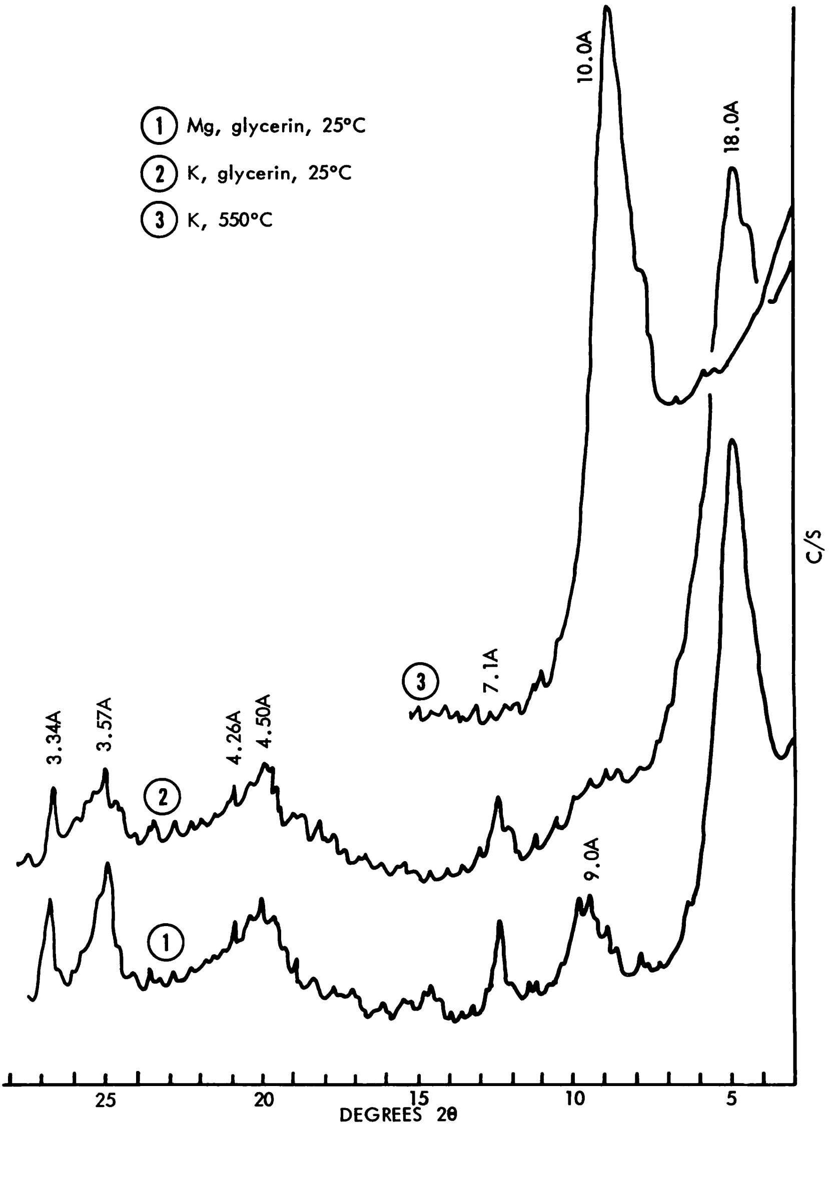


Figure 9—X-ray Diffractograms of < 2μ Clay Core No. AM-11(20'-24')

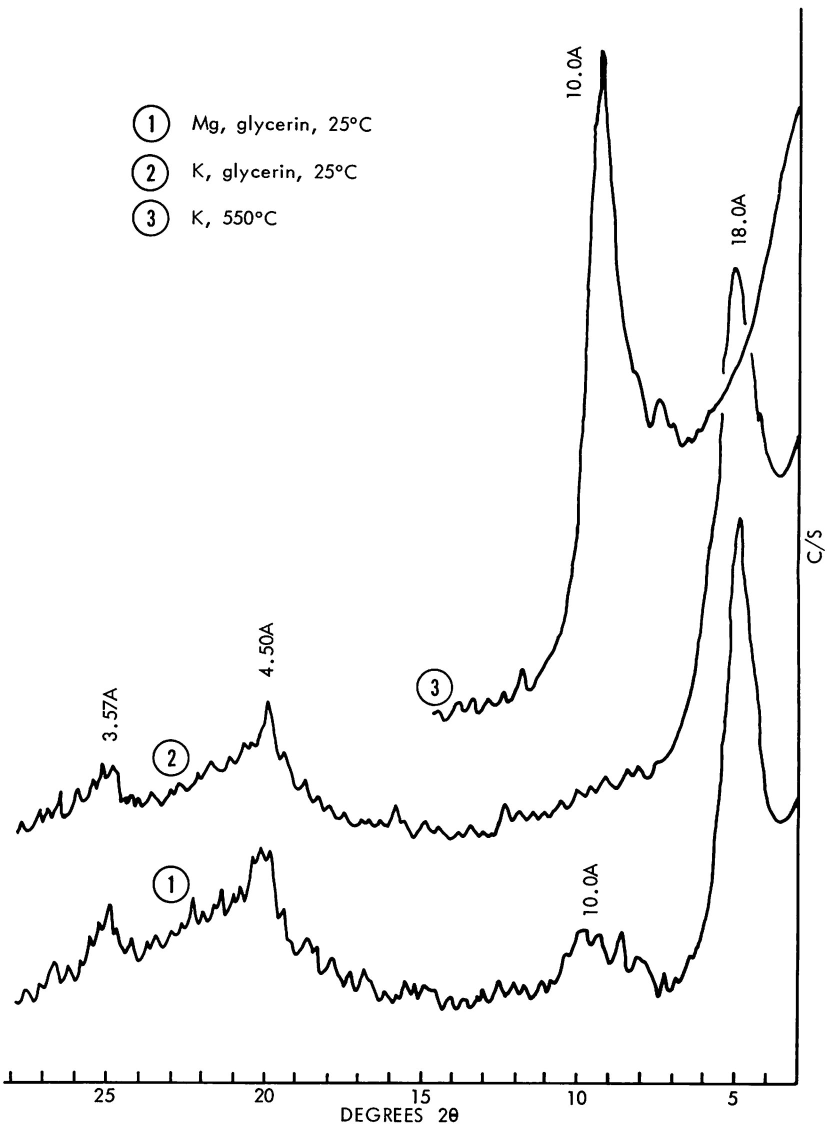


Figure 10—X-ray Diffractograms of < 2μ Clay Core No. AM-24(12′-26′)

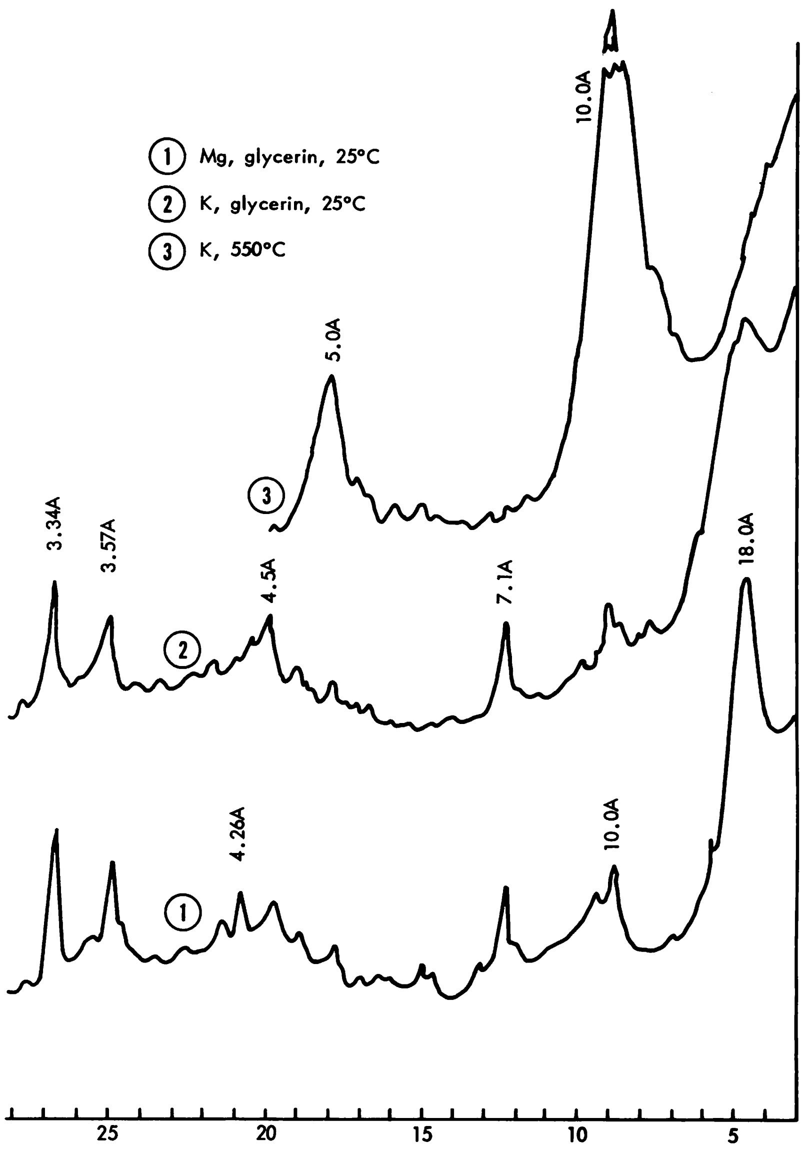


Figure 11—X-ray Diffractograms of < 2μ Clay Core No. AM-31(10′-18′)

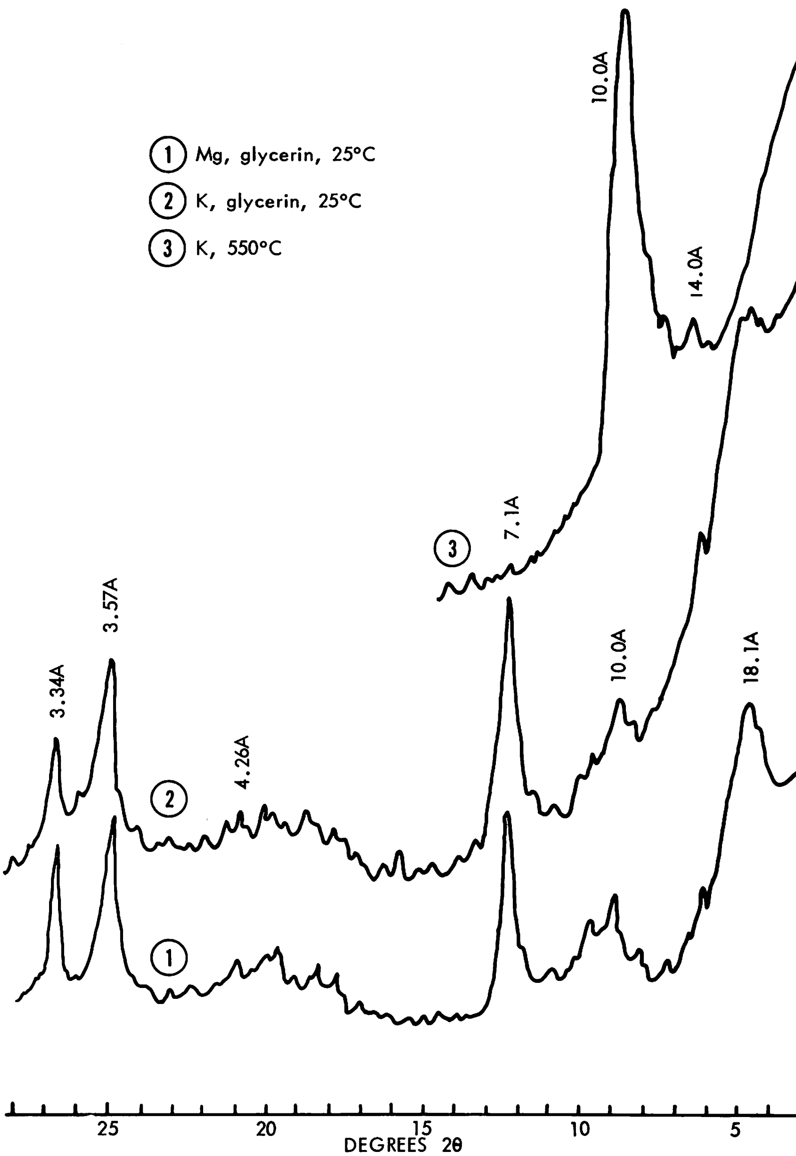


Figure 12—X-ray Diffractograms of < 2μ Clay Core No. AM-46(42′-104′)

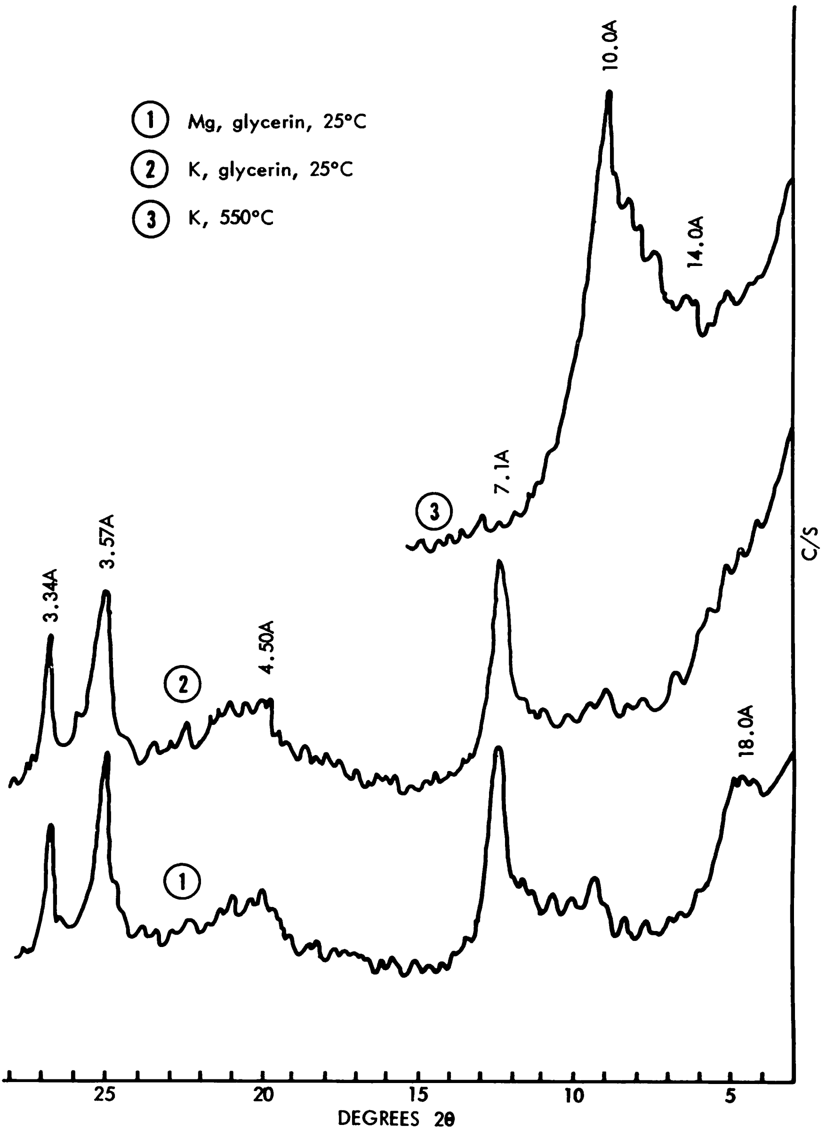


Figure 13—X-ray Diffractograms of < 2μ Clay Core No. AM-47(10′ 14′)

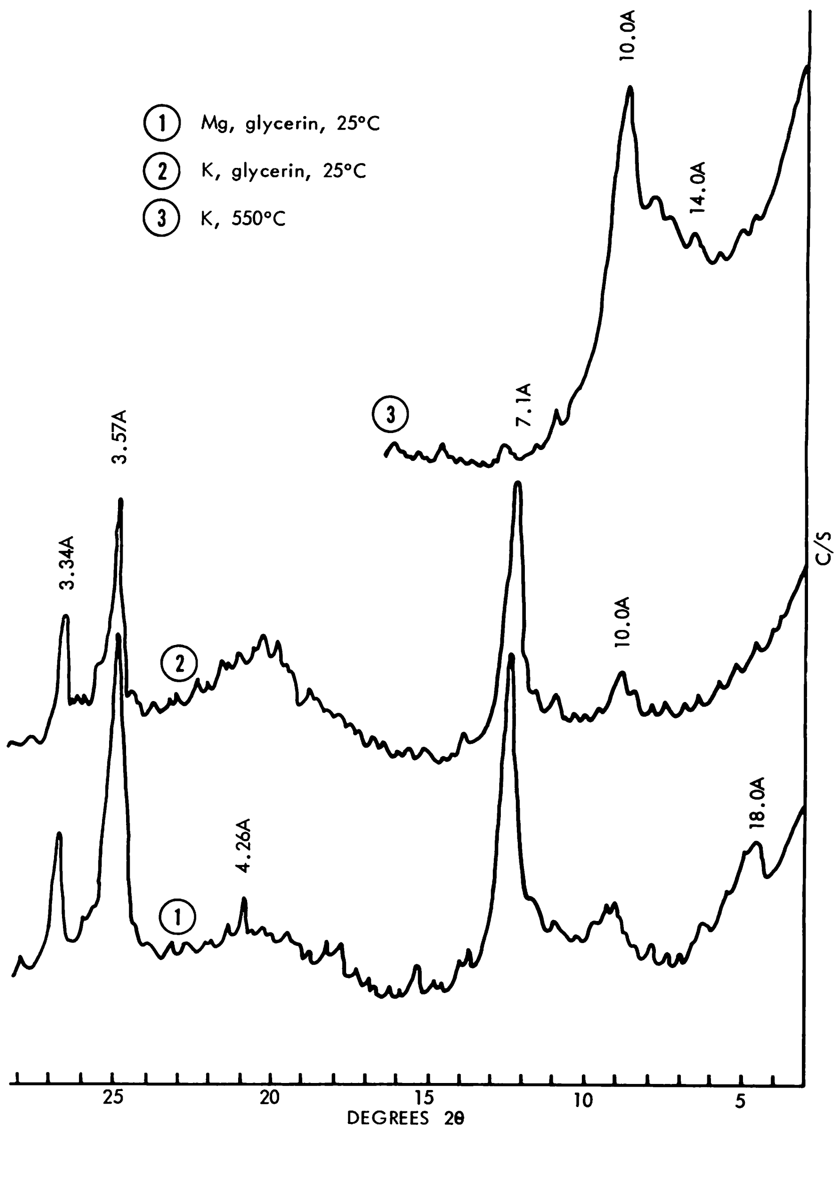


Figure 14—X-ray Diffractograms of $< 2\mu$ Clay Core No. AM-47(14′-20′)

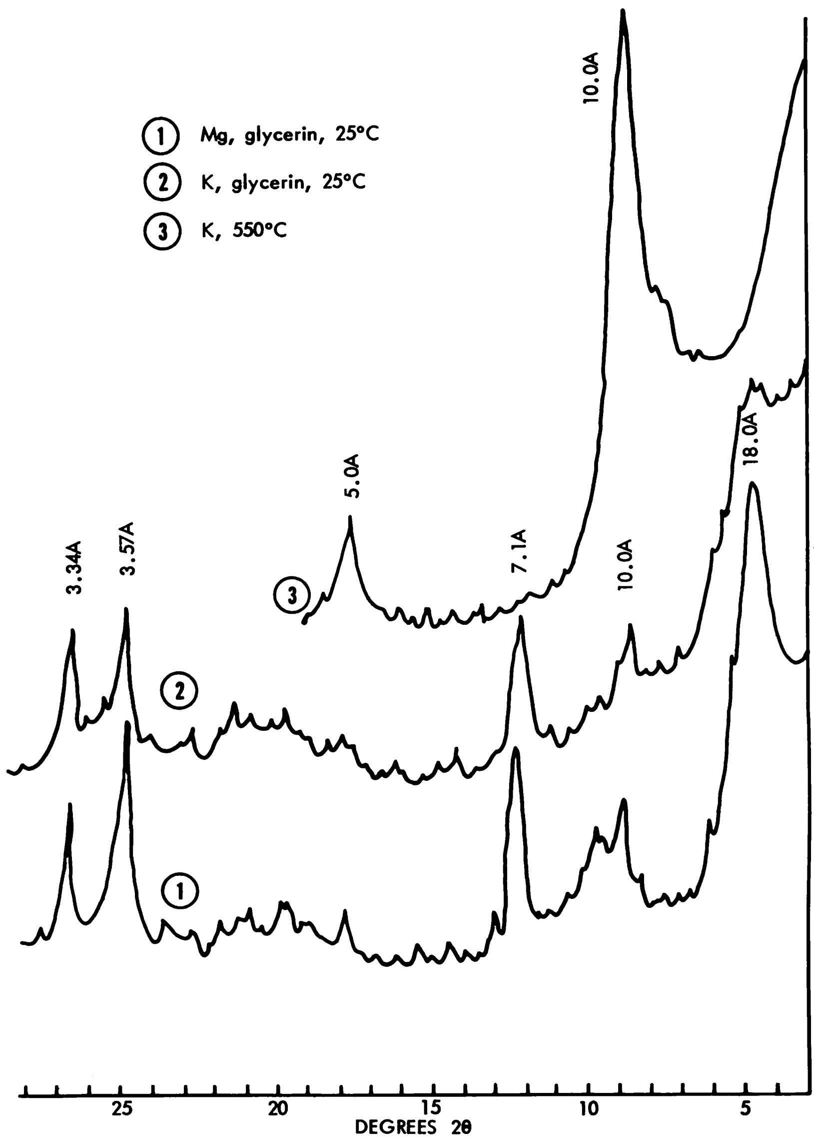


Figure 15—X-ray Diffractograms of < 2μ Clay Core No. AM-48(4'-18')

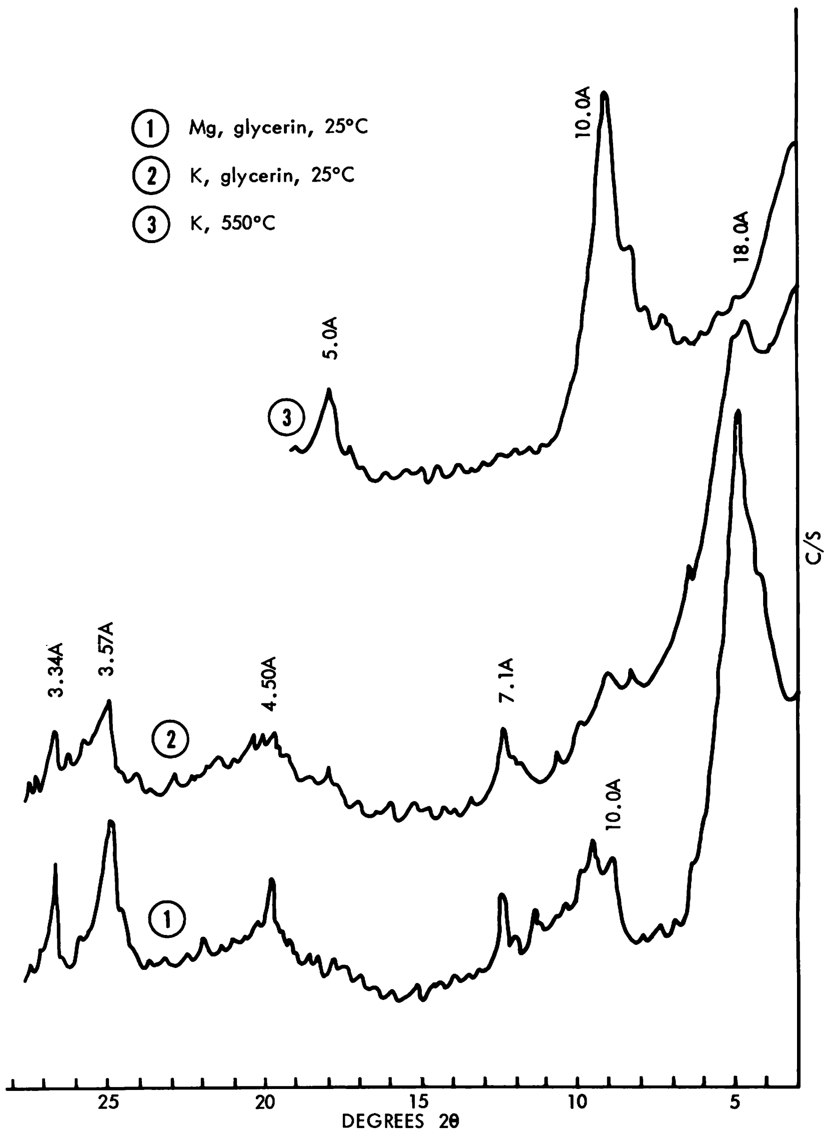


Figure 16—X-ray Diffractograms of < 2μ Clay Core No. AM-48(18′-32′)

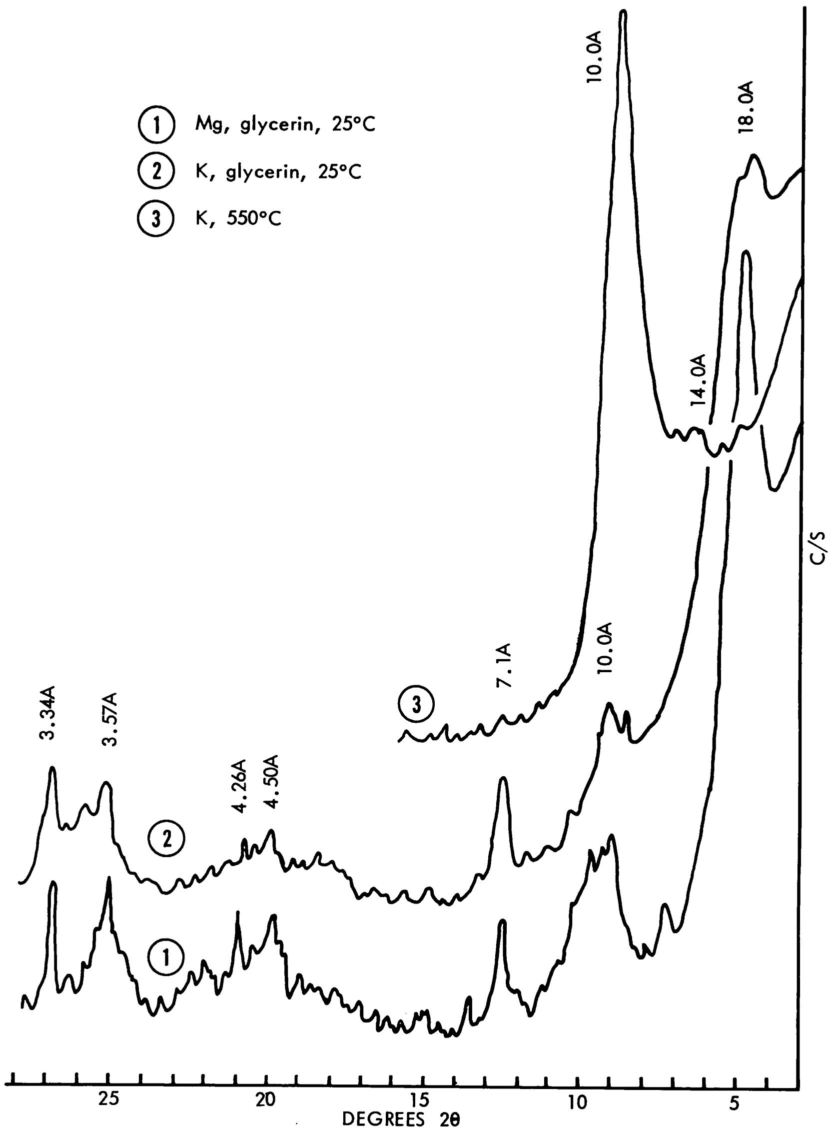


Figure 17—X-ray Diffractograms of < 2μ Clay Core No. AM-48(32′-42′)

Table 3. Clay Mineral Identification by DTA

Core No.	Endotherms		Exotherms	
	°C	Mineral	°C	Mineral
AM-2 (2'-12')	130	Montmorillonite	940	Kaol-mullite
	240	Montmorillonite		
	610	Kaolinite		
AM-2 (12'-17')	130	Montmorillonite	430	Org. matter
	610	Kaolinite	970	Kaol-mullite
AM-5 (22'-26')	130	Vermiculite	970	Kaol-mullite
	610	Kaolinite		
	360	Goethite		
AM-5 (26'-32')	130	Vermiculite	970	Kaol-mullite
	240	Vermiculite		
	610	Kaolinite		
AM-7 (4'-28')	130	Montmorillonite	925	Calcite
	150	Montmorillonite	970	Kaol-mullite
	180	Montmorillonite		
	220	Montmorillonite		
	600	Kaolinite		
	900	Calcite		
AM-7 (30'-60')	130	Montmorillonite	925	Calcite
	220	Montmorillonite	970	Kaol-mullite
	600	Kaolinite		
	900	Calcite		
AM-8 (6'-26')	130	Montmorillonite	925	Calcite
	220	Montmorillonite	970	Kaol-mullite
	600	Kaolinite		
	760	Montmorillonite		
	910	Calcite		
AM-9 (4'-28')	130	Montmorillonite		
	225	Montmorillonite		
	600	Kaolinite		
	750	Montmorillonite		
	885	Calcite		

Table 3. (continued).

Core No.	Endotherms		Exotherms	
	°C	Mineral	°C	Mineral
AM-11 (20'-24')	130	Montmorillonite	460	Org. matter
	150	Montmorillonite	940	Kaol-mullite
	180	Montmorillonite		
	600	Kaolinite		
	625	Quartz		
AM-24 (12'-26')	130	Montmorillonite	930	Calcite
	220	Montmorillonite		
	600	Kaolinite		
	720	Montmorillonite		
	900	Calcite		
AM-31 (10'-18')	130	Montmorillonite	940	Kaol-mullite
	220	Montmorillonite		
	600	Kaolinite		
AM-46 (42'-104')	130	Montmorillonite	360	Goethite
	220	Montmorillonite	940	Kaol-mullite
	380	Goethite		
	600	Kaolinite		
	760	Montmorillonite		
AM-47 (10'-14')	130	Montmorillonite	940	Kaol-mullite
	600	Kaolinite		
AM-47 (14'-20')	130	Montmorillonite	940	Kaol-mullite
	220	Montmorillonite		
	600	Kaolinite		
AM-48 (4'-18')	130	Montmorillonite	940	Kaol-mullite
	220	Montmorillonite		
	600	Kaolinite		
AM-48 (18'-32')	130	Montmorillonite	940	Kaol-mullite
	180	Montmorillonite		
	240	Montmorillonite		
	600	Kaolinite		
AM-48 (32'-42')	130	Montmorillonite	940	Kaol-mullite
	225	Montmorillonite		
	600	Kaolinite		

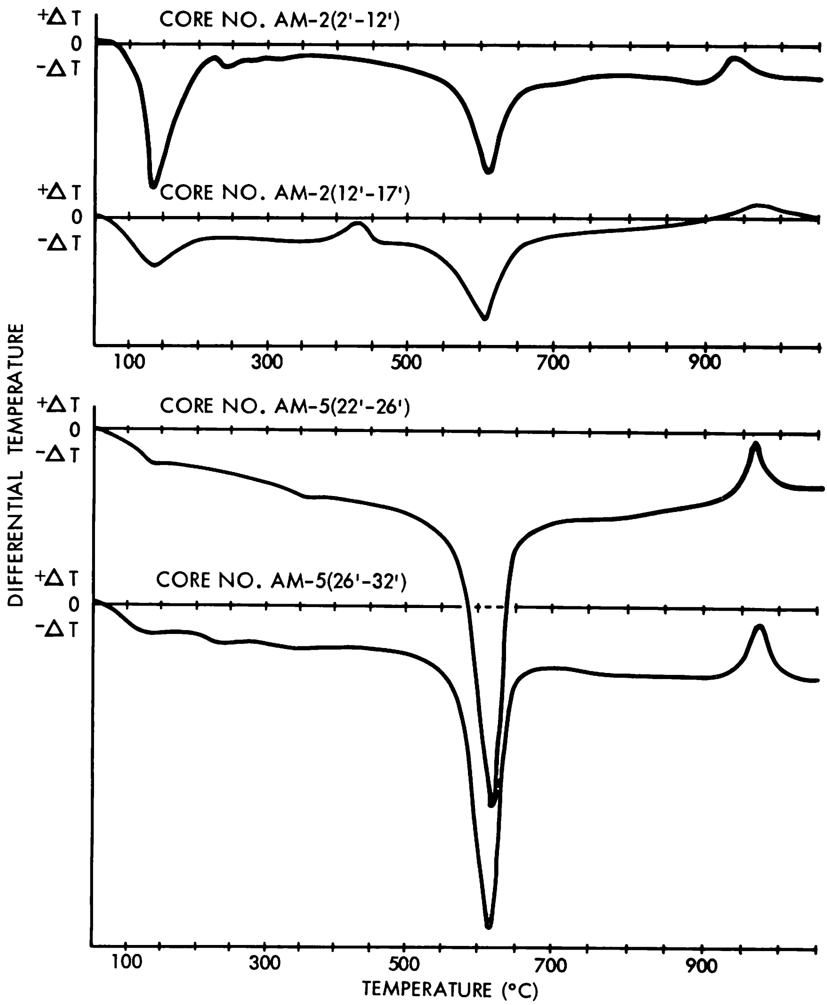


Figure 18.—Differential Thermal Curves.

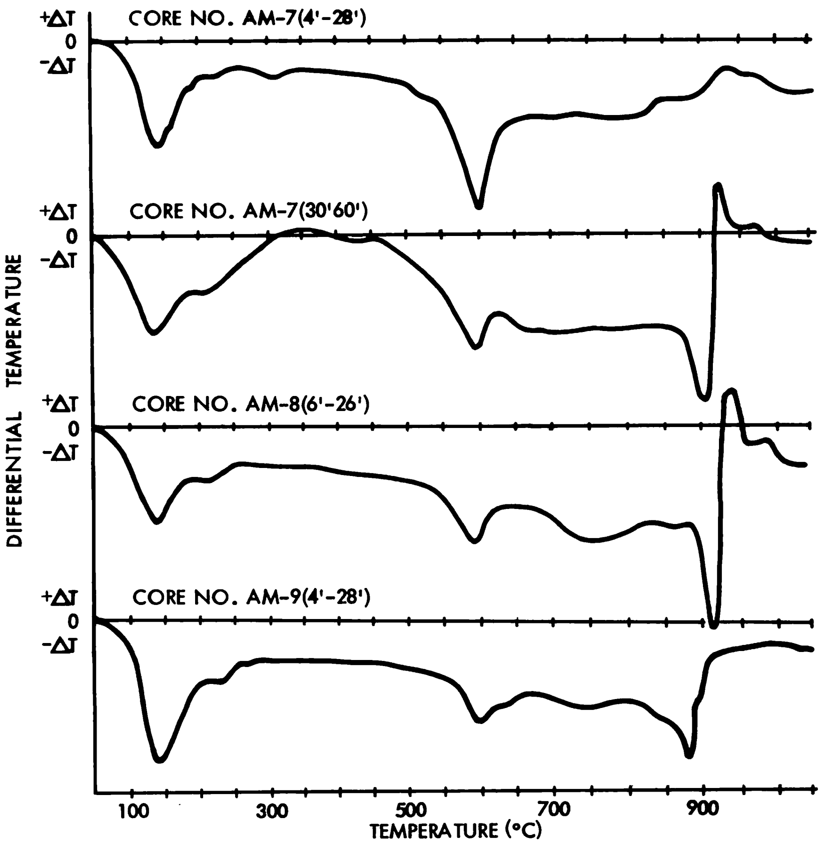


Figure 19.—Differential Thermal Curves.

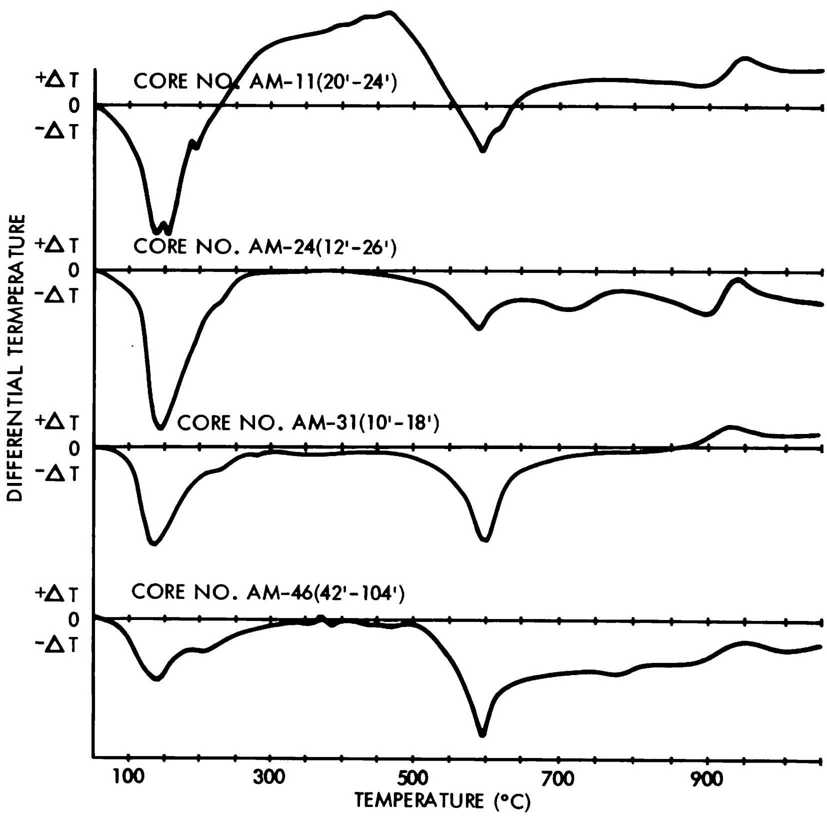


Figure 20.—Differential Thermal Curves.

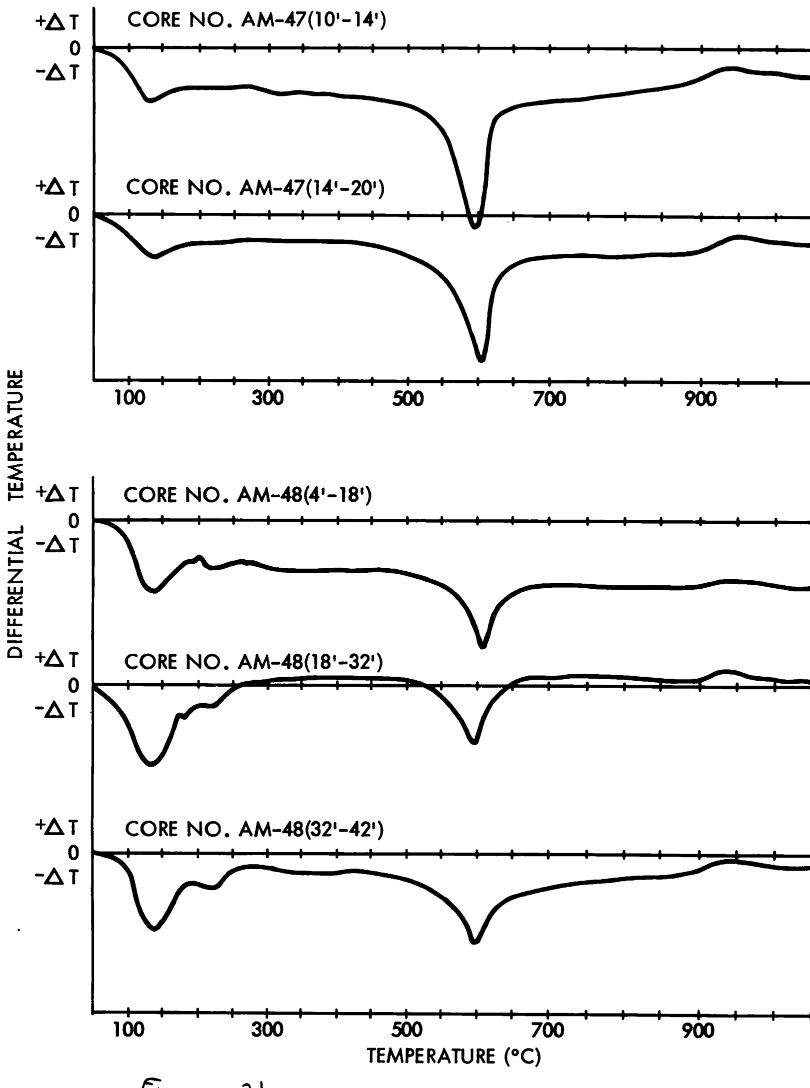


Figure 21.—Differential Thermal Curves.

Table 4. pH and Calcium Carbonate Equivalent of Clays

Sample Number	pH 1:2.5 H_2O	% Lime $CaCO_3$ Equivalent
AM-2 (2'-12')	4.4	0.00
AM-2 (12'-17')	3.3	0.00
AM-5 (22'-26')	4.9	0.00
AM-5 (26'-32')	5.6	0.00
AM-7 (4'-28')	7.6	10.09
AM-7 (30'-60')	7.7	32.51
AM-8 (6'-26')	7.8	40.29
AM-9 (4'-28')	7.8	18.41
AM-11 (20'-24')	3.6	0.00
AM-24 (12'-26')	4.6	0.00
AM-31 (10'-18')	5.2	0.00
AM-46 (42'-104')	8.2	2.78
AM-47 (10'-14')	5.2	0.00
AM-47 (14'-20')	6.5	0.00
AM-48 (4'-18')	5.8	0.00
AM-48 (32'-42')	5.9	0.00

TABLE 5. Particle-size Analysis for Sand, Silt, and Clay Contents

Core No.	% Sand >0.05mm	% Silt 0.002-0.05mm	% Clay <0.002mm
AM-2 (2'-12')	12.3	22.3	65.4
AM-2 (12'-17')	12.9	70.9	16.2
AM-5 (22'-26')	3.3	32.4	64.3
AM-5 (26'-32')	9.7	38.5	51.8
AM-7 (4'-28')	3.2	23.8	73.0
AM-7 (30'-60')	2.6	30.2	67.2
AM-8 (6'-26')	4.7	51.4	43.9
AM-9 (4'-28')	2.4	49.5	48.1
AM-11 (20'-24')	1.8	34.6	63.6
AM-24 (12'-26')	5.2	27.8	67.0
AM-31 (10'-18')	28.1	30.2	41.7
AM-46 (42'-104')	4.8	43.0	52.2
AM-47 (10'-14')	26.9	32.7	40.4
AM-47 (14'-20')	12.5	46.6	40.9
AM-48 (4'-18')	5.5	48.3	46.2
AM-48 (18'-32')	2.5	37.1	60.4
AM-48 (32'-42')	1.0	62.6	36.4

TABLE 6
CHEMICAL ANALYSIS OF CLAYS
WAYNE COUNTY, MISSISSIPPI
MISSISSIPPI STATE UNIVERSITY LABORATORY
ANALYSIS NOS. 463, 200-463, 216

Test Hole	Geologic Unit	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	SO_3	P_2O_5	Ignition Loss	Total
AM-2(2'-12'	Catahoula	63.36	10.25	4.90	0.64	0.0	0.91	0.10	1.23	3.72	0.40	12.54	98.05
AM-2(12'-17')	Catahoula	74.32	9.12	3.45	0.75	0.28	0.27	0.17	1.11	2.69	0.28	8.16	100.60
AM-5(22'-26')	Catahoula	62.70	21.65	4.07	1.08	0.0	0.02	0.13	0.96	1.94	0.36	9.50	102.41
AM-5(26'-32')	Catahoula	68.14	18.80	2.46	0.80	0.0	0.02	0.06	0.65	2.06	0.24	8.13	101.36
AM-7(4'-28')	Yazoo (Shubuta)	46.18	12.53	7.29	0.88	7.70	0.81	0.11	1.76	3.57	0.58	18.90	100.31
AM-7(30'-60')	Yazoo (Shubuta)	33.86	11.58	4.18	0.32	21.69	1.03	0.24	1.45	3.10	0.42	25.79	103.66*
AM-8(6'-26')	Yazoo (Shubuta)	28.36	10.25	4.82	0.30	29.38	0.78	0.05	1.17	2.66	0.53	28.19	106.49*
AM-9(4'-28')	Yazoo (N. Twistwood Cr.)	41.66	9.50	5.00	0.39	14.34	1.56	0.06	1.32	2.68	0.44	22.57	99.52
AM-11(20'-24')	Bucatunna	58.36	11.20	5.29	0.65	1.82	0.93	0.10	1.23	5.37	0.45	15.49	100.92
AM-24(12'-26')	Bucatunna	57.12	19.75	4.74	0.58	0.14	2.98	0.04	1.76	1.82	0.41	9.02	98.42
AM-31(10'-18')	Catahoula	70.42	9.12	4.29	0.55	0.14	0.43	0.09	1.65	2.86	0.33	7.92	97.86
AM-46(42'-104')	Forest Hill	61.84	14.05	4.85	0.66	2.11	0.93	0.25	2.28	4.20	0.45	11.61	103.23*
AM-47(10'-14')	Catahoula	75.72	9.87	4.60	0.65	0.14	0.05	0.09	0.75	1.63	0.41	6.81	100.72
AM-47(14'-20')	Catahoula	75.72	10.25	2.70	0.89	0.28	0.07	0.06	1.14	1.84	0.24	6.32	99.51
AM-48(4'-18')	Hattiesburg	69.70	13.48	4.79	0.64	0.42	0.38	0.11	2.08	1.80	0.44	8.76	102.60
AM-48(18'-32')	Hattiesburg	68.18	12.15	4.79	0.70	0.42	0.53	0.25	2.02	1.37	0.37	9.59	99.37
AM-48(32'-42')	Hattiesburg	61.94	14.43	5.22	0.69	0.56	0.95	0.28	2.47	1.58	0.47	11.91	100.50

* These totals were higher than might be expected.
However, rechecks of major components did not reveal any discrepancies.

TABLE 7
PRELIMINARY BLOATING TESTS OF CLAYS
WAYNE COUNTY, MISSISSIPPI

BUREAU OF MINES - TUSCALOOSA METALLURGY LABORATORY

Core No.	Lab. No.	Temp. °F.	Percent Absorption	Particle Size	Retention Time	Bulk Density gm/cc	Bulk Density lb/ft^3	Remarks
AM-7 (4'-28')	M-2-1	2100	21.2	3/4" pellets	15 min.	1.18	73.5	Minor pore formation. Heavy.
AM-8 (6'-26')	M-2-2	2100	22.1	3/4" pellets	15 min.	1.48	92.4	No pore formation. Heavy.
AM-9 (4'-28')	M-2-3	2100	3.5	3/4" pellets	15 min.	1.12	69.7	Good pore structure. Heavy.
AM-46 (42'-104')	M-2-4	2100	31.5	3/4" pellets	15 min.	.71	44.6	Fair pore structure. Light.

Note: AM-46 is suitable as a raw material for lightweight aggregate.

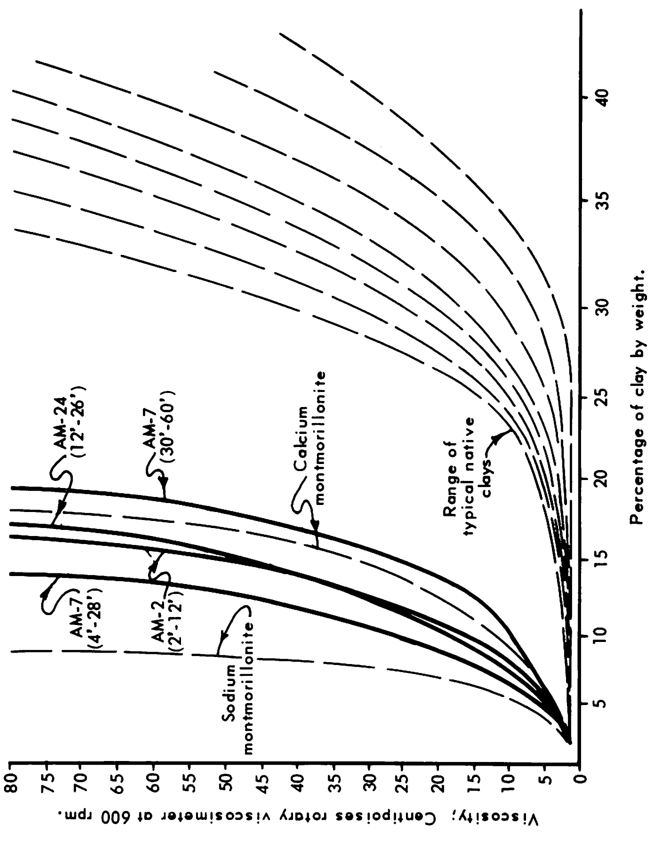


Figure 22.—Viscosity tests results of Wayne County clays compared to tests results of typical native clays as seen in Grim's Applied Clay Mineralogy. (Discussed in Economic Section by May)

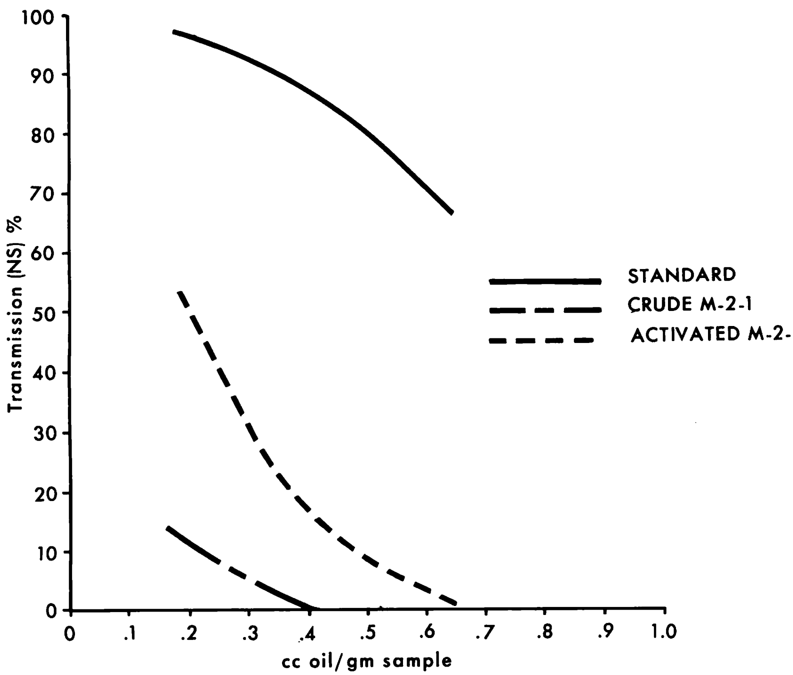


Figure 23.—Bureau of Mines oil decolorization tests of clay from test hole AM-7(4'-28'), designated M-2-1. (Discussed in Economic Geology Section)

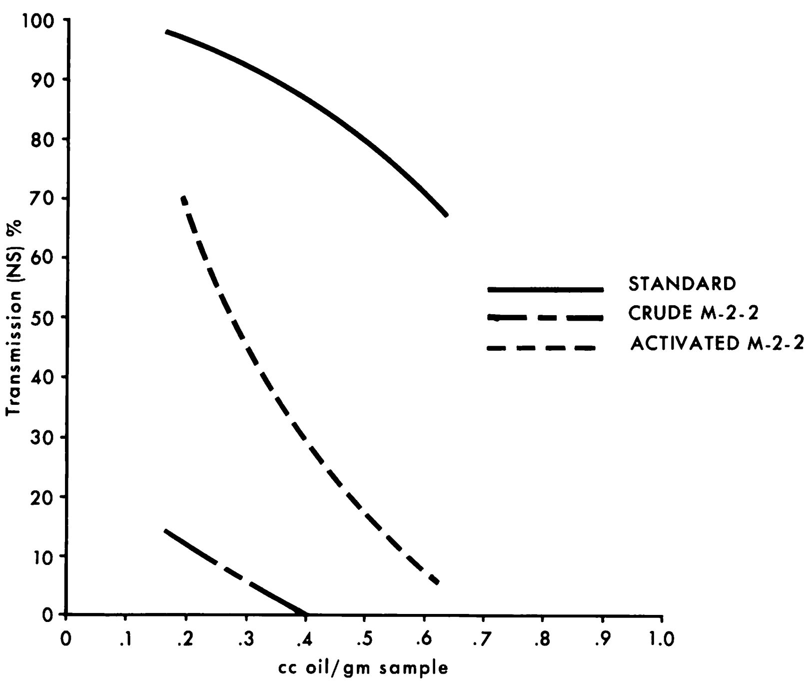


Figure 24.—Bureau of Mines oil decolorization tests of clay from test hole AM-8(6′-26′), designated M-2-2. (Discussed in Economic Geology Section)

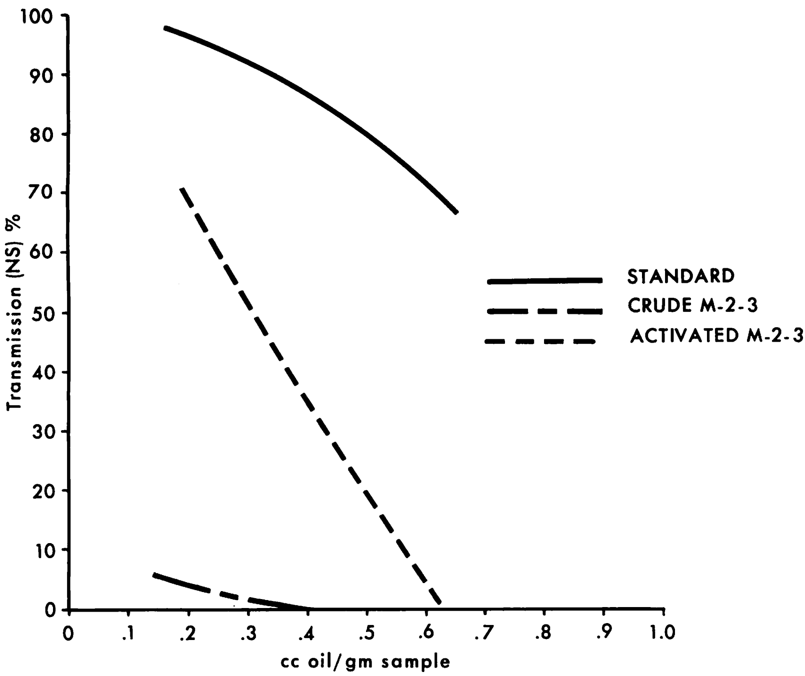


Figure 25.—Bureau of Mines oil decolorization tests of clay from test hole AM-9(4′-28′), designated M-2-3. (Discussed in Economic Geology Section)

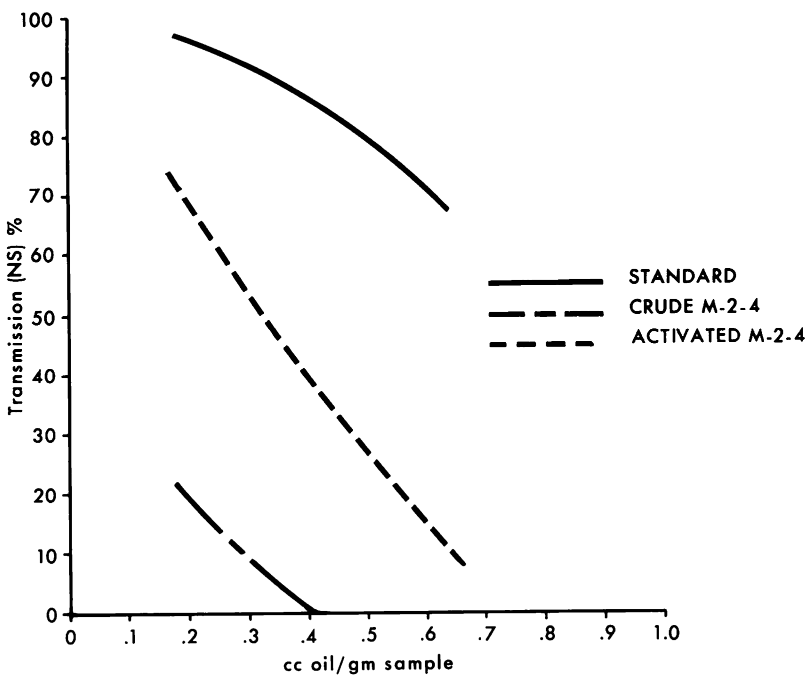


Figure 26.—Bureau of Mines oil decolorization tests of clay from test hole AM-46(42'-104'), designated M-2-4. (Discussed in Economic Geology Section)

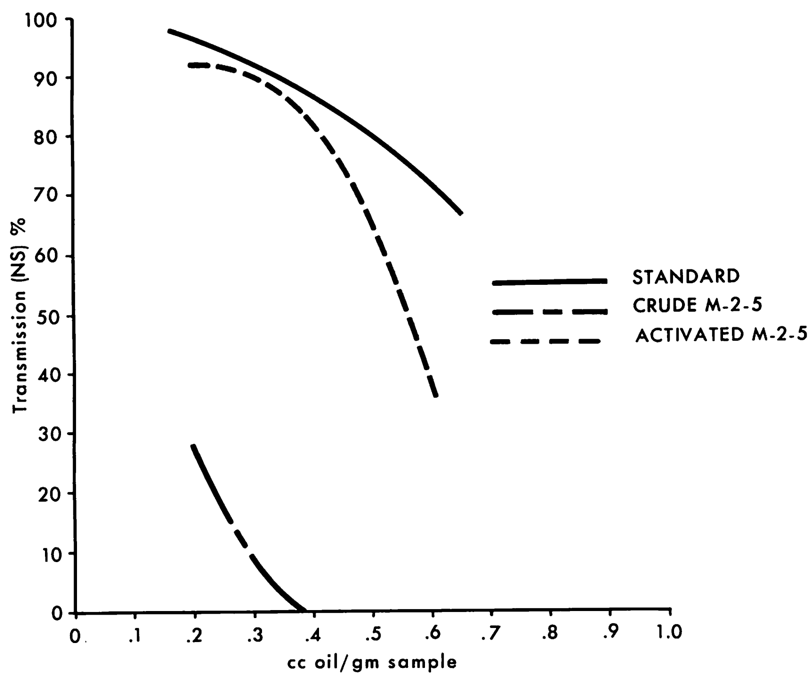


Figure 27.—Bureau of Mines oil decolorization tests of clay from test hole AM-24(12'-26'), designated M-2-5. (Discussed in Economic Geology Section)

CONCLUSIONS

The clay deposits of Wayne County which were examined were predominantly montmorillonitic with one major exception, AM-5, which was kaolinitic. Eleven of the core samples were acidic in nature and five were basic. The clay mineral content varied from a high of 73 per cent in AM-7 (4′-28′) to a low of 16 per cent in AM-2 (12′-17′). Carbonate particles were found liberally sprinkled throughout most of the corings from Wayne County.

Two of the above factors, montmorillonite clay plus the presence of carbonates, severely limit the number of clay deposits suitable for utilization in ceramic products.

One deposit, AM-5, had all the desired properties to make an excellent clay for use in any structural clay product, such as: brick, sewer pipe, drain tile, building block, terra cotta, conduits, roofing tile, and quarry tile.

Two deposits, AM-47 and AM-48, might be utilized in the production of structural clay products. These clays would need modification by the addition of proper additives plus the use of grog or calcined clay.

AM-31 would be marginal, but possibly could be modified enough by the proper additives to be used for some structural clay products.

Most of the deposits formed very tight bodies during extrusion, which made drying a problem along with drying warpage. The exception to this was the AM-5 deposit, which was easily dried with no warpage. The other bodies could be opened up, however, by the addition of a suitable grog.

The deposits that contained carbonate material would make lightweight aggregate. To determine if the aggregate is of commercial value would require an abradable test on the bloated material. This tests can be made by the U. S. Bureau of Mines, Tuscaloosa, Alabama.

The Bureau of Mines ran preliminary bloating tests on some of the Wayne County clays (Table 7-Clay report). The clay from test hole AM-46 tested favorably as a raw material for lightweight aggregate. The abradable test was not performed.

Viscosity tests (Figure 22-Clay report) indicate that the samples from AM-7(4′-28′), AM-7(30′-60′), AM-24(12′-26′), and AM-2(2′-12′) could be considered as raw material for use as drilling mud.

The Bureau of Mines also ran oil decolorization tests (Figures 23-27 Clay report) on samples from test holes AM-7(4′-28′), AM-8(6′-26′), AM-9(4′-28′), AM-46(42′-104′), and AM-24 (12′-26′). All the samples responded to activation with acid. The activated clay from test hole AM-24(12′-26′) came the closest to the standard in its oil bleaching capacity and should be considered for more advanced testing as a commercial prospect.

All the clay tests are discussed in the Economic Geology Section (May).

WATER RESOURCES OF WAYNE COUNTY

Wilbur T. Baughman and John E. McCarty

ABSTRACT

Ground water is available in sufficient quantity for present demand in most of Wayne County, but the quantity is limited in some areas. Very little or no treatment is needed for ground water produced for domestic or municipal use in the County; limited quantities of water needing no treatment is available in some localities.

Municipal and industrial wells are completed in the Catahoula, Vicksburg, and Cockfield aquifers. These wells generally have yields of 30 to more than 300 gallons per minute. Depths of water wells in the County range from less than 100 feet to more than 700 feet. Most of the wells are less than 300 feet deep. There is an abundance of ground water of fair to good quality in practically all of the County. Water having excessive color is a problem in some areas; excessive iron or acid water is common in other areas. Water containing high total dissolved solids is found in some areas of the County. Excessive chlorides are present in waters of some available shallow aquifers, thus sometimes limiting or prohibiting their use. Treatment for pH adjustment and iron removal is generally all that is required for most ground water produced in the County.

Miocene aquifers offer unrealized potentials for ground-water supply in much of southern Wayne County. Lower Eocene aquifers are potential sources of large quantities of water in parts of northern Wayne County.

Surface water is available in large quantity from the Chickasawhay River. The water is generally of good quality though the quality has declined in some areas because of oil-field brine pollution. Bucatunna Creek is a potential source of good quality surface water along the eastern portion of the County.

Minor to moderate flooding occurs on the flood plains of the Chickasawhay River and Bucatunna Creek. Flooding is also experienced along the flood plains of other streams, but to a lesser degree. Highest flows are normally experienced in late winter and early spring. Low flows normally occur in late summer and early fall.

INTRODUCTION

Water is considered to be one of the prime resources of any area and for that reason, this section is included as a vital and essential part of this report. This study of water resources in Wayne County was begun in early 1973.

Information has been gathered selectively for this report and an earnest attempt is made to present it in such a manner that it can be a useful tool for future planning and development of all natural resources in Wayne County. The County is fortunate in having sufficient water available in most areas. With adequate planning, orderly development of the resources of the County can be a reality.

Ground-water potential is exceptionally good in some areas of the County. Surface-water potential is also good and is virtually unused.

Definitions of various ground-water terms as used in this report are:

1. *Aquiclude* — a body of relatively impermeable material that is capable of absorbing water slowly but functions as an upper or lower boundary of an aquifer and does not transmit ground water rapidly enough to supply a well or spring. The term is synonymous with *aquitard.*
2. *Aquifer* — a formation, group of formations or part of a formation that contains sufficient saturated permeable material to conduct ground water and to yield economically significant quantities of ground water to wells and springs.
3. *Aquifuge* — an impermeable body of rock; a rock with no interconnected openings and thus lacking the ability to absorb and transmit water.
4. *Artesian* — used in describing ground water under pressure significantly greater than that of the atmosphere and whose upper surface is the bottom of an impermeable bed or a bed of distinctly lower permeability than the material in which the water occurs. The term is synonymous with *confined.*

Purpose of Investigation

A major problem associated with water supply development in any area is a lack of specific water information for use. Proper evaluation of water resources available in a county can be of great importance and value in successful development of industry and population centers. This portion of the Wayne County report is intended to supplement previous information known about the water resources of the County. It is the hope of the writers that information contained in this section will be beneficial to those planning water supplies for home, farm, municipal, industrial, and recreational purposes.

Demands for water are expected to increase in the future as they have in the past. Several factors regarding future water supplies are involved in the face of rising demands. Availability and sources of both ground water and surface water need to be known. The chemical quality of available water should be known. The extent and transmissibility should also be known. Attempts have been made to determine representative characteristics of the various aquifers where feasible and such selected data gathered is included in this report.

Methods of Investigation

Many water wells have been drilled in Wayne County in recent years. Information in the form of drillers' logs, drillers' completion reports, and electrical logs of bore holes have provided valuable data for this study. Electrical logs made of holes drilled in search of oil and gas have been very helpful in determining and evaluating ground-water potential. A better understanding of the complex ground-water conditions has been gained in the study of information obtained in the course of this investigation.

Particular attention has been given to correct locations of selected water wells inventoried in this study. Elevations of actual well sites were determined in the field with the use of topographic maps so that proper identifications of aquifers used for water supply could be determined with a greater degree of accuracy. Correct locations and elevations are very important if information determinations and water levels are to be valid and useful.

This report contains information on availability of aquifers, physical and chemical characteristics of water from each of the aquifers in use within the County, aquifer thicknesses, and water levels. Determination of the approximate base of the fresh water has been made through the interpretation of available electrical logs on oil tests and chemical analysis of water from selected water wells. A map showing the base of fresh water is included in this report (Figure 1).

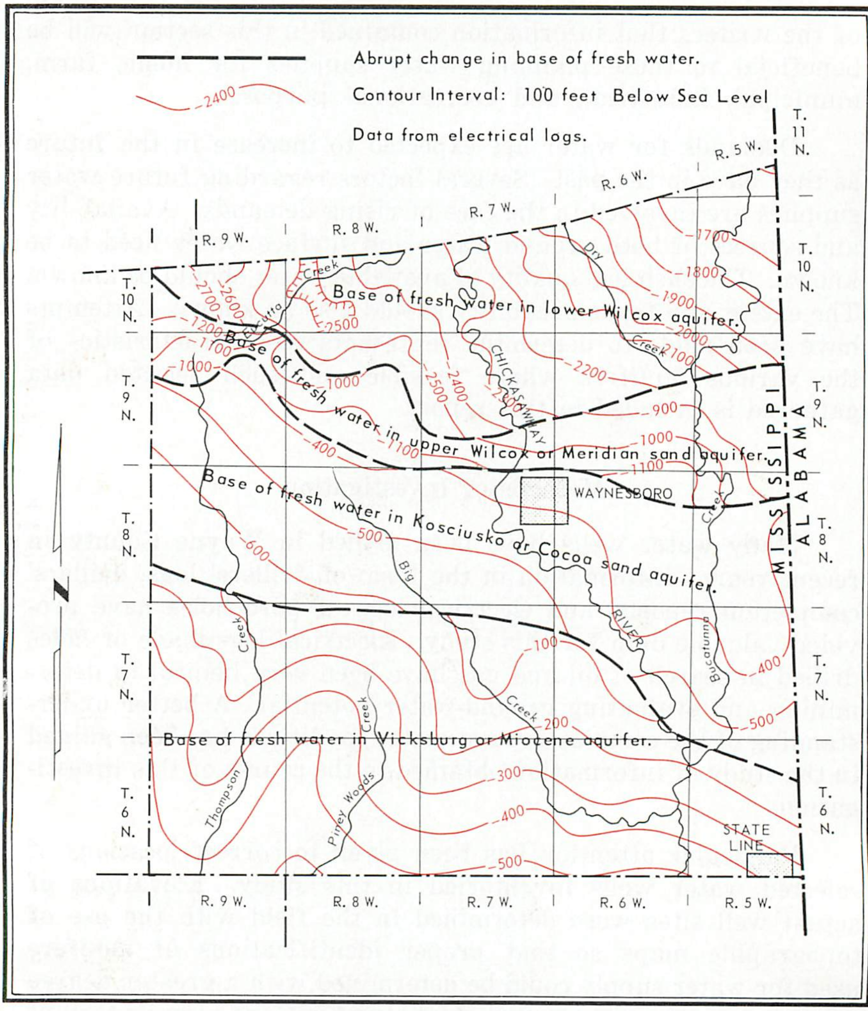
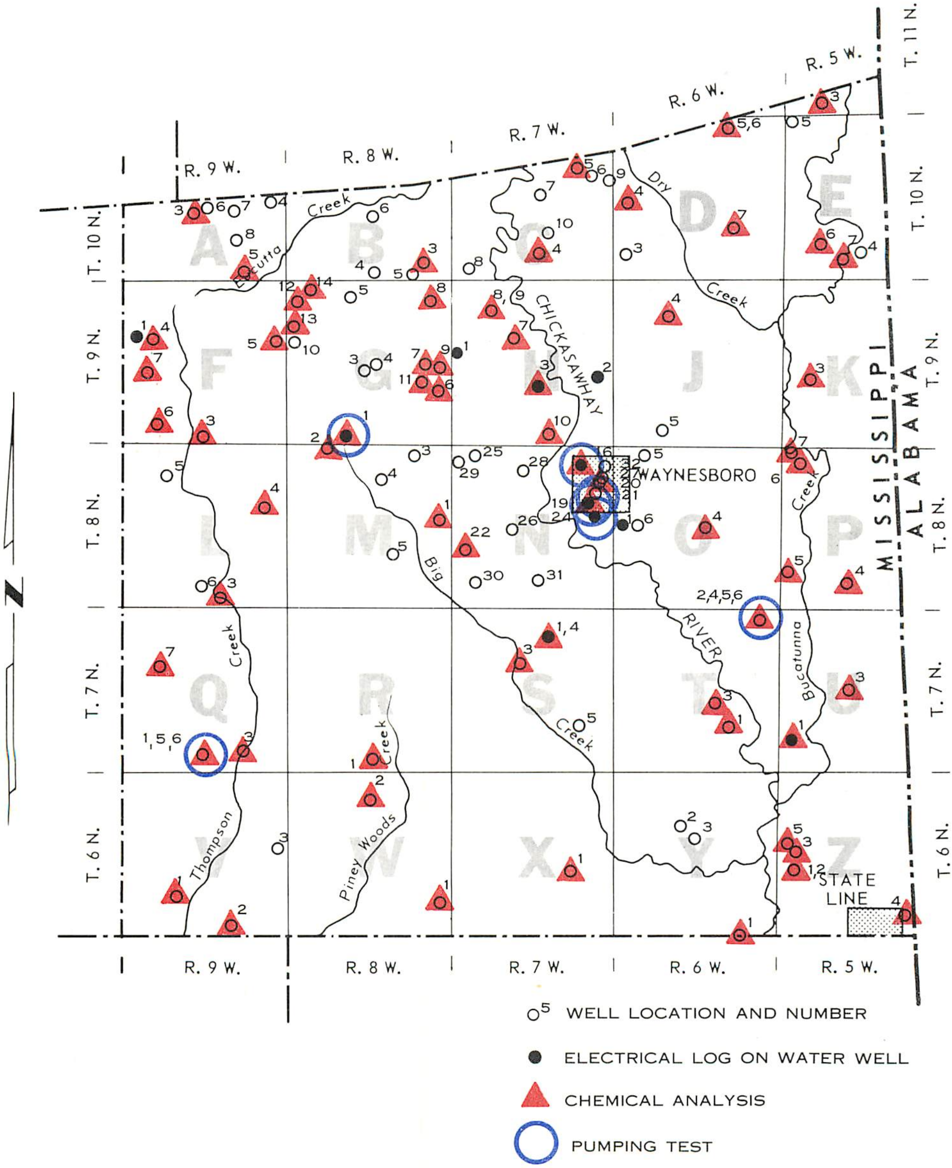


Figure 1.—Configuration of the base of fresh water in Wayne County (Luper).

Data used in this report were obtained by: (1) collection of information on location, elevation, depth, diameter, yield, chemical quality, water level and source aquifers on numerous water wells in the County, (2) examination of electrical logs on 32 test holes drilled in conjunction with this report, (3) examination of electrical logs of various oil tests, core holes, and water wells, (4) field examination of numerous water wells to verify locations and determine elevations, (5) collection and analysis of water from selected water wells and streams and

(6) aquifer testing at several sites to try to determine aquifer characteristics. The locations of selected water wells used in this report are shown in Figure 2.



Cooperation and Acknowledgments

Cooperation of various well drillers and well owners, Federal, County, City and State Agencies was most helpful during the course of this investigation. The writers wish to express appreciation for this help. Information on well completions previously gathered by the Mississippi Board of Water Commissioners has been very helpful. Information on chemical analyses made by the U. S. Geological Survey Water Resources Division and Mississippi State Board of Health has been helpful, and much of it is used in this report. Information gained from pumping tests conducted on certain water wells by the U. S. Geological Survey has been helpful and is included as a part of this report. Special acknowledgment is made to Edwin E. Luper, staff geologist, who made electrical log interpretations and constructed the base of fresh-water map included in this report (Figure 1). Acknowledgment is made to David Dockery, former employee of the Survey, who assisted in sampling surface water.

Present Water Use

Three rural water associations and the Town of Waynesboro used ground water as the source of water for their respective systems in the County as of December 1973[1]. One additional rural water association was in the planning stage. Much of Wayne County is sparsely populated due partly to the fact that many thousands of acres are owned by the Federal Government and by large paper, pulp, and timber companies. Surface water is unused as a source for any water systems within the County. Several industries in the County have their own water wells.

The Town of Waynesboro is the largest user of water in Wayne County. Waynesboro produces water from several wells completed in a Vicksburg age sand known locally as the "Waynesboro Sand." Clara Water Association has two wells completed in the Catahoula Formation and Whistler Water Association secures water from one well completed in the Catahoula Formation. Bucatunna Water Association secures its water supply from the Cocoa Sand member of the Yazoo Formation. Three irrigation wells owned by the Mississippi Forestry Commission are completed in the Catahoula Formation.

Surface-water use in Wayne County has been only on a limited basis. Three permits for withdrawal of surface water had been secured from the Mississippi Board of Water Commissioners as of December 1973[2]. All three were for irrigation purposes and held by individuals.

GROUND WATER

Availability

Ground water is available in Wayne County from several major aquifers (Table 1). These aquifers are sands in the

Table 1.—Stratigraphic column and water resources of Wayne County.

SYSTEM	SERIES	GROUP	STRATIGRAPHIC UNIT	THICKNESS	PHYSICAL CHARACTER	WATER RESOURCES
QUATERNARY	RECENT		Alluvium	0–72'	Silt, sand and gravel	Not an important aquifer. Supplies domestic wells along some of the streams. Water quality is poor.
	PLEISTOCENE		Terrace deposits	0–39'	Clay, sand and gravel	Generally not an aquifer. May supply some shallow dug wells. Poor water quality.
			Citronelle Formation	0–100'	Sand and gravel, some clay lenses	Not an aquifer. Occurs only in a small area of the northwestern portion of county.
TERTIARY	MIOCENE		Hattiesburg Formation	up to 48'	Clay and some silt and sand	Not known to be an aquifer. Occurs only in southwestern corner of county.
			Catahoula Formation	up to 600'	Sand, clay, silt and some pea gravel	An important aquifer in most of county except northeastern one–third. Large number of domestic wells in southern part of county completed in this aquifer. Capable of yielding large quantities of water in areas of county where sands are thick. Water is generally acidic, but of over–all good quality. Iron is most frequent problem.
	OLIGOCENE		Paynes Hammock Formation	5'–23'	Marl, clay and limestone	Not an aquifer.
			Chickasawhay Formation	14'–42'	Limestone, marl and clay	Not an aquifer.
		VICKSBURG	Bucatunna Formation	29'–102'	Clay, limestone, marl and sand	Generally not an important aquifer. A fair aquifer in certain locations. In Waynesboro, beds of sand are thick enough within the upper part of the group to furnish moderate yields of excellent quality water to municipal wells. Many domestic wells are completed in the Glendon Formation and generally produce sufficient quantities of excellent water. Yields of more than 20 gpm from the Glendon are exceptions. Water quality is generally good to excellent from this group.
			Byram Formation	3'–12'		
			Glendon Formation	15'–36'		
			Marianna Formation	26'–47'		
			Mint Spring Formation	3'–17'		
			Forest Hill Formation	45'–128'	Clay, silty, occasionally sandy	Generally not an aquifer. May supply small, shallow domestic wells in some cases near outcrop.
			Red Bluff Formation	11'–32'	Marl	Not an aquifer.
	EOCENE	JACKSON	Yazoo Formation: Shubuta Clay	34'–92'	Clay and calcareous sand, thin limestone layers	Generally not an aquifer. In eastern part of county, Cocoa Sand member is an important source of water for Bucatunna Water Association. Water is of good quality.
			Yazoo Formation: Pachuta Marl	10'–30'		
			Yazoo Formation: Cocoa Sand	28'–62'		
			Yazoo Formation: North Twistwood Creek Clay	41'–58'		
			Moodys Branch Formation	7'–18'	Glauconitic, fossilferous marl and sand	Generally not an aquifer. May supply small yields to some domestic wells.
		CLAIBORNE	Cockfield Formation	80'–114'	Clay, silt, sand and lignite, fossiliferous	An important aquifer for domestic supplies in northern part of county. Water is colored in most other parts of county. Quality is generally good in northern part of county and fair for certain other areas in northcentral part of county.
			Cook Mountain Formation	65'–140'	Shale, clay, limestone and sandstone	Not an aquifer.
			Kosciusko Formation	30'–180'	Sand, sandy clay and clay with lignite	An important source of water in northern part of county. Colored water is characteristic. Dissolved solids content is sometimes undesirably high even in some northernmost parts of the County.
			Zilpha Formation	63'–150'	Shale	Not an aquifer.
			Winona Formation	50'–88'	Calcareous sandstone and clay	Not an aquifer.
			Tallahatta Formation: Undifferentiated	85'–220'	Clay and sandstone	Not an aquifer.
			Tallahatta Formation: Meridian Sand	40'–120'	Sand and shale	Unused aquifer. A potential source of water in northern parts of county.
		WILCOX	(Undifferentiated)	1830'–2275'	Sand, sandy shale, clay and lignite	Unused aquifer. A potentially important source of water in northern parts of county where thick, massive sands are developed in lower third of formation.

Wilcox, Meridian, Kosciusko, Cockfield, and Catahoula Formations. Other aquifers of local importance include the Cocoa Sand Member of the Yazoo Formation, the Glendon Formation of the Vicksburg Group, sand developed locally in the Bucatunna Formation of the Vicksburg Group, and sands and gravels of Pleistocene and Recent ages. Some of the water-bearing sands pinch out locally, but others are widely distributed and their distribution is more predictable. In many local areas, some of the aquifers are without effective permeability and thus will produce very little or no water. Considerable differences in water-bearing characteristics are common due to variation in thickness, permeability of the aquifer, mineral content and grain size. Wells in Wayne County vary in depth from less than 100 feet to more than 700 feet (Table 2).

Precipitation on the outcrops of permeable materials of the various aquifers is the principel source of recharge in the County. Water movement within the aquifers is generally in a south-southwestward direction.

Many areas of the County are underlain by several aquifers. Miocene aquifers offer the most potential of those in use. Untapped Wilcox aquifers have great potential in some parts of northern Wayne County. In Wayne County, as in other areas, the shallowest aquifer producing sufficient water of useable quality is almost always used (Figure 2). In some areas, more than one aquifer is developed, but in other areas little choice is available.

Water of potable quality (less than 1000 mg/l of total dissolved solids) is available to a maximum of approximately 2700 feet (Figure 1). Contours on base of fresh-water map are based primarily on electrical log interpretations and do not reflect use of actual chemical analyses of ground water in most of the County. In certain areas, analyses of ground water taken from wells were used. For the purpose of this report, fresh water implies a water having less than 1000 mg/l (milligrams per liter) of total dissolved solids.

Some of the water samples collected from selected water wells in the County during the course of this investigation indicated pollution by oil field brines. Some brine springs were found in the County in areas of oil production. Such springs are the result of unlined brine disposal pits that were constructed

Table 2.—Records of selected wells in Wayne County.

Well No.: Numbers correspond to those on well-location maps, chemical-analysis tables and pumping test tables.

Majority of wells are rotary drilled.

Water Level: M, Measured; R, Reported, O, Observed.

Method of Lift: A, Air Lift; C, Cylinder; F, Natural Flow; J, Jet; N, None; P, Pitcher; T, Turbine; S, Submersible; B, Bucket.

Elevation: Elevations determined mostly from topographic maps having contour intervals of 10 or 20 feet.

Use of Well: D, Domestic; I, Industrial; IR, Irrigation; N, None; O, Observation; P, Public Supply; S, Stock; T, Test, A, Abandoned.

Remarks: C, Chemical Analysis; O, Observation Well; P, Pumping Test.

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above(+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
A3	Hess Pipeline Co.	1970	596	4, 2$\frac{1}{2}$	Cockfield	340	94 (R)	1970	T	I	50 (R)	1970	C
A4	Arthur Roberts	1964	130	2, 1$\frac{1}{4}$	Catahoula	462	112 (R)	1964		D			
A5	James Van Orden	1967	134	2	Vicksburg	327	62 (R)	1967	J	D	6 (R)	1964	C
A6	Thomas Brazier	1968	41	2, 1$\frac{1}{4}$	Catahoula	358	26 (R)	1968		D			
A7	Zion's Rest. Meth. Ch.	1965	46	2	Catahoula	380	33 (R)	1965	J	D			
A8	Howard Brazier	1971	92	2	Vicksburg	286	1 (R)	1971	J	D	12 (R)	1971	
B3	Paul Waller	1971	131	2, 1$\frac{1}{4}$	Catahoula	425	89 (R)	1971	J	D	8.5 (R)	1971	C
B4	Oscar Barnette	1967	221	2	Vicksburg	423	150 (R)	1967	J	D	4 (R)	1967	
B5	C. E. Waller	1969	232	2	Vicksburg	433	155 (R)	1969	C	D	3.5 (R)	1969	
B6	Larco Drlg. Co.	1966	419	6, 3	Cockfield	301			A	I	70 (R)	1966	
C4	Dell Cook				Cockfield?	282	+ (0)	1973	N, F	D			C
C5	James Chapman	1964	249	2, 1$\frac{1}{4}$	Cockfield	256	58 (R)	1964	J	D			C
C6	Everett Doggett, Jr.	1962	237	2, 1$\frac{1}{4}$	Cockfield	225	23 (R)	1962					
C7	George Hayes	1968	245	2	Cockfield	251	101 (R)	1968	J	D	5 (R)	1968	
C8	Clear Creek Bapt. Ch.	1969	129	2	Vicksburg	365	110 (R)	1969	C	D	3.5 (R)	1969	
C9	Chaparrel Bapt. Ch.	1969	248	2, 1$\frac{1}{4}$	Cockfield	255	52 (R)	1969	J	D	7 (R)	1969	
C10	Edna Holley	1971	190	2	Cocoa	245	147 (R)	1971		D	3 (R)	1971	

Table 2.—Records of selected wells in Wayne County. (continued)

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above (+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
D3	Jim Gray	1964	490	2, 1¼	Cockfield	405	204 (R)	1964	C	D			
D4	Pete Duvall	1954	527	2	Kosciusko	282	52 (R)	1954		D, S	10 (M)	1965	C
D5	W. E. Mathers	1952	190	2	Cockfield	283	55 (R)	1952	J	D, S	10 (est)	1965	C
D6	J. R. Shows	1965	190	2	Cockfield	285	57 (R)	1965	J	D, S	5 (R)	1965	
D7	E. P. Stagg	1965	220	3	Cockfield	242	19 (R)	1965	A	I	10 (R)	1965	C
E3	Ms. C. A. Thomas	1972	178	4	Cockfield	252	38 (R)	1972	J	D	10 (R)	1972	C
E4	Glenn Sanderson	1972	147	2	Cockfield	195	+1 (R)	1972	J, F	D	8.5 (R)	1972	
E5	Cecil Brown	1968	300	4	Kosciusko	310			J	D			
E6	H. T. Moody	1972	207	2	Cockfield	225	65 (R)	1972	J	D	10 (R)	1972	C
E7	Frost Bridge Camp Grounds	1961	110±	2	Cockfield	191	+ (0)	1973	N, F	D	3 (M)	1973	C
F1	W. A. Pryor	1971	135	4, 2	Catahoula	340	55 (R)	1971	S	S	50 (R)	1971	E
F3	Flowing well @ bridge on U. S. 84			4	Catahoula	250	+ (0)	1973	N, F	N			C
F4	W. A. Pryor	1952	100	2	Catahoula	352			J	D			C
F5	John L. McGill	1969	148	2, 1¼	Catahoula	383	85 (R)	1969	J	D	6 (R)	1969	C
F6	Pleasant Grove Bapt. Ch.	1960	357	2	Vicksburg	331	103 (R)	1960	J	D, P			C
F7	Henry Lindsey	1964	685	2	Cockfield	320	110 (R)	1964	J	D, S			C
G1	Whistler Wtr. Assn.	1973	212	8, 6	Catahoula	380	85 (M)	1973	T	P	300	1973	C, P, E
G3	Lincoln Street	1965	229	2	Vicksburg	333	98 (R)	1965	J	D			
G4	G. B. Snelgrove	1964	64	2, 1¼	Catahoula	300	27 (R)	1964		D			
G5	Allen Woodward	1966	131	2	Vicksburg	301	35 (R)	1966		D			
G6	Claude Brown, Jr.	1964	53	2, 1¼	Catahoula	282	25 (R)	1964	C	D			C
G7	Willy Miller	1973	210	2	Vicksburg	318	108 (R)	1973	J	D	5.5 (R)	1973	C
G8	Conrad Waller	1968	203	2	Vicksburg	352	145 (R)	1968	J	D	4 (R)	1968	C

Table 2.—Records of selected wells in Wayne County. (continued)

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above (+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
G9	Exxon	1950	580	4	Cockfield	325	168 (M)	1964	S	I			C
G10	L. H. Finley	1962	140	2, 1¼	Catahoula	392	102 (R)	1962		D			
G11	Jim Williams	1970	240	2	Vicksburg	312	98 (R)	1970	J	D	6 (R)	1970	C
G12	Pete Reynolds	1967	171	2	Vicksburg	335	73 (R)	1967	J	S	8 (R)	1967	C
G13	Pete Reynolds		60	2	Catahoula	340			J	D			C
G14	Eucutta Gulf Camp	1945	600	6	Cockfield	328	130 (M)	1964	C	Abn'd			C
H1	Humble Oil Co.	1970	732	4	Cockfield	316	90 (R)	1970	S	I	18 (R)	1970	E
H2	Mid State Paving Co.	1971	450	4, 2	Cockfield	250	86 (R)	1971	S	I	32 (R)	1971	E
H3	Warren L. Sims	1972	697	2	Kosciusko	240	10 (R)	1972	J	D	15 (R)	1972	C, E
H7	S & W Hog Farm	1962	670	4	Kosciusko	225	2 (R)	1963	S	D, S	25	1965	C
H8	John P. Doherty	1972	90	2	Catahoula	348	73 (R)	1972	J	D, S	6	1972	C
H9	John P. Doherty	1969	132	2	Vicksburg	320	111 (R)	1969	S	D, S	18 (R)	1969	C
H10	James Porter	1960	120	4	Vicksburg	170	30 (M)	1965	J	D, S	10 (M)	1965	C
H11	James Porter	1960	482	2	Cockfield	169	+23 (R)	1960	N	D, S	8 (R)	1960	C
J4	O. Z. Whigham	1970	519	2, 1¼	Cockfield	370	182 (R)	1970	C	D	3.5 (R)	1970	C
J5	Babe Daws	1967	184	4	Vicksburg	318	120 (R)	1967		D, S	20 (R)	1967	
K3	Antioch Bapt. Ch.	1967	151	2	Vicksburg	303	102 (R)	1967	J	D	6 (R)	1967	C
L3	D. M. Loper	1968	186	2	Catahoula	218	+ (0)	1973	J, F	D			C
L4	Donald W. Mills	1967	178	4	Catahoula	256	74 (R)	1967	J	S	30 (R)	1967	C
L5	A. O. Blue	1970	173	2, 1¼	Catahoula	290	47 (R)	1970	J	D	7 (R)	1970	
L6	Ms. Sally Arrington	1960	180	2, 1¼	Catahoula	229	14 (R)	1960		D			
M1	Nancy Anderson	1969	425	4	Vicksburg	365	183 (R)	1969	S	S	20	1969	C

Table 2.—Records of selected wells in Wayne County. (continued)

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above(+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
M2	C. C. Davis	1963	377	2	Vicksburg	345	129 (R)	1963	J	D			C
M3	Frank Johnson	1962	133	2, 1¼	Catahoula	355	73 (R)	1963		D			
M4	Dave Kelly	1966	126	2, 1¼	Catahoula	380	88 (R)	1966		D			
M5	L. J. McMichael	1962	88	2, 1¼	Catahoula	312	62 (R)	1962		D			
N16	Town of Waynesboro	1973	82	18, 8	Vicksburg	180	31 (M)	1973	T	P	329	1973	C, E
N19	Town of Waynesboro	1973	138	18, 8	Vicksburg	160	40 (M)	1973	T	P	340	1973	C, P, E
N20	Town of Waynesboro	1953	122	16, 8	Vicksburg	195	37 (M)	1973	T	P	350 (R)		C
N21	Town of Waynesboro	1957	118	18, 8	Vicksburg	168	38 (M)	1957	T	P	385 (M)	1957	P
N22	Lee's Chapel Bapt. Ch.	1966	360	2, 1¼	Catahoula	360	57 (R)	1966		D			C
N24	Town of Waynesboro	1973	122	18, 8	Vicksburg	158	17 (M)	1973	T	P	304	1973	C, P, E
N25	John T. Mozingo	1972	131	2, 1¼	Catahoula	350	65 (R)	1972	J	D	7.5 (R)	1972	
N26	Bernice Walker	1962	132	2	Catahoula	312	85 (R)	1962		D			Abnd.
N27	Town of Waynesboro	1900	580	4	Cockfield	191	+2 (M)	1964	J, F	P			C
N28	Mid State Paving Co.	1972	92	4	Catahoula	300	70 (R)	1972	S	I	40 (R)	1972	
N29	J. R. Richey, Jr.	1970	332	2	Catahoula	365	175 (R)	1970		D	3.5 (R)	1970	
N30	Cecil Davis	1963	58	2, 1¼	Catahoula	305	26 (R)	1963	J	D			
N31	J. L. Martin	1968	196	2	Catahoula	260	78 (R)	1968	J	D, S	3.5 (R)	1968	
N32	Town of Waynesboro	1958	118	10, 8	Vicksburg	195	20 (R)	1958	T	P	350 (R)	1958	
O1	Scotch Plywood Co. #1	1969	128	4, 2½	Vicksburg	168	30 (R)	1969	S	I	100 (R)	1969	E
O4	John Cooper	1972	289	2	Vicksburg	272	112 (R)	1972	J	D	7 (R)	1972	C
O5	Cecil Williams	1972	98	2	Catahoula	341	64 (R)	1972	J	D	6 (R)	1972	
O6	St. Regis Pulp Yard	1968	426	2	Cocoa	175	4 (R)	1968	J	I	6.5 (R)	1968	
P4	Clifford Waller	1966	146	2, 1¼	Catahoula		99 (R)	1966	J	D	7 (R)	1966	C
P5	Edwin Porter	1966	442	2	Cocoa	178	+ (0)	1973	N, F	D, S			C

Table 2.—Records of selected wells in Wayne County. (continued)

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above(+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
P6	Hollis McRae	1963	346	2	Cocoa	241	70 (R)	1973	J	D			C
P7	J. C. McRae	1970	135	2	Vicksburg	245	91 (R)	1970	J	D	10 (R)	1970	C
Q1	U. S. Forest Ser.- Wausau Cntr.	1965	640	4, 2	Catahoula	294	100 (R)	1965	S	D, S	32 (R)	1965	C, E
Q3	Thompson Cr. Rec. Park	1963	173	2	Catahoula	190	+ (0)	1973	N, F	D	2 (M)	1973	C
Q5	U. S. Forest Ser.- Wausau Cntr.	1965	460	2	Catahoula	294			J	T	15 (R)	1965	C, P
Q6	U. S. Forest Ser.- Wausau Cntr.	1962	210	4	Catahoula	294	100 (R)	1962	S	D, S	30 (R)	1962	C
Q7	U.S.A. No. 1	1965	375	3	Catahoula	283			A	I	15 (R)	1965	C
R1	Chas. Henderson	1965	242	2	Catahoula	335	111 (R)	1965	J	D, S			C
S1	Clara Water Assn. No. 1	1966	342	4, 2½	Catahoula	302	114 (R)	1966	S	P	60 (R)	1966	C, E
S3	Clara Cons. School	1962	148	2	Catahoula	205	16 (R)	1962	A	P	15 (R)	1962	C
S4	Clara Water Assn. No. 2	1966	340±	4, 2½	Catahoula	298	28 (R)	1966	S	P	60 (R)	1966	C
S5	Alvin Ard	1962	178	2, 1¼	Catahoula	208	32 (R)	1962	J	D			
T1	John I. Sanderson		107	2, 1¼	Catahoula	133	+ (0)	1973	N, F	N			C
T2	Mt. Zion Church	1950	125	2	Catahoula	262	100 (R)	1955	J	D			C
T3	J. V. McCaa	1953	650	2	Cocoa	146	+40 (R)	1953	N, F	D, S	60 (R)	1953	C
T4	Miss. Forestry Comm. #1	1957	192	18, 10	Catahoula	265	96 (M)	1964	T	IR	300 (R)	1957	
T5	Miss. Forestry Comm. #2	1957	142	18, 10	Catahoula	265	96 (R)	1957	T	IR	309 (R)	1957	
T6	Miss. Forestry Comm. #3	1957	182	18, 10	Catahoula	265	98 (R)	1957	T	IR	335 (R)	1957	P
U1	Bucatunna Water Assn.	1965	670	8	Cocoa	152	+8 (R)	1965	N, F	P	25 (R)	1965	C, E
U3	G. C. McCary	1966	292	2, 1¼	Vicksburg	165	15 (R)	1966	J	D, S			C

Table 2.—Records of selected wells in Wayne County. (continued)

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above (+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
V1	O. C. Ingram		250	2	Catahoula	215			J	S			C
V2	Curt Brewer	1964	400	2	Catahoula	265	60 (R)	1964	J	D, S			C
V3	Mulberry Bapt. Ch.	1971	278	2	Catahoula	292	112 (R)	1971	J	D	6 (R)	1971	
W1	Ernest Brewer	1971	272	2	Catahoula	315	116 (R)	1971	J	D, S	6 (R)	1971	C
W2	Ms. C. Henderson	1963	372	2	Catahoula	340	140 (R)	1963	J	D, S			C
X1	Hursel Smith	1971	217	2, 1¼	Catahoula	188	33 (R)	1971	J	D, S	8.5 (R)	1971	C
Y1	G. W. Douglas	1969	374	2	Catahoula	125	+ (R)	1969	N, F	D, S			C
Y2	Vernon Rigney	1969	175	2	Catahoula	225	70 (R)	1969	J	D	6 (R)	1969	
Y3	Raz Smith	1961	147	2, 1¼	Catahoula	220	19 (R)	1961	J	D			
Z1	A. G. Revette	1963	680	2	Vicksburg	140	+ (0)	1973	N, F	D, S			C
Z2	A. G. Revette	1963	420	6	Catahoula	140	+ (0)	1973	N, F	S			C
Z3	A. G. Revette	1971	294	4, 2½	Catahoula	140	+18 (R)	1971	N, F	S	50 (R)	1971	C
Z4	Miss. State Highway Dept.	1963	240	2	Catahoula		124 (R)	1963	J	D	7 (R)	1963	C
Z5	Jerry Revette	1967	366	4, 2	Catahoula	137	+ (0)	1973	N, F	D	15 (R)	1967	C

in permeable surface materials. Practices in the oil fields in some instances have greatly reduced the availability of good quality ground water and in many instances have greatly increased the cost of water wells.

Quality of Water

Variations in chemical and physical quality are possible and often present within a small geographic area. In Wayne County, this is true for various areas and there are several reasons for these conditions; some are natural, but in some instances they are man-made. Chemical and physical properties of water are the controlling factors in determining its usefullness. Table 3 shows available chemical analyses of various samples of water from wells in Wayne County.

Highly mineralized waters are undesirable for most purposes. Dissolved minerals in ground water prohibit its use for various industrial purposes (Table 4) and may limit or prohibit it for domestic use. Water of good quality that is low in dissolved solids (less than 500 mg/l) and abundant in supply is a valuable asset in any locality. Water that contains less than 500 mg/l of dissolved solids will generally meet the requirements of most industrial as well as domestic uses with little or no treatment. Water containing higher dissolved solids is unsatisfactory for many uses. Water containing more than 1000 mg/l total dissolved solids usually contains minerals which give the water a bad taste and is generally corrosive to metal pipes, tanks, fixtures, etc.

Acid water or water with a low pH (less than 7.0) is an objectionable characteristic of much ground water and surface water. It causes corrosion of metal pipes and fixtures. Blue and green stains are indications of low pH water when used in copper pipes.

Dissolved iron in excess of 0.3 mg/l is a common problem with some waters. Waters with an excessive iron concentration (greater than 0.3 mg/l) deposit rust stains in sinks, bath tubs, water closets, and other plumbing fixtures. High iron concentrations also give water a bad taste. Well water containing iron in appreciable amounts may be completely clear and colorless when first pumped. After the water stands for a time in contact with the oxygen in air, ferrous iron changes to ferric and begins

Table 3.—Chemical analyses of water from selected wells in Wayne County.

Well No.	Depth	Water Bearing Unit	Date Analyzed	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total Dissolved Solids	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific Conductance (micromhos at 25° C)	pH	Temperature (°F)	Color
				Analyses in Milligrams per liter																		
A3	596	Cockfield	1973		0.8								115				30		740	8.9	70	10
A5	134	Vicksburg	1973		0.03								5	0-1			30		<50	8.9	67	0
B3	131	Catahoula	1973		0.12							0	7.5	0			14		<50	5.7	60	0
C4	?	Cockfield (?)	1973		0.08							9	21	2			21		1000	8.5	68	140
C5	249	Cockfield	1973		0.17							58	85	2			48		1025	8.5	69	17
*D4	527	Kosciusko	1964	22	0.35	3.5	0.8	322	3.9	838	0	0.0	12	2.3	0.7	780	12			7.9	75	450
*D5	190	Cockfield	1964	20	0.36	31	8.4	54	7.0	256	0	19	4.2	0.3	0.1	270	112			7.9	73	5
*D7	220	Cockfield	1965	20	0.10	9.0	2.1	168	4.3	406	0	45	9.8	0.6	0.2	459	31			7.6	68	10
E3	178	Cockfield	1973		0.75								4.5	0-1			6		235	6.8	67	10
E6	207	Cockfield	1973		0.08							32	10	1-2			10		638	8.5	69	48
E7	110±	Cockfield	1973		0.17							15	73.5	>2			79		1135	8.1	67	15
F3	?	Catahoula	1973		0							4	5	0-1			15		<50	5.3	65	0
F4	100	Catahoula	1973		0.26								2.7	0			15		<50	5.0	68	0
F5	148	Catahoula	1973		7.7							3	80	0			30		292	5.5	67	0
F6	357	Vicksburg	1973		0.06							3	3	1-2			32		385	8.9	69.5	5
*F7	685	Cockfield	1965	14	0.14	3.4	0.9	276	4.3	712	0	8.8	25	3.0	0.0	686	12			7.8	71	250

*Analysis by U. S. Geological Survey
**Analysis by Mississippi State Board of Health
All other analyses made in field by Mississippi Geological Survey

Table 3.—Chemical analyses of water from selected wells in Wayne County. (continued)

Well No.	Depth	Water Bearing Unit	Date Analyzed	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total Dissolved Solids	Hardness as $CaCO_3$		Specific Conductance (micromhos at 25° C)	pH	Temperature (°F)	Color
																	Calcium, Magnesium	Non-carbonate				
				Analyses in Milligrams per liter																		
**G1	212	Catahoula	1973		0								8				4.0			5.5	67	
G6	53	Catahoula	1973		1.4							7	60	0			40		245	5.2	65	0
G7	210	Vicksburg	1973		0.1							13	8	0			18		328	8.7	68	2
G8	203	Vicksburg	1973		0.1							8	5	0			155		238	8.2	67	0
G9	580	Cockfield	1973										45						1110			363
G11	240	Vicksburg	1973		0.25							10	7.5	0-1			100		280	8.6	68	0
G12	171	Vicksburg	1973		0.08							23	6	0-1			99		405	8.0	68	0
G13	60	Catahoula	1973		7.40							5	1090	0			383		3975	5.6	67	6
*G14	600	Cockfield	1965	12	0.42	2.0	0.2	185	3.1	412	0	30	27	0.5	0.4	463	6			7.3		50
H3	697	Kosciusko	1973		0.08							28	188	> 2			20		2090	8.6	75	440
H7	670	Kosciusko	1973		0.12							48	90	> 2			13		2050	8.4	77	520
H8	90	Catahoula	1973		0.1								15	0-1			10		< 50	5.2	65.5	0
H9	132	Vicksburg	1973		3.8								665	0-1			330		2590	6.9	63.5	0
*H10	120	Vicksburg	1965	11	0.03	3.9	1.3	95	2.3	258	0	9.6	1.8	0.6	0.1	264	15			7.4	68	15
J4	519	Cockfield	1973									17	20						1200			250
K3	151	Vicksburg	1973		0.1							5	2.5				190		340	7.8	70	0
L3	186	Catahoula	1973		0.93								7.5				Trace		71	5.8	68	0
L4	178	Catahoula	1973		1.8							12	5				30		90	5.7	68	0

*Analysis by U. S. Geological Survey
**Analysis by Mississippi State Board of Health
All other analyses made in field by Mississippi Geological Survey

Table 3.—Chemical analyses of water from selected wells in Wayne County.
(continued)

Well No.	Depth	Water Bearing Unit	Date Analyzed	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total Dissolved Solids	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific Conductance (micromhos at 25° C)	pH	Temperature (°F)	Color
									Analyses in Milligrams per liter													
M1	425	Vicksburg	1973		0							5	15	0-1			20			8.4	70	0
*M2	377	Vicksburg	1965	10	0.06	5.6	3.6	114	2.7	319	0	6.8	3.2	1.2	0.2	304	29			8.2	72	5
**N16	82	Vicksburg	1973		<0.1	33.8	4.8	<10	0.4			23.37	14	0.1		173	104			7.1	66	
**N19	138	Vicksburg	1973		0.3								2				134			7.9		
*N20	122	Vicksburg	1955	9.4	0.20	36	9.6	21	2.9	180	0	16	6.2	0	0.3	198	129			7.4	67	5
N22	360	Catahoula	1973		4.3							39	5	0-1			5.5			5.3	72	65
**N24	122	Vicksburg	1973		0	27	12.4	25	3.8			36	11	0.2		200	119.4			7.4		0
*N27	580	Cockfield	?	25		2.9	0.7	396	6.0	942	0	1.6	72			970	10			8.7		450
O4	289	Vicksburg	1973		0.08							5	20	>2			24			8.7	70	0
P4	146	Catahoula	1973		3.5							8	4	0-1			15			6.4	68	0
P5	442	Cocoa	1973		0.08							36	16	1-2			13			8.8	73	0
P6	346	Cocoa	1973		0.16							26	7.5	0-1			45			8.6	73	0
P7	135	Vicksburg	1973		0							5	8	1-2			60			8.0	68	0
*Q1	640	Catahoula	1965	18	0.14	2.4	0.0	55	1.4	142	0	8.2	1.3	0.2	0.2	157	6			7.5		0
Q3	173	Catahoula	1973		3.5								10				15		63	5.5	66	0
*Q5	460	Catahoula	1965	11	0.69	7.1	1.8	9.0	1.3	42	0	8.4	1.9	0	0	61	25			6.3		0
*Q6	210	Catahoula	1965	29	6.2	5.6	2.7	5.1	2.1	34	0	7.6	2.8	0.1	0	72	25			6.1	68	20
*Q7	375	Catahoula	1965	11	1.4	5.9	2.3	1.8	1.3	19	0	8.4	3.0	0	0	43	24			6.8	68	5

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**Analysis by Mississippi State Board of Health
All other analyses made in field by Mississippi Geological Survey

Table 3.—Chemical analyses of water from selected wells in Wayne County.
(continued)

Well No.	Depth	Water Bearing Unit	Date Analyzed	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total Dissolved Solids	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific Conductance (micromhos at 25° C)	pH	Temperature (°F)	Color
									Analyses in Milligrams per liter													
*R1	242	Catahoula	1965	37	1.1	6.0	2.9	4.8	2.6	36	0	9.0	2.7	.1	0	83	27			6.4	68	5
S1	342	Catahoula	1973		0.9								2	0			35		124	6.6	68.5	0
*S3	148	Catahoula	1964	11	0.05	0.8	0.5	1.6	0.5	3	0	3.6	2.2	0	0	21	6			5.9	70	0
**S4	340±	Catahoula	1968		0.7								7				29			6.5	68.5	5
T1	107	Catahoula	1973		3.7								10	0-1			55		121	6.4	67	0
*T2	125	Catahoula	1956	3.3	5.0	0.7	0.5	5.5		12	0	0	4			40	4			5.5		
*T3	650	Cocoa	1964	7.5	0.02	2.2	1.1	310	7.8	716	0	0	67	2.9	0.2	752	10			7.9	75	30
*U1	670	Cocoa	1965	14	0.07	1.2	0.7	209	3.3	479	8	0	28	1.5	0.2	501	6			8.4	75	0
U3	292	Vicksburg	1973		0.08							5	5	0-1			120		268	8.2	70	0
V1	250	Catahoula	1973		> 5								5				30		117	5.7	66	6
*V2	400	Catahoula	1965	20	6.6	3.2	2.4	4.1	2.3	25	0	6.6	2.3	0.1	0	53	18			6.8	70	5
W1	272	Catahoula	1973		1.5								10				20		78	5.7	68	0
*W2	372	Catahoula	1955	18	7.6	6.3	2.0	4.1	2.5	40	0	0.4	2.6	0.1	0	56	24			6.2	70	5
X1	217	Catahoula	1973		3.9								10	0-1			70		119	6.8	66	0
Y1	374	Catahoula	1973		0.2							2	65	0-1			30		435	6.6	68	0

*Analysis by U. S. Geological Survey
**Analysis by Mississippi State Board of Health
All other analyses made in field by Mississippi Geological Survey

Table 3.—Chemical analyses of water from selected wells in Wayne County.
(continued)

Well No.	Depth	Water Bearing Unit	Date Analyzed	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total Dissolved Solids	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific Conductance (micromhos at 25° C)	pH	Temperature (°F)	Color
				Analyses in Milligrams per liter																		
Z1	680	Vicksburg	1973		0.75								< 5	0			55		310	8.2	69	0
Z2	420	Catahoula	1973		1.03									0			70		309	8.0	67	5
Z3	294	Catahoula	1973		3.8								50	0-1			65		143	6.2	68	0
Z4	240	Catahoula	1973		> 5								3	0					152	6.9	67	0
Z5	366	Catahoula	1973		1.44								5	0-1			85		309	7.9	68	0

*Analysis by U. S. Geological Survey
**Analysis by Mississippi State Board of Health
All other analyses made in field by Mississippi Geological Survey

Table 4.—Water-quality tolerances for industrial applications.

(American Water Works Association, 1950, Water quality and treatment, p. 67, table 3-4. Remarks: A, no corrosiveness; B, no slime formation; C, conformance to Federal drinking water standards: D, Al_2O_3 less than 8 ppm, SiO_2 less than 25 ppm, Cu less than 5 ppm. Chemical constituents in parts per million.)

Industrial Use	Turbidity	Color	Fe	Mn	Fe + Mn	Hard-ness	Alka-linity	pH	Total solids	Remarks
Air conditioning 1/	...	...	0.5	0.5	0.5	...	...	...	...	A,B
Baking	10	10	.2	.2	.2	(?)	...	...	...	C
Boiler feed:										
0-150	20	80	...	...	...	75	...	8.0+	3000-1000	
150-250	10	40	...	...	...	40	...	8.5+	2500-500	
250 psi and up	5	5	...	...	...	8	...	9.0+	1500-100	
Canning:										
Legumes	10	...	0.2	0.2	0.2	25-75	...	...	...	C
General	10	...	0.2	0.2	0.2	...	...	...	...	C
Carbonated beverages 3/	2	10	0.2	0.2	0.3	250	50	...	850	C
Confectionery	...	...	0.2	0.2	0.2	...	...	(4)	100	...
Cooling 5/	50	...	0.5	0.5	0.5	50	...	...	...	A,B
Ice (raw water) 6/	1-5	5	0.2	0.2	0.2	...	30-50	...	300	C
Laundering	...	...	0.2	0.2	0.2	50	...	...	...	
Plastics, clear, uncolored	2	2	.02	.02	.02	...	...	...	200	
Paper and pulp 7/										
Groundwood	50	20	1.0	0.5	1.0	180	...	...	...	A
Kraft pulp	25	15	0.2	0.1	0.2	100	...	...	300	
Soda and sulfite	15	10	0.1	.05	0.1	100	...	...	200	
Light paper, HL-grade	5	5	0.1	.05	0.1	50	...	...	200	B
Rayon (viscose) pulp:										
Production	5	5	.05	.03	.05	8	50	...	100	D
Manufacture	0.3	...	0.0	0.0	0.0	55	...	7.8-8.3	...	
Tanning 8/	20	10-100	0.2	0.2	0.2	50-135	135	8.0	...	
Textiles:										
General	5	20	.25	.25	...	20	...	...	...	
Dyeing	5	5-20	.25	.25	.25	20	...	...	...	
Wood scouring 10/	...	70	1.0	1.0	1.0	20	...	...	...	
Cotton bandage	5	5	0.2	0.2	0.2	20	...	...	...	

1/ Waters with algae and hydrogen sulfide odors are most unsuitable for air conditioning.
2/ Some hardness desirable.
3/ Clear, odorless, sterile water for syrup and carbonation. Water consistent in character. Most high-quality filtered municipal water not satisfactory for beverages.
4/ Hard candy requires pH of 7.0 or greater, as low value favors inversion of sucrose, causing sticky product.
5/ Control of corrosion is necessary as is also control of organisms, such as sulfur and iron bacteria, which tend to form slimes.
6/ $Ca(HCO_3)_2$ particularly troublesome. $Mg(HCO_3)_2$ tends to greenish color. CO_2 assists to prevent cracking. Sulfates and chlorides of Ca, Mg, Na should each be less than 300 ppm (white butts).
7/ Uniformity of composition and temperature desirable. Iron objectionable since cellulose absorbs iron from dilute solutions. Manganese very objectionable, clogs pipelines and is oxidized to permanganates by chlorine, causing reddish color.
8/ Excessive iron, manganese, or turbidity creates spots and discoloration in tanning of hides and leather goods.
9/ Constant composition; residual alumina less than 0.5 ppm.
10/ Calcium, magnesium, iron, manganese, suspended matter, and soluble organic matter may be objectionable.

to cloud the water as it becomes insoluble. A deposit of rust-colored material will then collect in the bottom of the container. Iron-bearing waters favor growth of bacteria such as *crenothrix*, which often become abundant in such water, and cause the clogging of water mains and recirculating systems. The bacteria form a jelly-like sheath as they multiply, thus trapping more and more ferric iron. When these sheaths break loose, they form large clogging masses. In such cases, treatment is the ultimate solution.

A hardness of 50 mg/l or less in water is generally considered soft. A hardness of 50-150 mg/l is considered slightly hard and hardness in excess of 200 mg/l is considered hard and needs to be treated for household use. Softening water to less than about 85 mg/l is usually not done when treating for hardness. Hardness in water is evidenced by scale deposits in water pipes and hot water heaters. Hard water requires much more soap to produce suds, and thus is undesirable. Minerals commonly causing hardness are calcium and magnesium.

Most of the ground water in Wayne County is soft to moderately hard with low to moderately high mineralization and of the calcium or sodium bicarbonate type. The pH varies from 5.0 to 8.9. Lowest pH values are found near the outcrop areas of aquifers, while higher pH values are found downdip in deeper aquifers further removed from their outcrop. Miocene aquifers generally have a lower pH than aquifers of Oligocene and Eocene age. Vicksburg aquifers generally produce water that is at least slightly alkaline (pH higher than 7.0), even near the outcrop. The most common problems with ground water in the County are conditions of excessive iron concentrations and low pH. Color is a problem in certain areas and with waters from some of the aquifers, thus rendering them undesirable for some purposes. Other problems are high concentrations of CO_2 and hardness. Though much of the ground water in the County is low to moderate in hardness, water in some local areas and in the southern part of the County (from Catahoula and Vicksburg aquifers) does have objectionable hardness.

Pollution of ground water in Wayne County is found in areas of oil and gas fields and is due to practices of brine and salt water handling and disposal. Pollution of shallow aquifers is all too common in some of these areas. Some local pollution occurs in improperly located and improperly sealed water wells. Wells located too close to and downgrade of feed lots, sewage lines, and septic tanks, when improperly sealed, allow percolation of drainage waters into the wells.

Water Levels

Static water levels in Wayne County vary from less than 100 feet to more than 350 feet above mean sea level. Many wells from different formations flow in various areas of the County. Most water levels are less than 100 feet below ground level. Flowing wells from various aquifers are generally possible at lower elevations in stream valleys. Almost all aquifers in the County are artesian.

Water levels are declining less than 1 foot per year in most of the County. Greater declines are not anticipated in the foreseeable future.

Test Drilling

Information regarding aquifers was gained through the drilling and electrical logging of test holes in various parts of the County. The Survey drilled 49 holes relative to this study. Electrical log surveys on 32 of the bore holes provided valuable information regarding composition of the various materials penetrated, aquifer thicknesses, stratigraphic positions of the aquifers, and ground-water potentials. Particular attention was given to identifying and delineating aquifers in the various holes drilled. Determinations of producing aquifers in many instances was greatly aided by information obtained from the drilling of test holes in the course of this study.

Aquifer Tests

Pumping tests were conducted on only a limited number of water wells in Wayne County. Tests were not possible on Wilcox or Meridian aquifers because no water wells have been made in those zones. No wells completed in Kosciusko, Cockfield or Cocoa aquifers were available or adaptable for pumping tests. Consequently, only a very limited number of pumping tests were actually possible in the County.

Results from four pumping tests made by the U.S. Geological Survey are included in the tabulations (Table 5) on aquifer and well characteristics determined from pumping tests. The results of two pumping tests by the Mississippi Geological Survey and one by Griner Drilling Service are included in the tabulations. Inconclusive pumping test data were obtained on four other tests conducted jointly by the Mississippi Geological Survey and Griner Drilling Service on wells for the Town of Waynesboro and are not included in the tabulations. Four of the wells listed (Table 5) were completed in the Catahoula aquifer and the other three were completed in the "Waynesboro Sand" aquifer developed in the Bucatunna Formation of the Vicksburg Group.

Specific capacity (*gallons per minute produced for each foot of decline in the water level in the well*) on the various wells tested varied from 3.1 on the "Waynesboro Sand" to 23

Table 5.—Aquifer and well characteristics determined from pumping tests.

Well No.	Owner	Depth of Well (Ft.)	Aquifer Thickness (Ft.)	Hydraulic Coefficients: Transmissibility (gpd/ft.)	Hydraulic Coefficients: Permeability (gpd/ft^2)	Hydraulic Coefficients: Storage	Specific Capacity (gpm/ft. at the end of 24 hours)	Remarks
				CATAHOULA AQUIFER				
G1	Whistler Water Assn.	212	75	17,500	233	--	7.7	MGS Test
Q5	Wausau Work Center	640	70	56,000	800	--	6.1	USGS Test
S1	Clara Water Assn.	342	48	21,000	430	.001	4.1	USGS Test
T3	Waynesboro Tree Nursery	182	52	58,000	1,100	.0001	23	USGS Test
				VICKSBURG AQUIFER				
N19	Town of Waynesboro	138	60	17,000	283	--	7.9	Contr. Test
N21	Town of Waynesboro	118	55	25,000	450	--	12	USGS Test
N24	Town of Waynesboro	122	68	5,000	74	--	3.1	MGS/Contr. Test

on the Catahoula aquifer. Specific capacity of a well is very important in determining pump setting, pump size, and well efficiency. Many times, properly conducted pumping tests can reveal such information as insufficient well development. Well yield (*discharge or flow of a well in gallons per minute*) is usually based only on need and gives little indication of actual aquifer potential. Well yield and specific capacity depend on well and aquifer characteristics and may be determined by interpretation of pumping test data. Such information is very important in planning large ground-water supplies from wells.

Transmissibility (*rate of flow of water through a vertical strip of the aquifer one foot wide, under a hydraulic gradient of one foot per foot expressed in gallons per day per foot*) is the index of an aquifer's ability to transmit water. Transmissibilities of aquifers tested in the County ranged from 5,000 gpd/ft on a Town of Waynesboro well completed in the "Waynesboro Sand" to 58,000 gpd/ft on an irrigation well for the Waynesboro Tree Nursery completed in the Catahoula aquifer. An aquifer with low transmissibility has high resistance to the flow of water and therefore will have a low specific capacity. Such is the case with the Waynesboro well mentioned above, which has a specific capacity of 3.1 gpm/ft. Wells tapping aquifers with high transmissibilities will generally have high specific capacities.

Permeability (*rate of flow of water through a one-foot-square section of the aquifer under the unit hydraulic gradient, expressed in gallons per day per square foot*) is the capacity of a porous medium for transmitting water and therefore is a good indicator of the potential yield of an aquifer. It is generally obtained by dividing transmissibility by the aquifer thickness in feet. High permeabilities such as determined on the Waynesboro Tree Nursery well (Table 5, well no. T3) are great plus factors in the planning of large ground-water supplies.

No aquifer tests were performed on wells completed in potential ground-water sources such as the Wilcox, Meridian, Kosciusko, and Cockfield aquifers. No wells are completed in the Wilcox or Meridian aquifers at the time of this writing. Transmissibility and permeability are expected to be good to very good in some Wilcox sands at certain locations within some areas of potential use in the County. No wells completed in

Cockfield or Kosciusko aquifers within the County (and in use during the course of this study) were available for pumping tests to determine well and aquifer characteristics adequately. Therefore no tests were conducted on these aquifers. Permeability and transmissibility in Cockfield and Kosciusko sands are poor to fair, based on observations of electrical logs in the area of potential use.

Data listed (Table 5) represents specific local information on the particular wells pumped and is not meant to imply general characteristics of the aquifers on a county-wide basis. Hydraulic characteristics vary greatly on the different aquifers in the County.

Large yield wells are possible from Catahoula aquifers in parts of Wayne County. Low to moderate yield wells are possible from some Vicksburg aquifers and from Cockfield and Kosciusko aquifers. Wells yielding large quantities (in excess of 500 gpm) of fresh water are believed to be possible in some parts of the County from Wilcox sands. Moderate yields are probably available (in some areas of potential use) from the Meridian Sand aquifer.

Future development of ground-water resources in Wayne County will no doubt utilize potential sources of fresh water mainly from the Catahoula, Vicksburg, and Wilcox aquifers. Pumping tests will then be possible on wells completed in other areas of the County and more adequate aquifer characteristics may then be determined on the various aquifers.

AQUIFERS

Wilcox

The lower Wilcox is a potential source of ground water across extreme northern Wayne County. Fresh water could be obtained from these sands from less than 1,600 to more than 2,800 feet below sea level (Figure 1). Lower Wilcox sands are well developed in much of this part of the County and would likely be very prolific water producers at numerous locations. No water wells in the County have been drilled to the Lower Wilcox sands at the time of this writing. Cost of drilling and completing a water well in this aquifer has been a deterring factor in the past. Lack of suitable ground-water sources at shallower depths will certainly bring about utilization of this potentially most important aquifer in northern parts of the County.

Upper and middle sand zones within the Wilcox Formation are developed well enough in parts of northern Wayne County to be potential sources of ground water. Utilization of some of these sands offer the potential of moderate to large quantities of potable ground water for much of the County.

Moderate to large quantities of ground water are available from the Wilcox aquifer. Provided no brine pollution has occurred in areas of oil-field activity, it is believed by the writer that this aquifer system offers perhaps the greatest potential for fresh water of good quality. Water from the Wilcox aquifer in northern Wayne County would probably have little or no hardness or iron, total dissolved solids within tolerable limits, high pH, and be of a sodium bicarbonate type. Color is not likely to be any problem, however it is difficult and sometimes impossible to predict. Color in water from lower sand zones of the Wilcox in adjacent southern Clarke County is very slight and hardly noticeable.

Water levels on wells completed in sands of the Wilcox aquifer system should flow at some lower elevations in northern Wayne County. Static heads would likely be in the range of 200 to 225 feet above mean sea level.

Movement of water within the Wilcox aquifer is in a south-southwesterly direction. Sand thickness within the Wilcox Formation in northern Wayne County varies from less than 50 feet to more than 200 feet. Large yields of 1,000 to 2,000 gpm are possible from some Wilcox sands in the area of potential use. Transmissibilities are probably in the range of 25,000 to more than 100,000 gpd per foot with lower zones having the highest transmissibilities.

Meridian Sand

The Meridian Sand Member of the Tallahatta Formation is the lowermost unit of the formation. The aquifer has not been tapped in Wayne County, but is a potential source of ground water in northern parts of the County. It is often developed in much of the area, but has a potential of supplying moderate to large quantities of water to wells in several localities. It is difficult to predict aquifer thickness because of the variability of the sand development. The Meridian sand is often included with upper Wilcox sands when it overlies Wilcox sands with no apparent break in sand development. For this reason they are often considered as one. Such lithologic conditions are developed over short distances, thus making individual sand bodies difficult to trace.

Depth to the Meridian aquifer has been a limitation to its utilization. Shallow, inexpensive wells to the first potable ground-water source is common practice in well development, thus heretofore making it unfeasible to test potential aquifers at greater depths.

Thickness of the Meridian Sand varies from only a few feet to more than 50 feet. Static head in Wayne County would probably be about 225 feet above mean sea level on the aquifer and therefore wells should flow at lower elevations.

Water movement in this aquifer is in a south-southwesterly direction. Moderate to large yields are possible in some localities within the area. Transmissibilities may range from less than 5,000 to more than 50,000 gpd per foot.

Kosciusko

Several domestic wells in northeastern Wayne County are completed in Kosciusko sands. The Kosciusko aquifer is the source of water for no community water systems nor is it a source of water for many domestic water wells. Color and high total dissolved solids are characteristic of water from the aquifer in much of the area of its use in the County (Table 3). Few additional wells are expected to be constructed in the aquifer due to the undesirable color level of the water even in extreme northern areas of the County.

Chemical quality of water from the Kosciusko is very poor to fair in the County. The water is sodium bicarbonate type, soft and alkaline with a pH of 7.9 to 8.6 (Table 3). The color is too high (Table 3, well nos. D4, H3 and H7) for many industrial and domestic uses. Total dissolved solids were above 500 mg/l in water from each of the three wells analyzed, therefore making it undesirable in still another respect.

The Kosciusko aquifer is artesian in all of Wayne County. The water level is approximately 220 to 235 feet above mean sea level. Flowing wells are possible in areas of lower elevations in much of the County, though none were noted during this investigation.

Water movement in the Kosciusko aquifer is in a south-southwestward direction. Sand development in the formation in the County is very poor to poor, as indicated by electrical logs. It is not considered a good potential source of ground water in the County due to color and high dissolved solids, though it will probably produce fresh to slightly brackish water in most of the northern half of the County.

Cockfield

The Cockfield aquifer system is the source of much of the domestic water supply in extreme northern and northeastern Wayne County (Table 2). It is not the water source of any community water systems but is a potential source in several areas of small to moderate supplies of water for some of the communities in northeastern areas, such as Matherville. Several industrial wells in the northern part of the County serving oil company operations have utilized this aquifer. Just south of the Waynesboro area is probably the downdip limit of fresh water in the aquifer in the County.

Cockfield water, as indicated by available analyses (Table 3), is generally slightly alkaline (pH above 7.0), soft, low in iron, slightly colored to highly colored. Concentrations of objectionable quantities of iron (more than 0.3 mg/l) are infrequent even in areas near the outcrop of the formation.

Flowing wells are in use in various localities in northern parts of the County at lower elevations. Static water levels vary from flowing to more than 200 feet below ground level. Static heads vary from approximately 160 feet to more than 280 feet above mean sea level on wells inventoried. Abnormal variations in static head (piezometric surface) are probably due to faults affecting the recharge of the aquifer system since recharge is in the area influenced by the Hatchitigbee Anticline.

Water movement in the Cockfield aquifer is in a south-southwestward direction. Poor sand development within the

Cockfield limits its potential as does color in some areas. High total dissolved solids in the southwestern one-third of the County as well as high color levels prohibit the use of it as a source of acceptable water.

Cocoa Sand

The Cocoa Sand is a source of ground water in the eastern portion of Wayne County. It is not the source of large quantities of water, though in some areas where it is sufficiently developed, it may produce moderate yields. Color is rarely objectionably high and is known to occur in only one inventoried well. This aquifer is a good source of ground water in areas where sand development is adequate for well completions. Sand development is rarely free enough of clay to permit proper screening; most wells are completed without well screens.

Chemical quality of water from this aquifer in the County is good to excellent. Total dissolved solids is less than 1000 mg/l on all wells analyzed, pH is high, iron is low to very low (Table 3), and color was noticeable in water from only one well. The water is sodium bicarbonate type and very soft.

Static water levels of the Cocoa Sand range from flowing to 147 feet below ground level. Static head on wells inventoried varied from approximately 100 feet to more than 175 feet above mean sea level. Flowing wells producing from the aquifer are possible in a few areas of the County.

Poor sand development in the aquifer limits its potential to the eastern portion of the County. In the eastern areas, very good sand development has been noted on electrical logs, thus suggesting that it is an available source of good quality water in several localities. Clay content in the aquifer is a problem in some areas of potential use where wells must be screened and pumped. Water movement is in a south-southwestward direction.

Vicksburg

Two formations of the Vicksburg Group are frequently used as sources of water supply in Wayne County. The Glendon formation is commonly referred to by local water well drillers as "Honeycomb Rock" because it often is cavernous and has much small to large pore space. It is a preferred aquifer for domestic wells in much of the northeastern half of the County.

The volume of water available from it is most frequently very small to small (3 to 10 gpm), though in some localities it may be capable of yielding 25-50 gpm or even more.

The "Waynesboro Sand" is developed in the Bucatunna Formation of the group and is a good source of small to moderate quantities of water. It is the source of water for the Town of Waynesboro. It generally produces water of good to excellent quality, as does the "Honeycomb Rock."

The "Waynesboro Sand" and the "Honeycomb Rock" both produce alkaline water except in instances of brine pollution. The water is generally soft to moderately hard, low to very low in iron, no noticeable color, and of calcium or sodium bicarbonate type from both zones.

The aquifer is generally artesian in Wayne County, though the "Waynesboro Sand" is a water-table aquifer in much of the vicinity of its greatest use (Town of Waynesboro). Static water levels on the "Honeycomb Rock" range from flowing to 183 feet below ground level. Static heads range from approximately 140 feet to more than 280 feet above mean sea level.

Water movement in the "Honeycomb Rock" (Glendon Formation) is generally in a south and southwestward direction. Utilization of this aquifer as a ground-water supply in the area of potential use downdip of outcrop (see Plate 1, May) depends on development of porosity within it in the form of solution cavities, and on the quantity of water desired. Water movement within the "Waynesboro Sand" is quite irregular in direction due to the fact it is a channel deposit, but is generally in a southerly direction in Wayne County. Utilization of the "Waynesboro Sand" as a water supply might be erratic because it is only present in very limited lateral distances. In planning for moderate to large yield wells, the sand development would have to be located and evaluated (where present) by an intensive test-hole program to determine its thickness, and finally, to determine the potential yield. This would be essential due to recharge limitations often characteristic of this type aquifer.

Catahoula

Catahoula sands are an important source of ground water for domestic, irrigation, stock and industrial use in the southwestern two-thirds of Wayne County. Most of the water wells in this portion of the County are completed in this aquifer. The aquifer contains sand developments capable of moderate to large quantities of water in various parts of southwestern Wayne County. Two of the three rural water systems in operation at the time of this writing are securing water from wells completed in the Catahoula.

Waters from the Catahoula are generally acid to slightly acid, with the pH ranging from 5.0 to 6.9. Some wells in extreme southern Wayne County produce waters that are slightly alkaline to alkaline from the Catahoula. Iron concentration is a common problem in water from this aquifer. The waters are generally soft to only moderately hard and of the sodium or calcium bicarbonate type. They normally have no color. Treatment for pH adjustment and/or iron removal is necessary in many areas of potential and present use as public water supply and for some industrial uses.

Water levels of different sands within the Catahoula vary considerably. Wells inventoried indicate water levels ranging from flowing to 175 feet below ground level. Flowing wells are possible at many localities within the County.

Thick massive sands are developed in the Catahoula in several localities in southern parts of the County. These sands are capable of yielding moderate to large quantities of water to properly constructed wells. Water movement in the Catahoula aquifer is south-southwest.

Terrace Deposits

A few bored and dug wells in Wayne County may have been completed in terrace sands. It is an unimportant water table aquifer in the County. Poor water quality and seasonal fluctuations in water levels, as well as limited quantity of water available from these deposits discourage the utilization of it as a source of water. Terrace deposits overlie bedrock formations (Plate 1, May) in many areas of the County and depend on local precipitation for recharge. In turn, they are important to the recharge of the bedrock aquifers.

Alluvium

Alluvial deposits consist mainly of silt, sand, and gravel and are as much as 72 feet thick in the County. These deposits overlie bedrock formations in flood plains of streams in much of the County. Generally, these deposits are not continuous enough for extensive development as sources of ground water. Water in the alluvium is under water table conditions and therefore, water level is dependent on precipitation and streamflow in the adjacent stream. Few wells are made in the alluvial deposits due to poor water quality and varying water levels, but it can be utilized in some localities where deposits are thick enough and suitable aquifer material (sands and gravels) is present. Like the terrace deposits, the permeable water-bearing alluvial deposits are important to the recharge of subjacent bedrock aquifers.

SURFACE WATER

Drainage

Wayne County is located in the Pascagoula River Drainage Basin (Fig. 5, May), the second largest drainage basin in the State. Wayne County can be divided into the Leaf River Drainage Basin and the Chickasawhay River Drainage Basin (Fig. 3). Approximately three-fourths of Wayne County is located within the boundaries of the Chickasawhay River Drainage Basin; the remainder of the County is within the confines of the Leaf River Drainage Basin.

In Wayne County, the principal tributaries that comprise the drainage area of the Chickasawhay River are Bucatunna Creek, Big Creek, Yellow Creek, and Eucutta Creek. Bucatunna Creek has the second largest drainage area in the County. It covers about one-fourth of Wayne County, primarily along the eastern boundary.

Thompson Creek is the smallest of the three major drainage basins in Wayne County, but it is the largest drainage area in the County located within the Leaf River Drainage Basin. Approximately one-third of the County is within its drainage area. Thompson Creek flows south, roughly parallel to the western boundary of the County, and joins the Leaf River northeast of Beaumont, in Perry County.

Availability

The largest source of surface water in Wayne County is the Chickasawhay River. Between 1939 and 1950, the average flow of the Chickasawhay River near Waynesboro was 2,575 cfs (cubic feet per second). The minimum flow recorded at the Waynesboro gaging station was 149 cfs on August 28, 1943[3]. The maximum recorded flow at the Waynesboro gaging station was 58,300 cfs on February 26, 1961; however, the U. S. Geological Survey has estimated that the flood of April 1900 had a peak flow of approximately 73,000 cfs near Waynesboro[4]. The average minimum flow of the Chickasawhay River near Waynesboro is 70 mgd (millions gallons per day) (Table 6).

Bucatunna Creek is a potential source for water supply. Based on records of the U. S. Geological Survey from January 1939 to September 1949[5], the average flow of Bucatunna Creek recorded at the gaging station at Denham was 807 cfs; the minimum flow recorded was 22 cfs from October 25-28, 1941, and the maximum flow recorded was 16,400 cfs on April 27, 1944. The average minimum flow of Bucatunna Creek at Denham is 7.1 mgd (Table 6). To sustain a 50 mgd flow at this location, it has been estimated[6] that it would require a storage area of 11,000 acre-feet, which does not allow for seepage loss or evaporation.

Although there are several gaging stations in Wayne County (Fig. 3), the gaging stations on the Chickasawhay River near Waynesboro and on Bucatunna Creek at Denham are the only two that have operated as continuous-record gaging stations (Table 7). The average minimum flow of selected streams in Wayne County is presented in Table 6.

A reservoir on Maynor Creek is in the final stage of construction and should be finished by May 1974[7] The Maynor Creek Reservoir will have a normal pool of 400 acres and its primary use will be for general recreation and fish and wildlife enhancement.

Flooding

The greatest flood known in Wayne County occurred in April 1900. This flood was of such great magnitude that it has been used as a gage in evaluating subsequent floods. The April 1900 flood was 2 feet higher at Waynesboro than the flood of February 1961.[8]

The flood of February 1961 caused an estimated $73,000 damage at Waynesboro.[9] The river crested at Waynesboro on

Table 6.—Average minimum flows of selected streams (based on period 1941-1960.[15]

National order No	Station	Average minimum flow in mgd
02B 4773.5	Chickasawhay River at Shubuta	44
4773.6	Eucutta Creek near Shubuta	6.3
4774.9	Yellow Creek near Waynesboro	11
4775	Chickasawhay River near Waynesboro	70
4776	Patton Creek near Waynesboro	1.3
4780	Bucatunna Creek at Denham	7.1
4780.2	Big Red Creek near Bucatunna	4.4
4780.3	Bucatunna Creek near Bucatunna	22
4781	Big Creek at Clara	1.6
4781.4	Big Creek near Bucatunna	4.6
4748	Thompson Creek at Richton	2.4

1. Shows, T. N. and others, 1966, Water for industrial development in Forrest, Greene, Jones, Perry, and Wayne Counties, Mississippi: Mississippi Research and Development Center, p. 37.

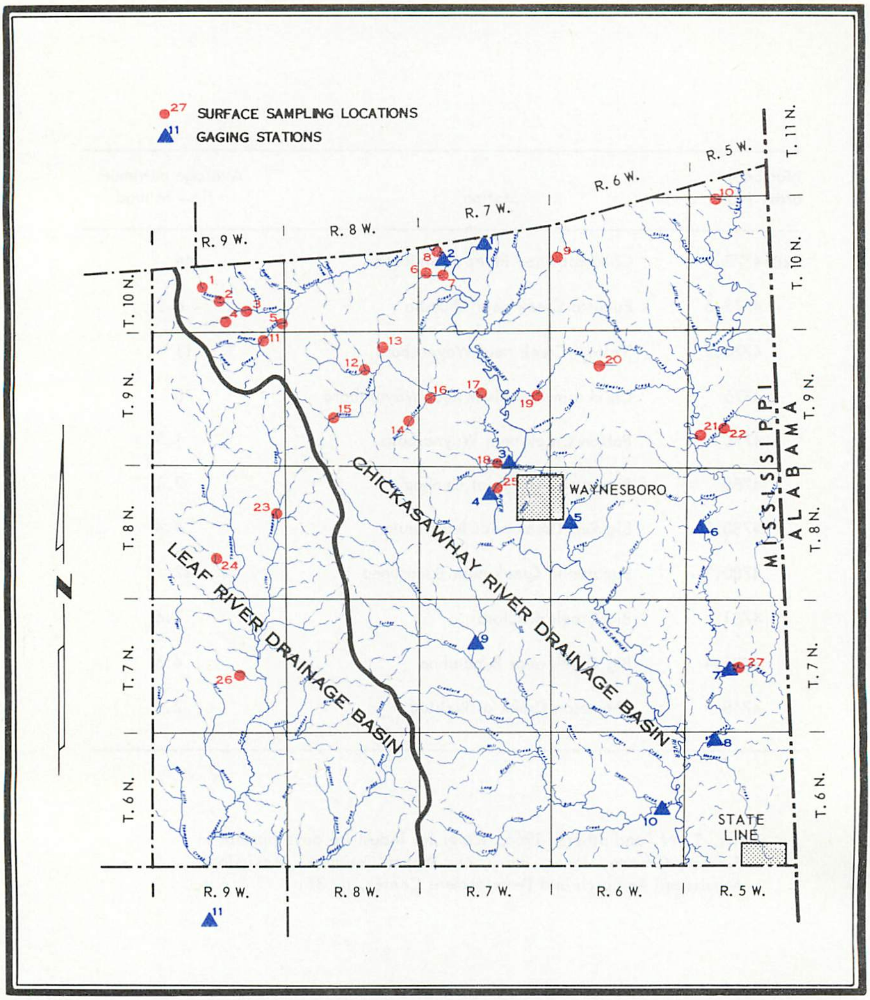

Figure 3.—Gaging station and surface sampling locations in Wayne County.

Table 7.—Stream-gaging stations and locations.

(Type of record: 1, continuous - record gaging station; 2, low-flow partial-record station; 3, daily sampling site; 4, DO and BOD sampling site; 5, sediment sampling site; a, approximate drainage area; b, at site 5.5 miles downstream; c, period operated as continous-record gaging station.)

Location	U.S.G.S. Identification Number	Station	Drainage Area (sq. mi.)	Period of Streamflow Record	Type of Record: Streamflow	Type of Record: Chemical Quality	Location
1	02B-4773.5	Chickasawhay River at Shubuta	[a]1,460	1943 1953 1963-	2	-	On line between Secs. 9 and 10, T.10 N., R.7 W., at bridge on U. S. Highway 45, 1 mile southeast of Shubuta (Wayne County).
2	02B-4773.6	Eucutta Creek near Shubuta	[a] 70	1963-	2	-	NE/4, Sec. 18, T.10 N., R.7 W., at bridge on county highway, 2 miles southwest of Shubuta.
3	02B-4774.9	Yellow Creek at Waynesboro	[a] 50	1963-	2	-	SE/4, Sec. 35, T.9 N., R.7 W., at bridge on county highway, 1/2 mile northwest of Waynesboro.
4	02B-4775	Chickasawhay River near Waynesboro	[a]1,660	[c]1939-50 1957-58 1963-	1, 2	3, [b]4, 5	NW/4, Sec. 10, T.8 N., R.7 W., at bridge on U. S. Highway 84, 2 miles west of Waynesboro.
5	02B-4776	Patton Creek near Waynesboro	[a] 10	1956 1958 1960 1963-	2	-	SE/4, Sec. 18, T.8 N., R.6 W., at bridge on U. S. Highway 45, 1 3/4 miles southeast of Waynesboro.
6	02B-4780	Bucatunna Creek at Denham	468	[c]1938-49 1952-56 1958 1960 1963-	1, 2	-	S/2, Sec. 18, T.8 N., R.5 W., at bridge on county highway, 0.3 mile east of Denham.

Table 7.—(continued)

Location	U.S.G.S. Identification Number	Station	Drainage Area (sq. mi.)	Period of Streamflow Record	Type of Record: Stream-flow	Type of Record: Chemical Quality	Location
7	02B-4780.2	Big Red Creek near Bucatunna	a 69	1963-	2	-	NE/4, Sec. 21, T.7 N., R.5 W., at bridge on county highway, 3 miles northeast of Bucatunna.
8	02B-4780.3	Bucatunna Creek near Bucatunna	a 600	1963-	2	-	NW/4, Sec. 5, T.6 N., R.5 W., at bridge on U. S. Highway 45, 1 1/2 miles southeast of Bucatunna.
9	02B-4781	Big Creek at Clara	a 46	1942-43 1951-56 1958 1960 1963-	2	-	N/2, Sec. 16, T.7 N., R.7 W., at bridge on State Highway 63, at Clara.
10	02B-4781.4	Big Creek near Bucatunna	a 140	1963-	2	-	SE/4, Sec. 22, T.6 N., R.6 W., at bridge on county highway, 10 miles southwest of Bucatunna.
11	02B-4748	Thompson Creek near Richton	a 186	1942-43 1951-54 1956 1960 1961 1963-	2	-	NW/4, Sec. 32, T.5 N., R.9 W., at bridge on State Highway 42, 1/2 mile east of Richton (Perry County).

February 26, 1961 at 47.9 feet (167.81 feet above mean sea level) with a flow recorded at 58,300 cfs. In comparison, the flood of April 1900 crested at an estimated 50 feet (169.91 feet above mean sea level) at Waynesboro with an estimated flow of 73,000 cfs.[10]

Before building near the Chickasawhay River or any large stream in Wayne County the flood records of the area should be investigated. This can be accomplished by visiting local libraries and newspapers, or by contacting the U. S. Geological Survey, Water Resources Division, Jackson, Mississippi.

Water Quality

In most parts of Wayne County the surface water varies from a soft to a moderately hard calcium bicarbonate type, depending upon the amount of contact, if any, a stream has with the calcareous formations along the northern portion of Wayne County. In areas where the surface water is polluted by brine from oil fields the water may change to a hard sodium chloride type.[11] Oil-field brine also causes a noticeable increase in calcium plus magnesium[12]. Table 9 is a summary of surface water quality data available for Wayne County. Generally, the surface water in Wayne County has a low concentration of dissolved solids (or low specific conductance), except where contaminated by oil-field brine.

Brine Pollution

Between February 20, 1973 and May 18, 1973, surface water in Wayne County was analyzed at 27 locations for specific conductance, temperature, sodium chloride (salt) in mg/l (milligrams per liter), chloride in mg/l, and pH. This period of stream water analysis coincided with the late winter and early spring rains when the streams were swollen. The surface water was analyzed again during the late summer (August 13-15, 1973), when the streams were near their base flow. The location of the 27 surface water sampling sites is shown in Figure 3; Table 8 contains the result of the chemical analyses of the surface water samples.

Streams and creeks in north central to northwestern Wayne County that flow through oil fields, or have tributaries that flow through oil fields, in most instances are being polluted by oil-field brine, destroying the aquatic life present in the streams.

Table 8.—Chemical analyses of water from selected surface water sampling sites.

Location	Sample Date	Specific Conductance	Temperature °C	°F	NaCl (mg/l)	Cl (mg/l)	pH
1	April 24, 1973	less than 50	21.1	70	37.5	23	6.7
	August 13, 1973	80	24.4	76	50	30	6.5
2	April 11, 1973	less than 50	11	51.8	37.5	23	6.6
	August 13, 1973	90	23.9	75	37.5	23	6.8
3	April 11, 1973	60	12	53.6	100	61	6.5
	August 13, 1973	260	25.6	78	250	152	6.3
4	April 11, 1973	260	12	53.6	300	182	5.5
	August 13, 1973	4800	27.8	82	2600	1576	5.5
5	April 5, 1973	1350	13.6	56.5	750	454	
	August 13, 1973	7000	26.7	80	4200	2545	5.5
6	May 17, 1973	120	18.9	66	37.5	23	7.7
	August 13, 1973	190	23.9	75	62.5	38	7.8
7	May 17, 1973	720	20	68	450	273	7.4
	August 13, 1973	900	23.9	75	700	424	7.2
8	May 17, 1973	750	20.6	69	550	333	6.9
	August 13, 1973	3500	26.1	79	2000	1212	5.5
9	April 3, 1973	930	16.7	62	450	273	
	August 15, 1973	5000	31.6	89	2937	1780	8.5
10	April 2, 1973	less than 50	13.3	56	12.5	8	6.9
	August 15, 1973	90	23	73.5	41	25	6.8
11	February 20, 1973				751	455	
	August 13, 1973	4000	33.3	92	2400	1454	5.5
12	March 28, 1973	315	13.3	56	150	91	5.6
	August 14, 1973	1100	28.9	84	677	410	4.2
13	May 17, 1973	400	17.8	64	350	212	6.6
	August 14, 1973	380	22.2	72	206	125	6.9
14	March 28, 1973	188	13.3	56	100	61	5.6
	August 14, 1973	240	23.3	74	140	85	6.4

Table 8.—Chemical analyses of water from selected surface water sampling sites. (continued)

Location	Sample Date	Specific Conductance	Temperature °C	°F	NaCl (mg/l)	Cl (mg/l)	pH
15	May 18, 1973	110	14.4	58	75	46	5.5
	August 14, 1973	170	22.2	72	91	55	5.3
16	March 27, 1973	540	14.4	58	275	167	5.5
	August 14, 1973	700	22.8	73	347	210	6.4
17	March 1, 1973	890	11	51.8	388	235	6.6
	August 14, 1973	850	23.9	75	462	280	6.8
18	March 1, 1973	less than 50	12	53.6	12.5	7.6	6.6
	August 14, 1973	less than 50	23.9	75	8.3	5	6.6
19	April 3, 1973	1060	15	59	500	303	
	August 14, 1973	2500	21.7	71	1535	930	8.2
20	April 4, 1973	800	15	59	450	273	
	August 15, 1973	5000	22.8	73	2417	1465	4.6
21	February 28, 1973	118	14	57.2	50	30.3	6.9
	August 15, 1973	240	26.7	80	99	60	7.0
22	February 28, 1973	118	14	57.2	25	15.1	7.6
	August 15, 1973	100	25	77	trace	trace	8.2
23	March 1, 1973	less than 50	13	55.4	25	15.1	5.5
	August 14, 1973	less than 50	25.6	78	16.5	10	5.7
24	April 11, 1973	less than 50	18	64.4	75	45	5.5
	August 14, 1973	725	27.3	81	371	225	less than 4
25	April 12, 1973	less than 50	19	66.2	37.5	23	6.7
	August 14, 1973	190	27.8	82	66	40	7.5
26	April 11, 1973	less than 50	14	57.2	175	106	5.7
	August 14, 1973	420	24.4	76	223	135	less than 4
27	February 27, 1973	less than 50			8.3	5	
	August 15, 1973	less than 50	26.7	80	8.5	5	6.3

Surface water in the areas of West Eucutta, Eucutta, North Yellow Creek, Yellow Creek, Chaparral, and Diamond Oil Fields (Fig. 49, May) had chloride content measured by the writer in excess of 250 mg/l, which is the maximum limit established by the U. S. Public Health Service for chlorides in drinkable water. Samples from streams in Wausau and Thompson's Creek Oil Fields approached this limit but did not exceed it; however, the chloride content of the streams may exceed the limit at times.

Samples unpolluted by chloride from oil field brines were from locations 1, 2, 6, 10, 18, 22, 23, and 27. Samples from location 21 may have been contaminated as a result of being downstream from several oil fields (Fig. 49, May). Analyses of water samples from location 24 (Wausau Oil Field) and 26 (Thompson's Creek Oil Field) indicated wide fluctuations in chloride content but did not exceed 250 mg/l chloride.

Oil-field brine has made Eucutta Creek the most polluted principal tributary of the Chickasawhay River in Wayne County. Eucutta Crek receives brine from West Eucutta Oil Field (location 4), Eucutta Oil Field (locations 5 and 11), Wolf Creek Oil Field, and North Yellow Creek Oil Field (locations 7 and 8). The highest chloride measurement was from a sample collected from within Eucutta Oil Field (2545 mg/l chloride being measured at location 5 on Little Eucutta Creek). Near Shubuta, chloride was measured by the U. S. Geological Survey at 1150 mg/l in Eucutta Creek (Table 9).

Yellow Creek is another principal tributary of the Chickasawhay River that receives a large amount of brine pollution from oil fields. Prior to flowing through Yellow Creek Oil Field, both Yellow Creek (location 15) and Silver Creek (location 14) have been contaminated by brine. Locations 12 and 13 are on the fringe of the oil field and location 16 is inside the field. At sample location 17, downstream from Yellow Creek Oil Field, chloride was measured at 280 mg/l. Further downstream, at the U. S. G. S. gaging station, chloride has been measured at 359 mg/l (Table 9).

Streams flowing through Chaparral Oil Field (location 9) and Diamond Oil Field (location 20) also had excessive chloride measurements, 1780 mg/l and 1465 mg/l, respectfully. Down stream from Diamond Oil Field, water sampled from Hortons

Table 9.—Water-quality data summary for 5 streams.

Date of Collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Strontium (Sr)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C) Parts per million	Tons per acre foot	Tons per day	Hardness as $CaCO_3$ Calcium-magnesium	Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°)	pH	Color
2-4748. THOMPSON CREEK AT RICHTON, MISS.[1]																							
Nov. 18, 1965	6.6	11	0.25				3.2		4		4.8		0.7		38	0.05	0.66	4	0	0.7	30	6.0	80
2-4773.6. EUCUTTA CREEK NEAR SHUBUTA, MISS.[1]																							
Nov. 19, 1965	19										1150							370			3620	7.0	
2-4774.9. YELLOW CREEK NEAR WAYNESBORO, MISS.[1]																							
Dec. 22, 1965	84										359							115			1190	6.5	
2-4775. CHICKASAWHAY RIVER NEAR WAYNESBORO, MISS.[2] (Data based on 60 analyses made during the water year October 1963 to September 1964)																							
Maximum value		14	1.4	44	7.9		97	4.2	58	16	280	0.9	1.7		526	.72		132	99	3.8	936	7.6	100
Minimum value		6.2	.00	2.6	1.2		3.4	1.2	15	2.4	5.3	.00	.00		32	.04		15	3	.4	48	6.4	5
Time-weighted average		11	0.05	21	3.8		44	2.0	37	9.5	89	0.2	0.4		239	0.33		66	35	2.3	371	6.9	20
2.4780.3. BUCATUNNA CREEK NEAR BUCKATUNNA, MISS.[1]																							
Nov. 18, 1965	70	8.9	0.13				51		24		98		0.2		218	0.30	41.1	45	25	3.3	372	6.5	20

1. "Water Resources Data For Mississippi - 1966" U.S. Department of the Interior, Geological Survey, p. 135.

2. "Water Quality Records in Alabama, Louisiana, and Mississippi - 1964" U.S. Department of the Interior, Geological Survey, p. 43-44.

Mill Creek had a chloride content analyzed at 930 mg/l (location 19). Stream drainage from both these oil fields enters the Chickasawhay River, adding more brine pollution.

The amount of chloride measured in the Chickasawhy River at Waynesboro (location 25) was low, although chlorides have been measured as high as 280 mg/l (Table 9). Chlorides were not measured in the Chickasawhay River near the Clarke County line; therefore, the chloride measured in the Chickasawhay River at Waynesboro cannot be directly attributed to the oil fields in one county or the other.

The primary cause of excessive brine pollution in the surface water in northern Wayne County is the use of unlined salt-water evaporation pits. Salt water seeps through the bottom of the evaporation pit and in numerous cases surfaces a short distance downhill, causing large numbers of trees to be killed (Fig. 4).

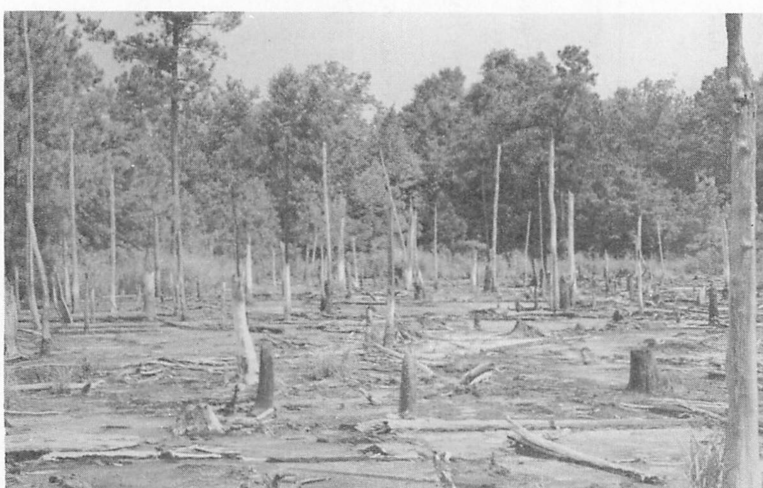

Figure 4.—Trees killed as a result of salt water seepage from evaporation pits. This scene is common in the oil fields in northern Wayne County. Location is in Eucutta Oil Field, in SE/4, SE/4, Sec. 6, T.9N., R.8W. August 1973.

The salt water then stays on the surface and enters the local drainage, causing chloride contamination of fresh water streams. The salt water evaporation pits also overflow (Fig. 5), letting

Figure 5.—Overflowing salt-water evaporation pit. Little Eucutta Creek is on the other side of the tree kill. Location is in West Eucutta Oil Field, in NE/4, SE/4, NW/4, Sec. 2, T.9N., R.9W. August 1973.

salt water flow freely into the surface water drainage. These practices are in violation of the Mississippi Oil and Gas Board Order 430-70, dated November 18, 1970:

6. (a) Disposal in pits:

(1.) Where salt water or waste oil or basic sediment is disposed of in pits, tanks or other receptacles, they shall be so constructed that the material or substance so stored will not cause pollution of fresh waters or contamination of soils beyond the confines of the pits, tanks, or other receptacles. Storage pits will be protected from surface waters by dikes and drainage ditches, and no siphons or openings will be placed in walls or dikes that would permit the escaping of the contents of the pits or tanks so as to cause pollution or contamination.

The practice of hauling salt water by truck from tank batteries and then dumping the salt water into evaporation pits (Fig. 6) is another cause of brine pollution. The salt water is

Figure 6.—Truck dumping salt water into an evaporation pit. Location is in Eucutta Oil Field, in NE/4, SE/4, NW/4, Sec. 6, T.9N., R.8W. August 1973.

generally dumped into evaporation pits that have high seepage rates, allowing salt water to seep through the bottom of the pit. The evaporation pit in Figure 7 is a good example. The walls of pit are not breached or broken at any point and the salt water is completely covered with crude oil, greatly reducing the rate of evaporation, yet the writer observed the fluid level of the pit drop 3 to 4 inches in three hours. This pit has been in existence for several years, and as there were no trees killed within a reasonable distance downhill from the pit, the writer assumes that this practice has permitted large amounts of salt water to percolate directly into the ground water.

Water Temperature

Many industries use surface water for cooling purposes, therefore, water temperature data is needed to determine the volume of water necessary to accomplish desired heat exchanges. Daily water temperatures from the Chickasawhay River near Waynesboro were recorded by the U. S. Geological Survey (Table 10). To assist in estimating seasonal cycles, the average monthly temperature is included in Table 10.

Figure 7.—Salt-water evaporation pit that has a high seepage rate. The knife point is at the fluid level of the pit approximately three hours prior to this photograph. Location is in Eucutta Oil Field, in NW/4, SE/4, SE/4, Sec. 12, T.9N., R.9W. August 1973.

Restrictions by Mississippi Law

The Mississippi Board of Water Commissioners, by legislative act of 1956, controls the appropriation of water from streams of the State. The responsibilities of the Board include the issuance of water permits, protection of existing water rights, and controlling the appropriation of additional available water to insure its most advantageous use. The law states that water in any water course, lake or other natural water body of the State is subject to appropriation in accordance with the provisions of the act. The law applies only to surface water.

The Board of Water Commissioners has the authority to permit the appropriation of water of any stream only in excess of the established average minimum flow. The average minimum flow of a stream is defined in the Mississippi water law as follows: "The average of the minimum daily flow occurring each of the five (5) lowest years in the period of the proceeding twenty (20) years." The average minimum flow for streams in Wayne County is presented in Table 6. The Board may author-

Table 10.—Temperature of water in Chickasawhay River near Waynesboro, Mississippi (October 1963 thru September 1964.[16]

(Once-daily measurement, usually at 0700, temperature of water in degrees Fahrenheit)

Month	Day 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Average
October	70	68	72	71	72	71	69	68	--	68	67	67	69	69	69	66	67	64	63	63	62	62	63	65	66	65	60	66	64	57	55	66
November	60	53	57	51	55	56	56	56	57	57	58	56	52	47	46	46	50	55	55	59	59	67	63	54	54	57	58	60	56	49	--	55
December	48	49	--	--	--	45	47	50	50	49	48	52	50	46	40	--	38	40	38	38	--	--	--	--	35	37	40	40	40	--	40	44
January	--	--	--	--	--	--	47	48	50	--	40	47	43	35	36	37	37	37	--	45	41	45	47	53	--	51	49	49	45	46	50	44
February	49	49	47	48	50	48	48	45	45	43	45	44	48	46	49	48	47	48	47	45	--	42	43	41	43	42	45	45	45	--	--	46
March	47	50	50	50	54	52	54	56	58	56	--	58	55	58	60	58	55	56	58	58	55	48	58	--	59	58	55	58	58	52	55	55
April	55	58	61	64	66	66	61	65	66	62	60	64	65	63	63	62	63	65	66	66	68	69	72	71	71	70	68	68	69	67	--	65
May	68	68	68	67	68	68	68	70	71	71	73	75	72	70	69	68	--	--	71	74	75	76	76	76	76	--	78	79	74	71	76	72
June	77	74	74	72	--	75	76	76	78	80	80	81	82	83	84	84	82	81	82	71	84	84	82	82	81	81	79	79	78	77	--	79
July	77	76	78	78	78	78	80	80	82	80	81	80	78	78	78	78	79	80	80	82	82	81	83	83	84	84	83	82	80	80	--	80
August	82	83	78	82	82	82	81	79	81	82	82	82	80	79	80	81	81	80	82	82	83	83	82	--	82	80	80	81	82	83	83	81
September	83	84	84	84	81	82	81	81	81	80	80	79	76	72	74	74	75	76	78	79	76	75	75	75	76	--	76	77	75	75	--	78

1. "Water Quality Records in Alabama, Louisiana, and Mississippi - 1964" Department of the Interior, Geological Survey, p. 45.

ize an appropriator to use the established minimum flow for industrial purposes when such water shall be returned within a reasonable time, as specified by the Board in its authorization, to the stream at a point downstream from its place of withdrawal. This appropriation can only be made if the Board determines such action will not result in any substantial detriment to property owners affected thereby or to the public interest.[13]

The law also states that the Board has authority to enter into compacts and agreements concerning the State's share of water flowing into streams, where parts of such water courses are contained within the territorial limits of a neighboring state.[14]

Conclusions

Present water use in Wayne County utilizes only a small part of the total water available. Ground-water development has been limited in most of the County and surface water as a source has been used only on a very limited scale. The potential for ground-water development in much of the County is good. Surface-water development potential is good provided man-made pollution is discontinued and prevented from further occurrence.

Ground water is available in small to large quantities from various aquifers in Wayne County. The Catahoula aquifer is the source of water supply for most of the southwestern one-half of the County. It is capable of giving up moderate to large quantities of water to properly constructed wells at numerous locations within its area of use. The Vicksburg aquifer system has the potential of yielding small to moderate quantities of water to wells in some areas. The Cocoa sand is capable of yielding small to moderate quantities of water where adequate development of sand occurs. The Cockfield aquifer contains fresh water (less than 1000 mg/l total dissolved solids) only in most of the northeastern part of the County and is capable of yielding small to moderate quanties of water to wells. The Kosciusko aquifer is fresh in most of the northeastern part of the County; it will yield small to moderate quantities of water to wells. The Meridian Sand and Wilcox aquifers have not been tested for water in any of Wayne County, but are believed to have the potential of yielding moderate to large quanties of water to properly constructed wells in several localities within the northern one-fourth of the County. Water in the Wilcox and Meridian Sand aquifer is believed to be fresh in this northernmost part of the County.

Water level declines are small in Wayne County due to small scale overall ground-water development. Declines will increase with more intense development of the ground-water resources.

Most of the water produced in the County is good in quality and used without treatment. In some localities within the County however, brine pollution has occurred in shallow formations, thus deteriorating the quality of water in the aquifers. This condition was found to be all too common in some areas of oilfield activity where unlined earthern pits have been constructed in permeable soils and used for disposal of salt water, waste oils, etc. Many of the pits so constructed allow brines to permeate directly into ground-water aquifers; brines from some pits seep out in the form of springs downhill from the pits and enter streams.

The water-quality problems asociated with ground water in Wayne County are generally those of low pH, excessive color, and excessive iron. Treatment for pH adjustment and iron removal is necessary in some areas. Excessive color in water restricts use of some aquifers in other areas of the County. Brine pollution prohibits use of some aquifers in areas of oil-field activity because chloride content in the water exceeds the minimum recommended limit established by the U. S. Public Health Service.

The largest stream in Wayne County is the Chickasawhay River. It is a potential source of large quantities of water. Surface water stored in reservoirs in many parts of the County would be suitable for most uses with little treatment, provided man-made pollution is prevented. Chemical quality of water in the streams is generally good to excellent, except in areas downstream of brine pollution. Chloride content in the Chickasawhay River does sometimes exceed the maximum recommended limit of 250 mg/l. Quantity available and pollution are the major factors affecting utilization of surface water in the County.

Flood hazard is moderate along the flood plain of the Chickasawhay River and minor along the flood plain of the Bucatunna Creek. Caution should be exercised in contemplating development in flood-prone areas along these streams.

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WAYNE COUNTY, MISSISSIPPI

GEOLOGIC MAP

GEOLOGY BY JAMES H. MAY

MISSISSIPPI GEOLOGICAL SURVEY

SCALE

1 0 1 2 3 4 MILES

THIS MAP IS BASED ON DATA AVAILABLE TO THE DATE MARCH 2, 1973

— — — APPROXIMATE LOCATION OF SHALLOW FAULT

LEGEND

QUATERNARY

RECENT

Qa Alluvium— sand, fine- to coarse-grained; pea gravel, predominantly quartz; clay and silt; includes low terraces.

PLEISTOCENE

Qt Terrace deposits— sand, fine- to coarse-grained; occasional gravel, chert and quartz; local clay lenses.

Pc Citronelle Formation— sand, fine- to coarse-grained; gravel, chert and quartz; local clay lenses; local gravel conglomerate.

TERTIARY

MIOCENE

Mh Hattiesburg Formation— clay, silty; sand, fine- grained; locally indurated.

Mc Catahoula Formation— sand, fine- to medium-grained; silt, argillaceous; clay, silty; locally indurated.

OLIGOCENE

Opc Paynes Hammock Formation— marl, fossiliferous, arenaceous; indurated ledges.
Chickasawhay Formation— limestones and marl, fossiliferous.

Ov Vicksburg Group— includes in descending order:
Bucatunna Formation— clay, carbonaceous, rare fossils;
Byram Formation— marl, fossiliferous;
Glendon Formation— limestone and marl, fossiliferous, hard ledges;
Marianna Formation— limestone, fossiliferous, argillaceous;
Mint Spring Formation— marl, arenaceous, fossiliferous.

Ofr Forest Hill Formation— clay, carbonaceous, sparingly fossiliferous; sand, fine- grained, silty.
Red Bluff Formation— marl, fossiliferous, ferruginous; partially indurated.

EOCENE

Eys / Eypc / Eyn Yazoo Formation— includes in descending order the following members: Shubuta Clay (Eys); Pachuta Marl and Cocoa Sand (Eypc); North Twistwood Creek Clay (Eyn).

Emb Moodys Branch Formation— marl, fossiliferous, glauconitic; partially indurated.

Ec Cockfield Formation— clay, silty, lignitic; sand, fine- to medium-grained, fossiliferous in part; includes tongues of Gosport Formation.

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WAYNE COUNTY, MISSISSIPPI

STRUCTURE MAP

DATUM TOP OF MOODY'S BRANCH FORMATION

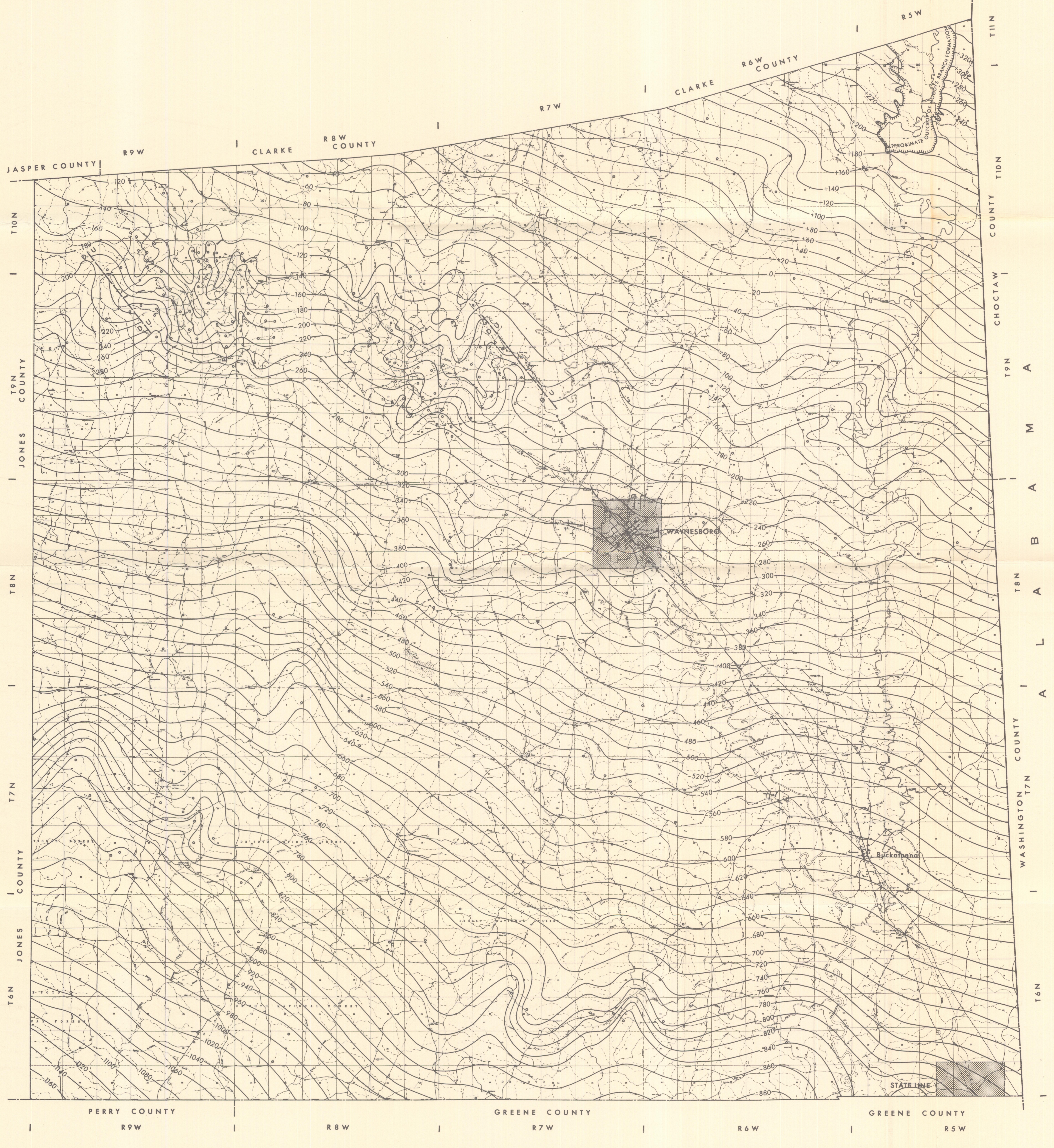
CONTOUR INTERVAL - 20 FEET
GEOLOGY BY JAMES H. MAY

MISSISSIPPI GEOLOGICAL SURVEY

1973

SCALE

THIS MAP IS BASED ON DATA AVAILABLE TO THE DATE MARCH 2, 1973



• DENOTES CONTROL POINT

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WAYNE COUNTY, MISSISSIPPI
STRUCTURE MAP
DATUM TOP OF GLENDON FORMATION

CONTOUR INTERVAL - 20 FEET
GEOLOGY BY JAMES H. MAY

MISSISSIPPI GEOLOGICAL SURVEY
1973

SCALE

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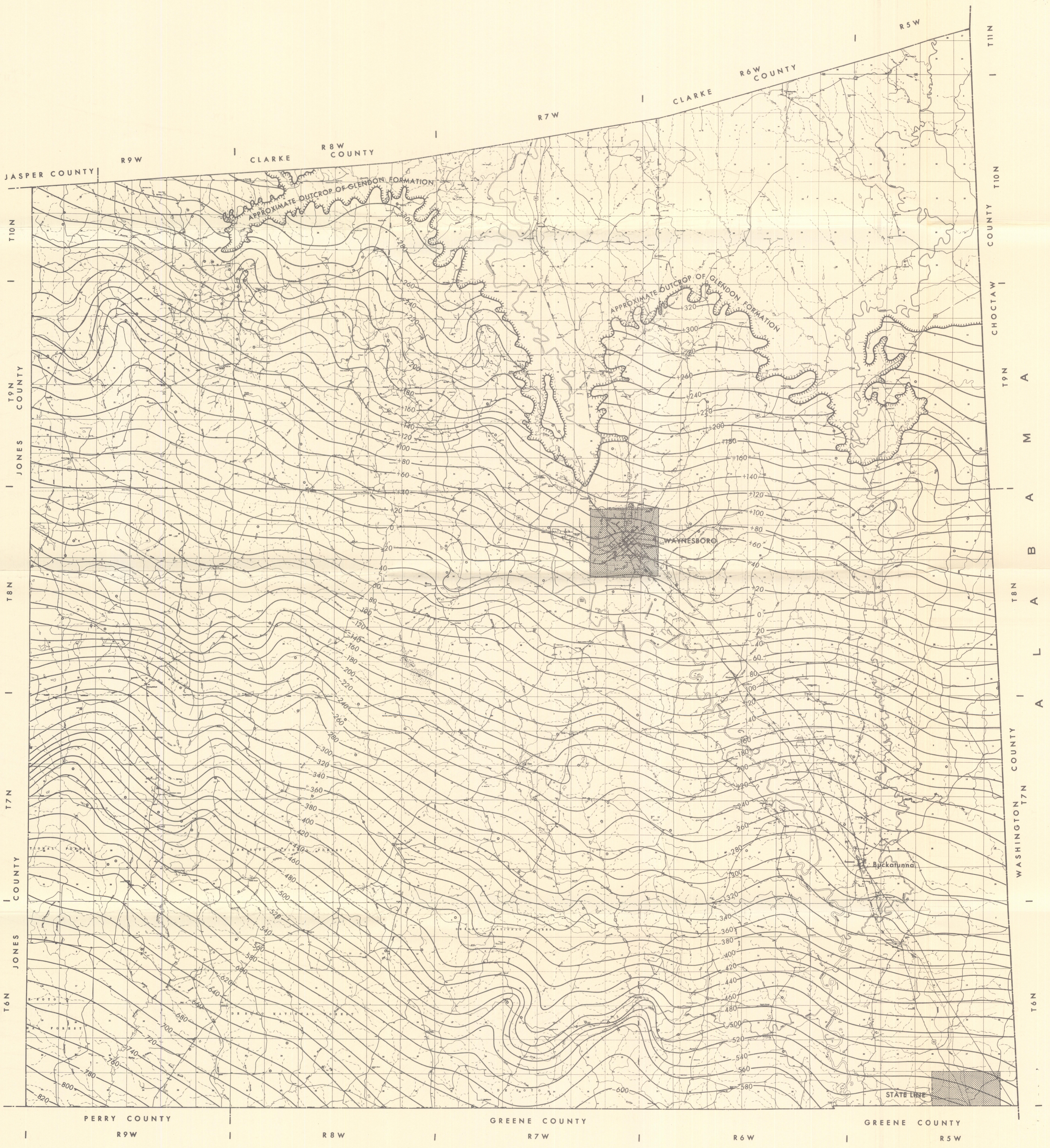

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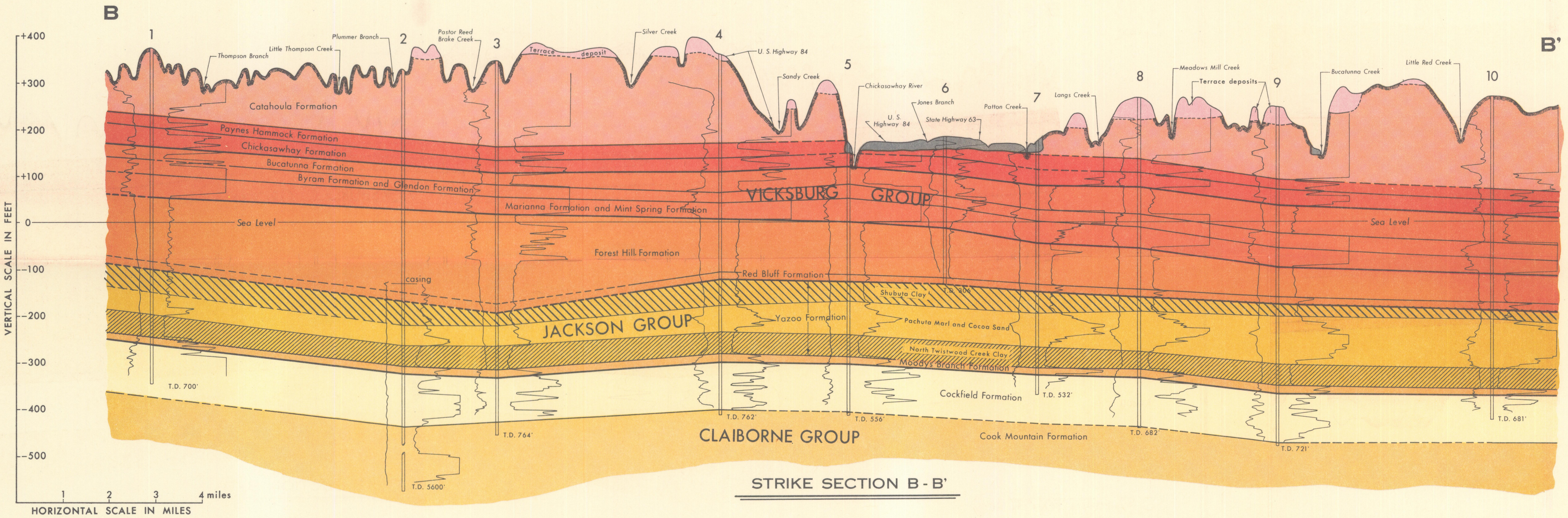
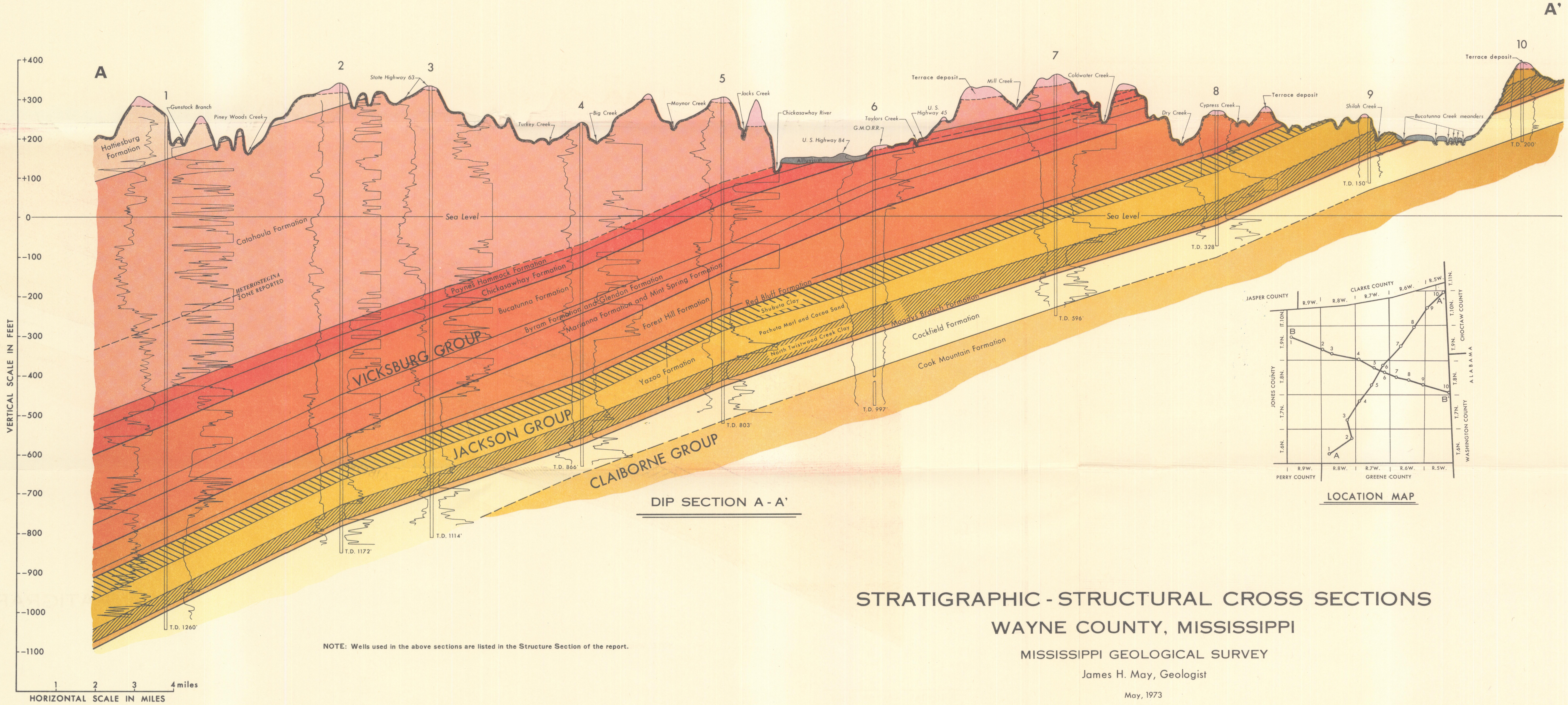


STRIKE SECTION B - B'



DIP SECTION A - A'

NOTE: Wells used in the above sections are listed in the Structure Section of the report.

LOCATION MAP

STRATIGRAPHIC - STRUCTURAL CROSS SECTIONS
WAYNE COUNTY, MISSISSIPPI

MISSISSIPPI GEOLOGICAL SURVEY
James H. May, Geologist

May, 1973

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