Attala County Mineral Resources

WILLIAM S. PARKS

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THOMAS E. McCUTCHEON

B. E. WASSON

(U. S. Geological Survey)

Section on Water Resources Prepared by the United States Geological Survey

BULLETIN 99

MISSISSIPPI GEOLOGICAL, ECONOMIC AND TOPOGRAPHICAL SURVEY

FREDERIC FRANCIS MELLEN
DIRECTOR AND STATE GEOLOGIST

JACKSON, MISSISSIPPI
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LETTER OF TRANSMITTAL

Office of the Mississippi Geological, Economic and

Topographical Survey

Jackson, Mississippi

May 13, 1963

Mr. Henry N. Toler, Chairman, and

Members of the Board,

Mississippi Geological Survey

Gentlemen:

The Survey's two most recent County bulletins have utilized an approach different from that used in the past. Bulletin 95, "Jasper County Mineral Resources" and Bulletin 99, "Attala County Mineral Resources," have employed a division-of-labor and a team effort in developing the geology and mineral resource data. We believe that higher quality and better presentation are inherent in this system.

Mr. Parks and his collaborators have done a superb task of working out the geology of Attala County. They have studied its mineral resources, and now present the data in a reconnaissance form most useful to Industry. We believe the quality of the scientific work going into Bulletin 99 will make it economically competitive with any similar report of any other state.

The Survey is proud of the encouragement and financial support given the work by the people of Attala County as acknowledged by Mr. Parks.

The 76 electrical logs on core holes in Attala County, donated to the Survey by Pan American Petroleum Corporation, will be placed in the Survey's open files. They have been of immense scientific value to Mr. Parks in his studies.

The Director believes that the publication, distribution, and utilization of Bulletin 99 will inevitably lead to further development and use of the abundant clays and sands, and other mineral resources of Attala County.

Respectfully submitted,

Frederic F. Mellen
Director and State Geologist

FFM: JS

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B. E. WASSON

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ATTALA COUNTY SURFACE GEOLOGY

WILLIAM SCOTT PARKS

ABSTRACT

Attala County, located near the geographical center of Mississippi, lies within the parallels 32° 50′ and 33° 20′ north latitude and the meridians 89° 15′ and 90° west longitude. It is within the Gulf Coastal Plain physiographic province and is within the North Central Hills division.

Uncommon geomorphic features typically represented are small caves and sink holes developed as a result of a set of conditions peculiar to the erosion of quartzitic rock layers overlying leached silts.

The bedrock strata exposed are a part of the Eocene series of the Tertiary system. The units from the base upward are the Hatchetigbee formation of the Wilcox group and the Tallahatta, Winona, Zilpha, Kosciusko, Wautubbee, and Cockfield formations of the Claiborne group. A distinctive lithologic unit recognizable at the base of the Zilpha formation is named the "Zama member" for a small village in southeastern Attala County.

Surface rocks and minerals of possible economic importance include clay, sand, quartzitic rock, iron rich materials, glauconite, and lignite. Of these materials, the clays and sands probably have the best development potential. The present clay industry consists of a brick manufacturing company and of a plant in which clay is processed for use as a foundry bonding clay. Present utilization of sand is chiefly in road and highway construction as topping materials. Preliminary tests indicate that with beneficiation some sands may be suitable for use in the manufacture of glass.

INTRODUCTION

The field work for the present investigation began on March 19, 1962, and terminated on December 14, 1962. The investigation consisted of a study of the character, distribution, and thickness of the various geologic units. Especial attention was given a search for materials of possible economic importance. A total of 23 Test Holes and 7 Core Holes was drilled in order to gain stratigraphic information and to obtain samples for laboratory testing.

DESCRIPTION OF THE AREA

LOCATION AND SIZE

Attala County, located near the geographical center of Mississippi, lies within the parallels 32° 50′ and 33° 20′ north latitude and the meridians 89° 15′ and 90° west longitude. This is a rough-

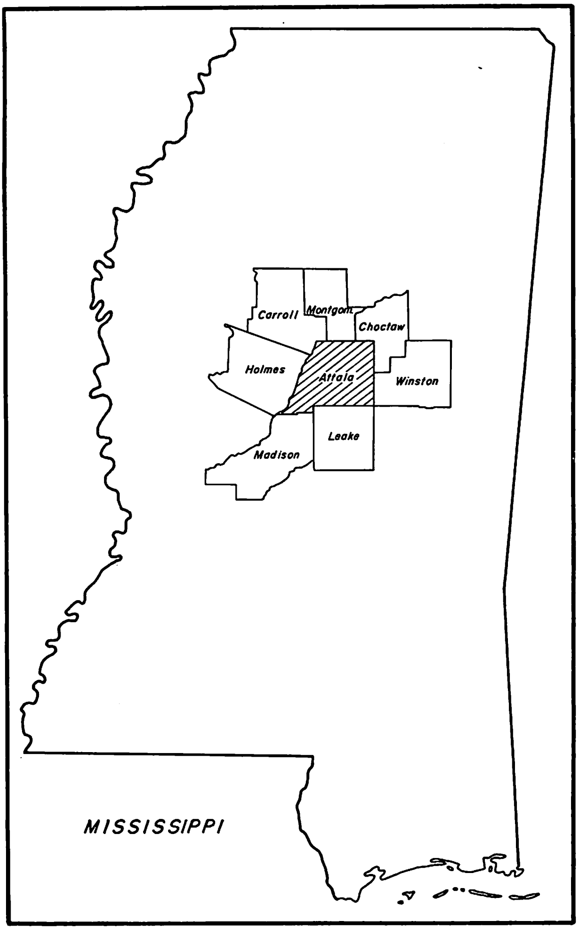


Figure 1.—Location of Attala County.

ly trapezoidal area of 463,360 acres or 724 square miles which has the Big Black River marking an irregular, diagonal, western boundary. The County has a maximum east-west extent of about 39 miles and a maximum north-south extent of about 27 miles. Attala County is bounded on the north by Carroll, Montgomery, and Choctaw Counties; on the east by Choctaw and Winston Counties; on the south by Leake and Madison Counties; and on the west by Holmes and Carroll Counties (Figure 1). Kosciusko, the county seat, is located 68 miles from Jackson, Mississippi; 153 miles from Memphis, Tennessee; 253 miles from New Orleans, Louisiana; 204 miles from Birmingham, Alabama; and 263 miles from Little Rock, Arkansas.

ACCESSIBILITY

Several State maintained highways crisscross Attala County making the area accessible from almost any general direction. All of the main thoroughfares pass through Kosciusko which is located in the central part. According to the County Engineer, there are 164.4 miles of asphalt surfaced roads (including the Natchez Trace), 856.9 miles of gravel surfaced roads, and 25.0 miles of unimproved roads. Plate 4 is a general highway map of the County.

Two highways are completely asphalt surfaced. State Highway 12, a northeast and west trending road through the northeastern, central, and western parts, links Kosciusko with Ackerman in Choctaw County and with U. S. Highway 51 at Durant in Holmes County. State Highway 35, a northwest and south-southeast trending road through the northwestern, central, and southern parts, joins Kosciusko with U. S. Highway 51 at Vaiden in Carroll County and with Carthage in Leake County.

Improved thoroughfares that are only in part asphalt surfaced are: (1) State Highway 19, a southeast and west-northwest trending road through the southeastern, central, and western parts connecting Kosciusko with Philadelphia in Neshoba County and with U. S. Highway 51 at West in Holmes County; (2) State Highway 14, an east-northeast and west-southwest trending road through the eastern, central, and southwestern parts connecting Kosciusko with Louisville in Winston County and with U. S. Highway 51 at Goodman in Holmes County; and (3) State Highway 43, an almost north-south trending road through the northern, central, and southern parts connecting Kosciusko with U. S. Highway 82 at Kilmichael in Montgomery County and with State Highway 16 two miles east of Canton in Madison County.

County maintained secondary roads are numerous, making most rural areas accessible. These roads are gravel or sand surfaced and are generally well graded and drained. Many of the secondary roads are all-weather roads, but some are impassable during periods of prolonged wet weather.

The historic Natchez Trace crosses the County on a general northeast-southwest axis. The completed, asphalt surfaced segment of the Parkway which passes Kosciusko near the southeast city limits is 164 miles in length and extends from its junction with U. S. Highway 51 eight miles north of Jackson to U. S. Highway 45 near Tupelo in Lee County. This scenic route, which provides a major tourist attraction, serves as a more or less direct passage to Jackson and Tupelo for non-commercial vehicles. Eventually, the Trace will extend about 450 miles from Natchez, Mississippi, to Nashville, Tennessee.

One railroad, the Aberdeen Division of the Illinois Central, serves Attala County. It extends through the western, central, and northeastern parts and passes through the towns of Sallis, McAdams, Kosciusko, Ethel, and McCool. This branch line connects with the Illinois Central Railroad main line from New Orleans to Chicago and also the Gulf, Mobile and Ohio from New Orleans to New York.

POPULATION

The 1960 Census shows a total population of 21,335 for Attala County, which is about 29.5 persons per square mile. This is a decrease of 19.9 percent from the 1950 Census figure. Of the total, 55.3 percent are white, 44.6 percent are negro, and 1 percent are classed as other races.

Kosciusko (pop. 6,800) is the largest town and has the only population classed as urban. The 1960 figure, which is 31.9 percent of the total for the County, shows a 0.7 percent increase since 1950. This increase is due to annexation to the town. Actually, the Census shows that the town has undergone a slight decrease in population in view of the 1950 Census area.

Other incorporated towns are Ethel (pop. 566), Sallis (pop. 223), and McCool (pop. 211). Small villages or communities that are shown on the general highway map are Boyette, Center, Hesterville, Joseph, McAdams, McVille, Newport, Possumneck, Smyrna, Wamba, Weeks, Williamsville, Zama, and Zemuly (Plate 4).

CULTURE AND INDUSTRY

The 1960 Census shows a total employed labor force of 6,110 of which 1,529 were reported as engaged in agricultural activities and 1,316 as employed in manufacturing enterprises. Even though these figures seem to indicate a near balance between agriculture and industry, the economy is basically agricultural. Several of the industries depend directly on farm and forest products in their operation. The principal sources of farm income are cotton, dairying, livestock (beef cattle and hogs), grain crops, and poultry.

In Attala County, there are approximately 20 manufacturing plants. The majority of these industries are located in Kosciusko. The most prominent manufactured products are bus and funeral car bodies, milk products, ladies hosiery, lamps, feed and flour, cotton seed oil, bottled drinks, boat and farm trailers, brick, industrial foundry bonding clay, and charcoal.

Although exploitation of the forests in the past left them in a poor state of management, re-forestation practices over the last 20 years have resulted in forestry regaining a portion of its role in the County's economy. Present production is chiefly pulpwood and some utilization of hardwoods and softwoods in the lumbering industry.

CLIMATE

Climatological data for Attala County for a 10-year period, 1951-1960, are shown in Table 1. The County has a warm-temperate climate, which is characterized by long summers having many hot days and by comparatively short mild winters having short spells of cold weather and infrequent light snowfalls. The highest temperature recorded was 107 degrees in July, and the lowest was minus 4 degrees in February, but extremes that approach these are rare. The annual precipitation is almost evenly distributed, rainfall being least during the summer and fall months and greatest during the winter and spring months. The average growing season is about seven months, usually from the last part of March to the first part of November.

Table 1

Normal Monthly, Seasonal, and Annual Temperature and Precipitation at Kosciusko, Attala County, Mississippi*

Month	Temperature			Precipitation		
	Average	Absolute maximum	Absolute minimum	Average	Total absolute minimum	Total absolute maximum
	F°	F°	F°	Inches	Inches	Inches
December	46.9	84	13	4.75	.90	9.89
January	46.5	80	12	5.13	1.87	7.70
February	49.3	82	-4	5.44	2.18	11.43
Winter	47.7	84	-4	15.32	4.95	29.02
March	54.3	86	18	5.84	3.41	13.10
April	63.8	91	30	6.12	3.83	10.03
May	71.6	95	39	4.51	1.38	7.86
Spring	63.2	95	18	16.47	8.62	30.99
June	78.6	101	49	2.91	1.03	8.22
July	81.4	107	58	4.49	1.24	7.50
August	81.0	105	54	3.46	2.02	7.37
Summer	80.3	107	49	10.86	4.29	23.09
September	75.3	106	45	2.45	.63	5.73
October	64.0	97	20	2.67	.00	5.99
November	52.9	87	16	4.40	.67	10.78
Fall	64.1	106	16	9.52	1.30	22.50
Year	63.8	107	-4	52.17	19.16	105.60

*Average temperature and precipitation based on a 10 year record, 1951 to 1960; compiled from available recordings in U. S. Department of Commerce, Weather Bureau, "Climatological Data," 1951 to 1960.

GEOMORPHOLOGY

TOPOGRAPHY

Attala County is within the Gulf Coastal Plains Province and is within the North Central Hills physiographic division. In Mississippi the North Central Hills is an extensive upland area bounded on the east by the Flatwoods, on the south by the Jackson Prairies, and on the west by the Loess Hills divisions. The terrane is extensively cut into hills and valleys by stream erosion and is at many places deeply dissected and rough. The North Central Hills is developed chiefly on the sands and clays of the upper Midway, the Wilcox, and the Claiborne groups. Generally the clays erode to almost flat or low rolling hilly surfaces, and the sands support moderate to high relief hills and ridges.

In Attala County the North Central Hills is a deeply dissected, very hilly, upland area that is crossed by several moderately broad alluvial plains. The hills are rounded to conical, and slopes are moderate to steep. The valleys are commonly wide, and the larger streams have developed flood plains.

Altitudes range from less than 250 feet to more than 700 feet above sea level. The highest elevations are in the extreme eastern part near the Winston County line where altitudes exceed 700 feet. The lowest elevations are in the extreme southwestern part along the Big Black River near the Madison County line where altitudes approach 200 feet. The areas of greatest relief are in the eastern and southeastern parts where the hill tops and ridge crests are as much as 150 to 200 feet above the valley floors.

The most prominent alluvial plain, which averages about two miles in width, is that of the Big Black River. However, inasmuch as the Big Black River defines Attala's western boundary, only a part of the alluvial plain is in the County. Other prominent alluvial plains, which average about a mile in width, are developed along the Yockanookany River and Lobutcha Creek.

DRAINAGE

Attala County lies within two major drainage basins—the Pearl River and the Big Black River. The divide that separates the two basins bisects the County diagonally, roughly into halves. It extends southwest across the County from a place about three miles west of the northeast corner to a place about three miles west of McVille, passing just west of Kosciusko. Major drainage is shown on Plate 1.

The eastern half is drained by the Yockanookany River and its tributaries, except for the southeastern part which is drained by Lobutcha Creek. The Yockanookany River is a southwest and south flowing stream which crosses the northeastern, central and southern parts. The River has no prominent tributaries. Lobutcha Creek is a west and south flowing stream which crosses the southeastern part. Both the Yockanookany River and Lobutcha Creek are tributaries of the Pearl River.

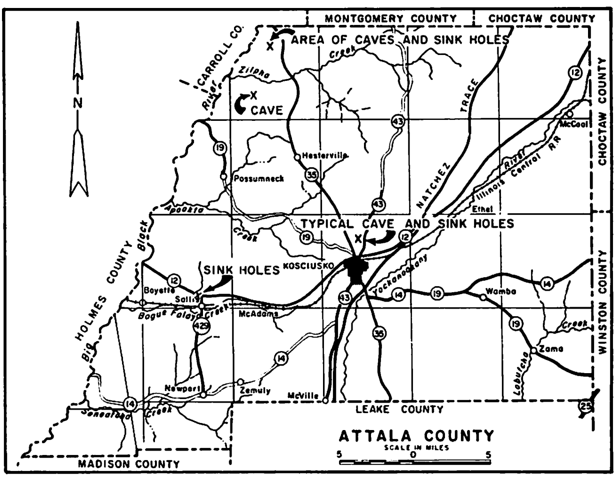


Figure 2.—Location of caves and sink holes.

The western half is drained by the Big Black River and its tributaries. The Big Black River, which forms the western boundary of the County, is a southwest flowing stream. Its more prominent tributaries in Attala County are, from north to south, Zilpha, Apookta, Bogue Falaya, and Seneatcha Creeks. These streams flow in general westerly directions.

CAVE AND SINK HOLE DEVELOPMENT

Small caves and sink holes are present at several localities in Attala County, associated with the quartzitic rocks that are locally developed at the Zilpha-Kosciusko contact (Figure 2). These features are uncommon inasmuch as they were formed primarily by physical erosion processes rather than by chemical solution, the process which is most generally associated with cave and sink hole development.

Everywhere examined, the *in situ* quartzitic rocks overlie light-gray or white, leached silts. They are commonly in beds one to five feet in thickness, but the individual bed may consist of one to three layers of rock, each a foot or more thick separated by partings of sand or silt. The rock layers are extensively fractured, forming blocks from a few feet to several feet across.

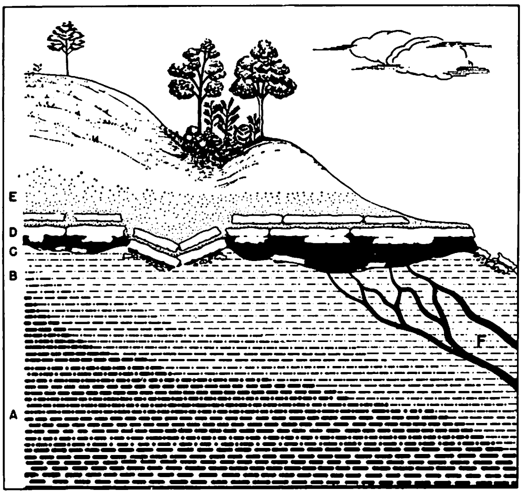


Figure 3.—Diagrammatic sketch of typical cave and sink hole located west of State Highway 43 (SW.1/4, NE.1/4, NE.1/4, Sec.9, T.14 N., R.7 E.) 1.7 miles north of the intersection of State Highway 12 at Kosciusko: (A) unleached carbonaceous clayey silts—sulfide zone; (B) partially leached silts—sulfate and hydroxide zone; (C) leached silts—hydroxide and oxide zone; (D) quartzitic rock layers—cave roof; (E) sand—aquifer; (F) cracks and tunnels—drainage. Drawing by David S. Sherard.

The development of the caves and sink holes is the result of a set of conditions peculiar to the erosion of the quartzitic rock layers *in situ*. The caves are formed near the top of hills at or near the head of small v-shaped hollows where surface run-off is greatest. Apparently surface waters flowing through the fractures in the rock layers have washed out tunnels and small cavities in the underlying silts by an undercutting action leaving the resistant rock as a roof. At places cave roofs have collapsed forming sink holes.

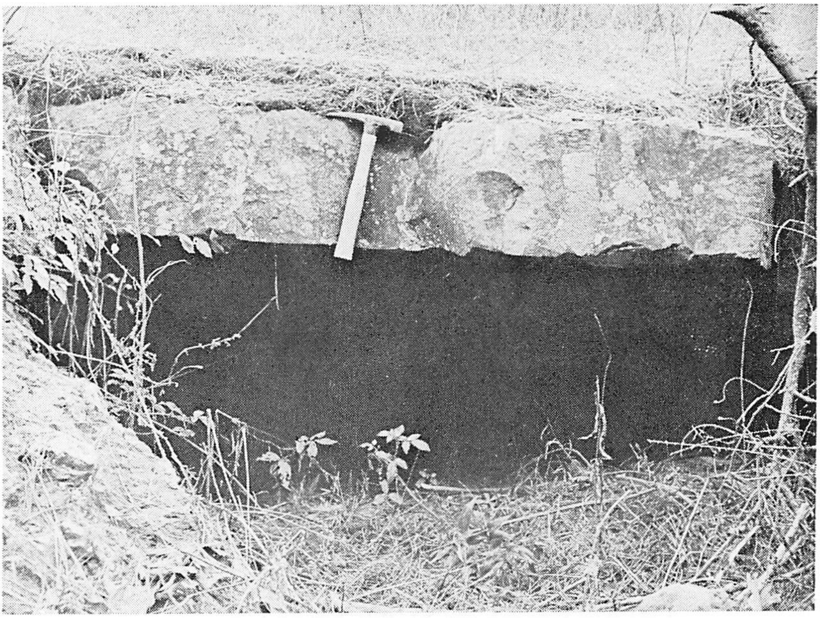


Figure 4.—Entrance to cave located west of State Highway 43 (SW.1/4, NE.1/4, NE.1/4, Sec.9, T.14 N., R.7 E.) 1.7 miles north of the intersection of State Highway 12 at Kosciusko. Photo by C. H. McMillan.

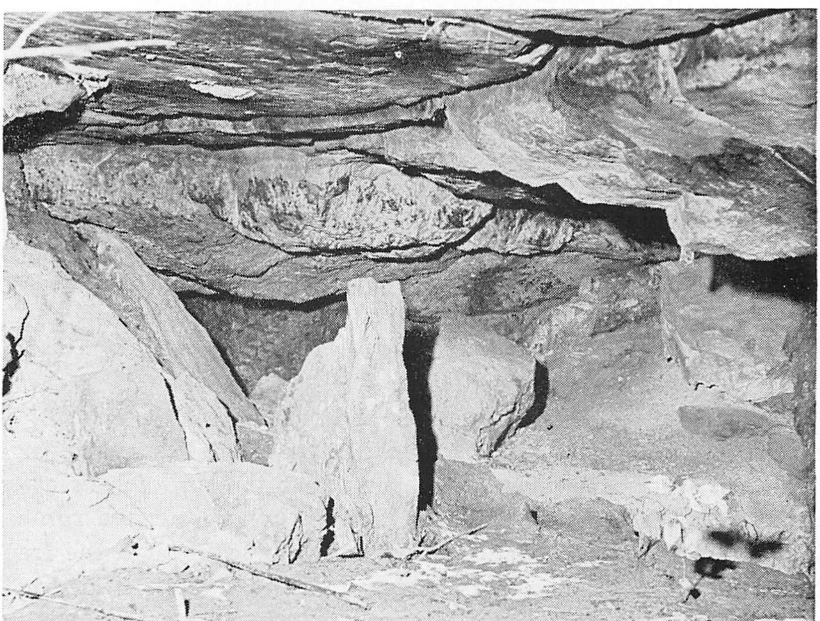


Figure 5.—Interior of cave located west of State Highway 43 (SW.1/4, NE.1/4, NE.1/4, Sec.9, T.14 N., R.7 E.) 1.7 miles north of the intersection of State Highway 12 at Kosciusko. Height from floor to ceiling approximately 2.5 feet. Photo by C. H. McMillan.

Figure 3 is a diagrammatic sketch of a more or less typical cave and sink hole. This cave, which is easily accessible, is located about 100 yards west of State Highway 43 on the west facing slope of a hill in a pasture (SW.¼, NE.¼, NE.¼, Sec.9, T.14 N., R.7 E.) at a distance 1.7 miles north of the intersection of State Highway 12 at Kosciusko. The cave entrance is about six feet wide and about two feet high (Figure 4). The cave consists of several interconnected tunnels leading off in different directions (Figure 5). At a few places, the height from floor to ceiling is as much as three or four feet. The cave extends into the hillside about 20 feet, but at one time it probably extended 30 feet or more into the hill. Nearby is a sink hole that is about 25 feet wide, 35 feet long, and a few feet deep. This large sink hole suggests that the cave was once much more extensive.

Another easily accessible cave of the same approximate size is located near an east-west road on the south facing slope of a steep hill (NE.¼, SE.¼, NW.¼, Sec.29, T.16 N., R.6 E.) at a distance of about a mile west of the junction of a north-south road across Zilpha Creek bottom.

An area that contains several caves and sink holes is on the northwest facing slope of a ridge overlooking the Big Black River flood plain (SW.¼, SE.¼, Sec.4, T.16 N., R.6 E.) at a distance of about a mile west of State Highway 35. This area is accessible only by log roads.

Several of the caves examined were reported to be larger and consist of several interconnected rooms. The presence of relatively large sink holes in these areas suggests that the larger caves may have once existed. Perhaps, the clearing of land has accelerated erosion and has led to the destruction of the larger caves. No large caverns are expected to be found due to their mode of development.

STRATIGRAPHY

GENERAL STATEMENT

The bedrock strata exposed in Attala County are a part of the Eocene series of the Tertiary system. The sediments are subdivided into seven units of formational rank. The units from the base upward are the Hatchetigbee formation of the Wilcox group and the Tallahatta, Winona, Zilpha, Kosciusko, Wautubbee, and

FIGURE 6
GENERALIZED SECTION OF EXPOSED STRATA IN ATTALA COUNTY

ERA	SYSTEM	SERIES	GROUP	Stratigraphic unit	Member	Thickness (feet)	Formation thickness (feet)	LITHOLOGIC CHARACTER
CENOZOIC	QUATERNARY	PLEISTOCENE AND RECENT		Colluvium and soil		0-10		Sand, silt, clay, and fragmental rock altered from bedrock by weathering processes and having undergone no transportation or having moved down the valleys relatively short distances.
CENOZOIC	QUATERNARY	PLEISTOCENE AND RECENT		Alluvium		0-25		Sand, silt, clay, and fragmental rock that underlie the flood plains or first bottoms of the major-streams and their larger tributaries.
CENOZOIC	QUATERNARY	PLEISTOCENE AND RECENT		Terrace deposits		0-20		Sand, silt, clay, and fragmental rock that underlie terraces or second bottoms associated with the major streams.
CENOZOIC	QUATERNARY	PLEISTOCENE AND RECENT		Loess		0-10		Brown to light-brown, clayey, sandy silt that forms a thin veneer or is in scattered remnant pockets on the hill tops and ridge tops in the western and southwestern parts of the County.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Cockfield formation		Up to 150		Chiefly sand containing lenses of silt and silty clay. Estimated total thickness ranges from 350 to 400 feet in Madison County. Only lower part exposed.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Wautubbee formation		80-100		Chiefly carbonaceous clay shale and clay, silt and non-glauconitic sand. At places contains small lenses, stringers, and pockets of glauconitic sand and lenses of glauconitic clay shale.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Kosciusko formation		240-280		A heterogeneous body made up chiefly of sand, silt, clay shale, and clay. Sand is the predominate facies, and the silt-clay facies are developed locally as lenticular bodies. Sand is prominent in the lower part and silt-clay in the middle.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Zilpha Formation	Upper clay shale and silt member	0-25	15-105	Chiefly carbonaceous clay shales and silts. Locally the strata contains fossil plant remains. Preserved only locally.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Zilpha Formation	Middle clay member	0-50	15-105	Relatively sand-and silt-free clay, that locally contains thin beds and pockets of silt and rarely a thin bed of glauconite and/or thin bed of concretionary siderite. Entire thickness preserved only locally.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Zilpha Formation	Zama member (new name)	30	15-105	Interbedded relatively sand-and silt-free clay, glauconite, glauconitic silt, glauconitic sandy clay, glauconitic clayey sand and concretionary siderite. Defined by prominent glauconite bed at top.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Winona formation		15-35		Glauconitic sand and green sand, locally fossiliferous; weathers to a red-brown or brick-red rusty sand that at places contains irregular thin beds and masses of limonitic sandstone and sandy ironstone.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Tallahatta Formation	Neshoba sand member	75-140	160-200	Chiefly sand containing lenses of clay shale, silt, and clay. Thickens to the northwest along strike at the expense of the Basic City shale.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Tallahatta Formation	Basic City shale member	10-85	160-200	Siliceous claystone, clay shale, siliceous sand, and quartzitic siltstone and sandstone. Thins to the northwest along strike. Interlenses and intertongues with the Neshoba sand.
CENOZOIC	TERTIARY	EOCENE	CLAIBORNE	Tallahatta Formation	Meridian sand member	0-40	160-200	Chiefly sand containing lenses of Basic City-type sediments and of clay shale and clay. Thins to the northwest along strike and may pinch out in northeastern Attala County or in southeastern Montgomery County.
CENOZOIC	TERTIARY	EOCENE	WILCOX	Hatchetigbee formation		Up to 75		A heterogeneous body made up of alternations and successions of clay, silt, sand, and lignite—the clays and silts predominating. Estimated total thickness ranges from 150 to 200 feet in Winston County. Only upper part exposed.

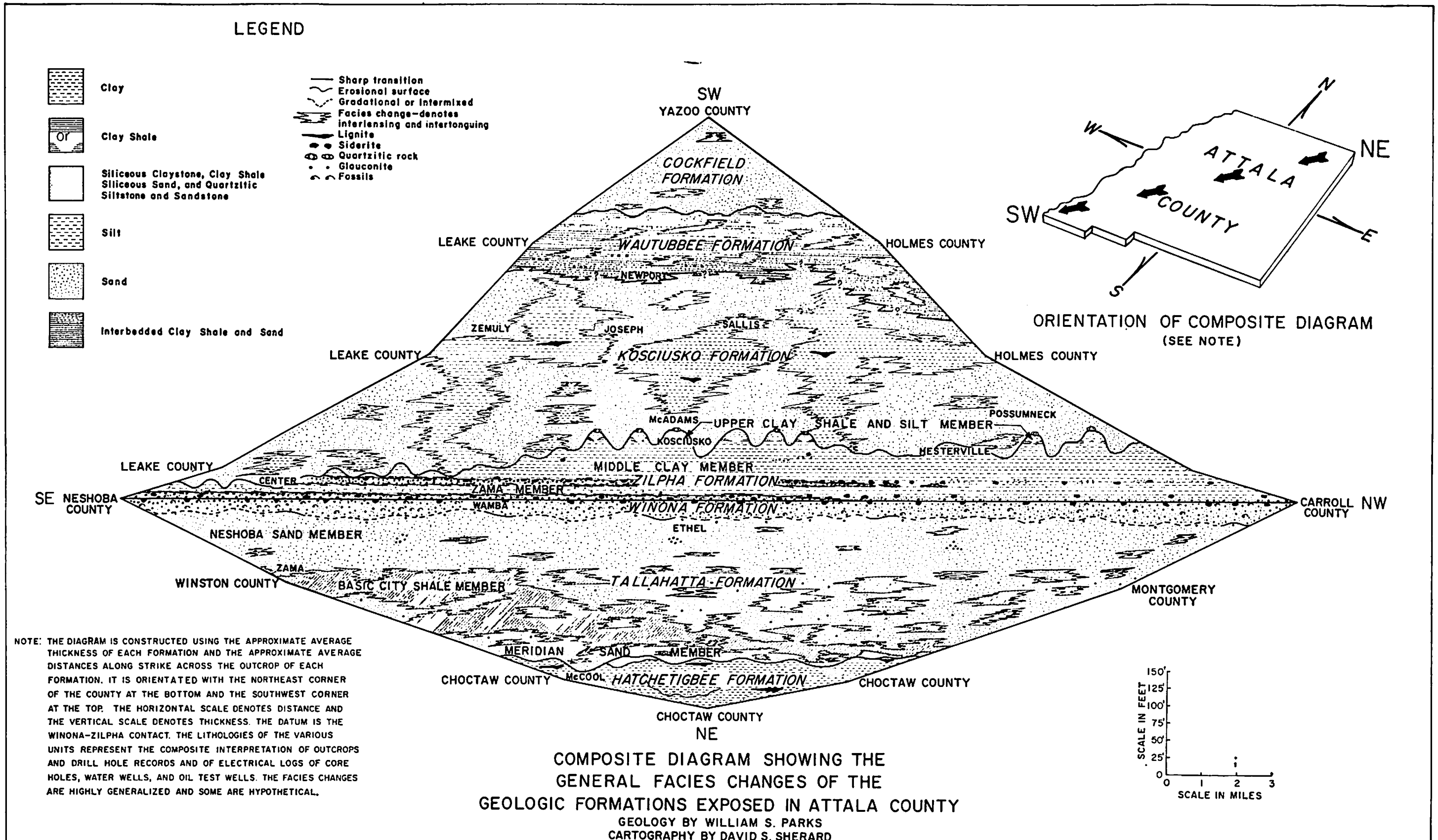


Figure 7.—Composite diagram showing generally the facies changes of the geologic formations exposed in Attala County.

Cockfield formations of the Claiborne group. Three members or facies are recognizable in the Tallahatta formation — a basal Meridian sand, a middle Basic City shale, and an upper Neshoba sand. Also, three members or facies are recognizable in the Zilpha formation — a basal Zama member (new name), a Middle clay, and an Upper clay shale and silt. Figure 6 is a generalized section of exposed strata; and Figure 7 is a composite section showing generally the facies changes along strike.

The geologic column includes sediments that were deposited in both marine and non-marine environs representing several transgressions and regressions of the sea. The deposits consist chiefly of sand, clay, silt, claystone, siltstone, and sandstone. The oldest strata crop out at the lower elevations in the northeastern part of the County. To the west-southwest in the general direction of dip, the sediments are successively younger, the youngest being at the higher elevations in the southwestern part. The total composite thickness of the exposed section of Attala County is estimated to be about 850 feet.

In many areas, the bedrock is covered by surficial materials which make up the alluvium and terrace deposits, colluvium, loess, and soils. These materials are a part of the Pleistocene series and Recent series of the Quaternary system.

WILCOX GROUP

HATCHETIGBEE FORMATION

The Hatchetigbee formation crops out at the lower elevations in the northeastern and extreme eastern parts of the County (Plate 1). The terrane developed on the formation is characterized by rolling hills of low to moderate relief.

Exposures of Hatchetigbee sediments are few and generally poor. The fine-grained materials characteristically develop a deep soil cover. At the lowest elevations, the formation is covered at many places by a veneer of alluvium or terrace deposits. Outcrops are commonly found in the deeper and fresher road cuts and in excavations where overburden has been removed. Because of limited exposures, the drill hole records were used in determining Hatchetigbee lithologies. Test Holes 18 and 19 and Core Holes 1, 2, and 5 penetrated surface and near surface beds.

Only the uppermost part of the Hatchetigbee formation is exposed in Attala County. That portion of the formation at the surface consists of a heterogeneous body made up of alternations and successions of clay, silt, sand, and lignite — the clays and silts predominating. The sediments are complexly interlensed and intertongued, and individual beds commonly grade both laterally and vertically into other materials in relatively short distances.

Although there is much variation in the Hatchetigbee clays due in large part to differences in the content of silt and of lignite and carbonaceous materials, the clays may be classed into several, more or less general, descriptive types — (1) dark-gray to black, slightly silty to silty, variably lignitic, plastic clays; (2) gray or blue-gray to dark-gray, moderately silty to silty, plastic clays; (3) light-gray, slightly silty to moderately silty, plastic clays; (4) dark-gray to black, silty and sandy clays and clay shales; and (5) dark-green to green, silty clays. The silts are commonly light-gray to gray and are both massive bedded and laminated.

When fresh, the sands are light-gray to white, but may be gray to dark-gray when they are silty, clayey, or lignitic. They weather to various colors — buff, yellow, tan, brown, and red-brown. The sands are of a wide range of grain size, but most of those examined were of the finer sizes. In general, the sands appear to be locally developed and to be present only as subordinate beds associated with the silts and clays.

The lignites are brown-black and variously impure and range from a feather edge up to several feet in thickness. Although the lignite beds may be present in the sands, they are more commonly associated with the clays and silts. Because they disintegrate readily on weathering and are commonly concealed by soil creep, slope wash, or slump, the lignites are rarely found at the surface. At places, thicker beds may be represented only by thin, weathered streaks or "smuts."

The entire thickness of the formation, which is exposed to the east in Winston County, is estimated by Mellen[1] to range from 150 to 200 feet. The thickness of that portion of the formation at the surface in Attala County is estimated to be about 75 feet.

CLAIBORNE GROUP

TALLAHATTA FORMATION

The Tallahatta formation crops out in a broad, northwest-southeast belt across a large part of the northeastern half of the County (Plate 1). The terrane developed on the Tallahatta is a sand and clay hills topography. Relief is greatest in the southern part of the outcrop belt where siliceous claystone and quartzitic rock are more prominently developed in the middle of the formation.

The Tallahatta formation, the basal unit of the Claiborne group, overlies the Hatchetigbee formation, the uppermost unit of the Wilcox group. Where well exposed, the contact is a sharp, slightly irregular to irregular boundary marking an erosional surface between the two units. Generally, basal Tallahatta sands overlie clay, silt, sand, or lignite of the Hatchetigbee formation.

Exposures of the Tallahatta sediments are numerous and many are excellent. Outcrops are commonly found in road cuts and in borrow pits. Test Holes 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 17 penetrated Tallahatta materials.

In the southern part of the outcrop belt, the Tallahatta formation may be divided into three members or facies — a basal Meridian sand, a middle Basic City shale, and an upper Neshoba sand. Northwestward along strike, the Meridian sand member thins and may pinch out in northeastern Attala County or in southeastern Montgomery County. Also northwestward along strike, the Basic City shale interlenses and intertongues with the Neshoba sand and loses its distinctive character as a unit. In northern Attala County, the Basic City shale member is replaced by a thickened Neshoba sand in which the Basic City is represented by locally developed lenses and by a thin basal section.

The Tallahatta formation ranges from 160 to 200 feet in thickness.

MERIDIAN SAND MEMBER

The Meridian member consists chiefly of sand containing thin interbeds and locally developed lenses of clay shale and clay. The Meridian also contains some lenses of materials that closely resemble the more typical sediments of the overlying Basic City. The ratio of sand to clay shale and clay in the Meridian is variable from place to place, but at most localities the member consists of sand having a few clay partings and scattered clay pellets. At some places it may contain several clay shale lenses and many thin interbeds of clay.

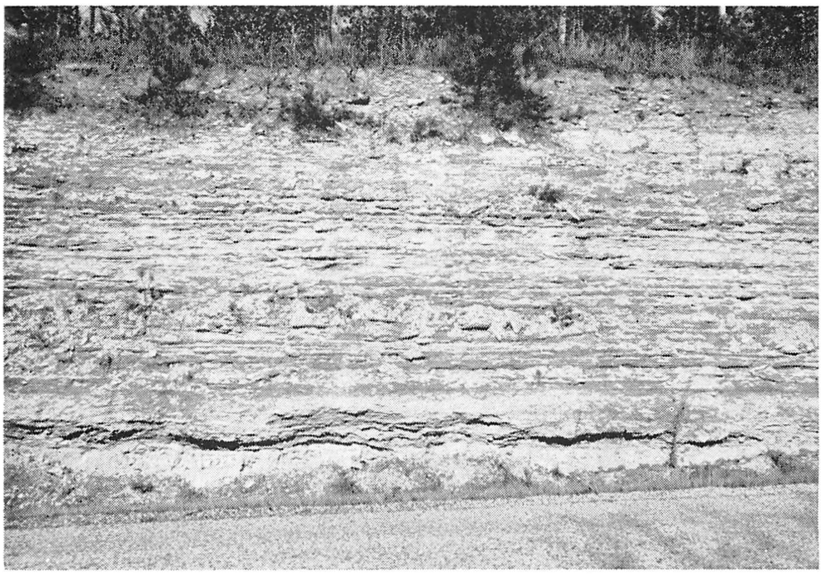


Figure 8.—Basic City claystone exposed in cut of State Highway 14 (NW.1/4, NE.1/4, Sec.24, T.14 N., R.9 E.) about a half mile southwest of the Winston-Attala County line. December 6, 1962.

The sands are gray to light-gray weathering to buff, yellow, tan, yellow-brown, and red-brown and are massive to highly cross-bedded, and commonly micaceous to very micaceous. They are generally fine- to medium- or medium-grained, but locally they may be fine- or coarse-grained. Fragments of silicified wood and/or scattered quartz pebbles and cobbles are found at some localities. The clay shales and clays are gray to dark-gray or black weathering buff to white and are sandy, silty, and locally carbonaceous and lignitic.

The Meridian ranges up to 40 feet in thickness. The member thins to the northwest along strike and may pinch out in northeastern Attala County or in southeastern Montgomery County.

BASIC CITY SHALE MEMBER

The Basic City member consists chiefly of siliceous claystone, semi-consolidated siliceous sand, clay shale, and thin interbeds of quartzitic rock. Locally the Basic City contains lenses of non-consolidated sand.

The claystones and clay shales are blue-gray to green-gray or dark-gray to black, silty, sandy, finely micaceous and locally carbonaceous. On weathering the claystones become a light-colored brittle rock that is relatively light-weight and breaks with a subconchoidal fracture (Figure 8).

The quartzitic rocks are both siliceous siltstones and siliceous sandstones, the former being more abundant. The rocks are semi-indurated to indurated, and some are cemented to dense hard quartzite. They vary in thickness from less than an inch to as much as a few feet, but those of more than a foot thick are uncommon. At places there are only a few thin layers of quartzitic rock in the sediments, and at others there are many thin interbeds.

The semi-consolidated siliceous sands are green-yellow to buff, fine-grained, and silty. The non-consolidated sands are light-gray to buff, weathering to yellow, yellow-orange, pink, purple, yellow-brown, and red-brown and are massive to cross-bedded, and generally fine-grained. They commonly contain pellets, partings, and stringers of clay.

Fucoidal structures are found in abundance in the more typical Basic City materials. Glauconite is present disseminated throughout the sediments in varying concentrations and is also present locally in laminae or thin beds.

The Basic City shale member varies from 10 to 85 feet in thickness. The member is best developed in the southern part of the outcrop belt. To the northwest along strike, it interlenses and intertongues with the Neshoba sand member. In the northern part of the outcrop belt it is represented by locally developed lenses in a thickened Neshoba sand and by a thin basal section.

NESHOBA SAND MEMBER

The Neshoba member consists chiefly of sand containing pellets, partings, and stringers of clay. Locally the member contains lenses of silt, clay, and clay shale.

The sands are light-gray to white weathering to buff, yellow, pink, purple, yellow-brown, and red-brown and are massive, even-bedded, irregular bedded, or cross-bedded. They range from very fine-grained to fine- to medium-grained, but are more commonly fine-grained. Generally the sands are non-glauconitic or sparingly glauconitic.

The Neshoba sand member varies from 75 to 140 feet in thickness. The member thickens to the northwest along strike inversely to the thickness of the Basic City shale member.

WINONA FORMATION

The Winona formation crops out in a narrow, highly irregular belt across Attala County, extending generally from the southeast corner to the northwest corner (Plate 1). The formation forms a cuesta along most of its principal outcrop belt. This cuesta is characterized by relatively broad flat-topped ridges and hills that commonly have a thin capping of weathered Zilpha clay. West of the outcrop belt where the Winona is present at lower elevations beneath hills developed on Zilpha clay, the

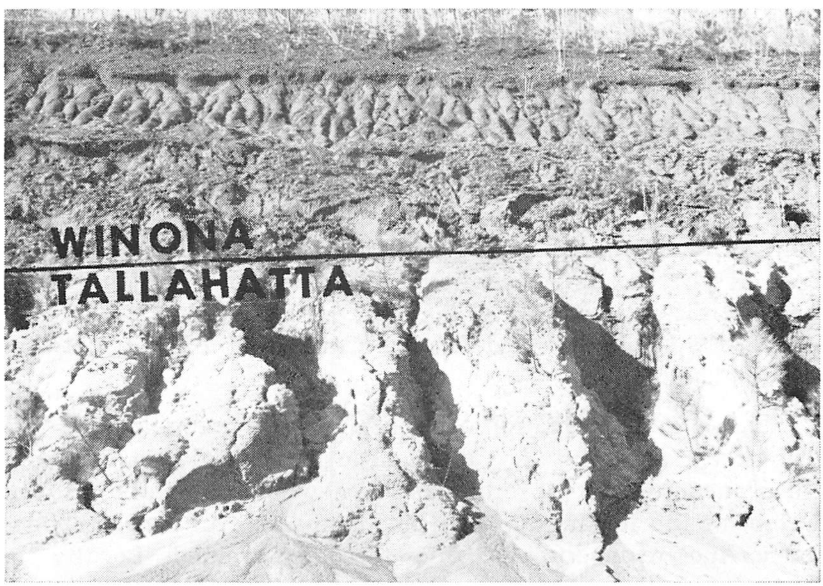


Figure 9.—Tallahatta-Winona contact exposed in cut of State Highway 19 (Center NW.1/4, Sec.22, T.13 N., R.9 E.) 0.7 mile southeast of Zama. April 2, 1963.

formation forms relatively broad, flat-bottomed valleys. East of the outcrop belt where small outliers of Winona are present at higher elevations, the formation forms caps on several isolated hills underlain by Tallahatta sands. These hills are commonly high relief, steep sided, and more or less conical in shape.

The Winona formation overlies the Neshoba sand member of the Tallahatta formation. The sediments of the two units contrast sharply. Commonly non-glauconitic to sparingly glauconitic, fine-grained sand of the Neshoba is overlain by glauconitic to very glauconitic, fine- to medium- or fine- to coarse-grained, variably silty, rusty sand of the Winona (Figure 9). At most localities, the contact is indistinctly defined, especially in weathered exposures, and there is much variation in the contact from place to place. Generally it can be placed within a three to five foot interval. At some localities, the sediments of the two units are intimately intermixed in the contact interval, and at others there appears to be a relatively uniform gradation. At a few places, the contact is a sharply defined, slightly irregular, erosional surface.

Exposures of Winona materials are numerous and many are excellent, but outcrops are commonly of deeply weathered sediments. Rarely unweathered materials are found in relatively deep, freshly made excavations. At several places, the entire formation is exposed in a single outcrop. Test Holes 1, 2, 3, 5, 10, 11, 12, 13, 14, 15, 17, and 20 and Core Hole AE-3 penetrated Winona sediments.

The Winona formation consists chiefly of green-gray to dark gray-green, variably silty, glauconitic to very glauconitic sand. The glauconite content diminishes somewhat from the top to the bottom of the formation. The sand is massive to poorly bedded and is fine- to medium- or fine- to coarse-grained. Locally the formation is fossiliferous, and at places it contains thin shell beds.

At the surface, the Winona is characterized by red-brown to dark brick-red, rusty, glauconitic sand that at many places contains irregular thin beds and masses of knobby or knotty, concretionary, limonitic sandstone and sandy ironstone (Figure 10). Generally, the limonitic sandstones and sandy ironstones are more prominently developed in the upper part of the unit. Fossils are poorly preserved and are commonly present as limonitic casts and internal molds. At some localities, the sand contains an abundance of fucoidal structures.

The Winona formation ranges from 15 to 35 feet in thickness, but averages about 25 feet. Although the Winona may thicken or thin from place to place, it thickens generally to the northwest along strike and to the west-southwest down dip in the subsurface.

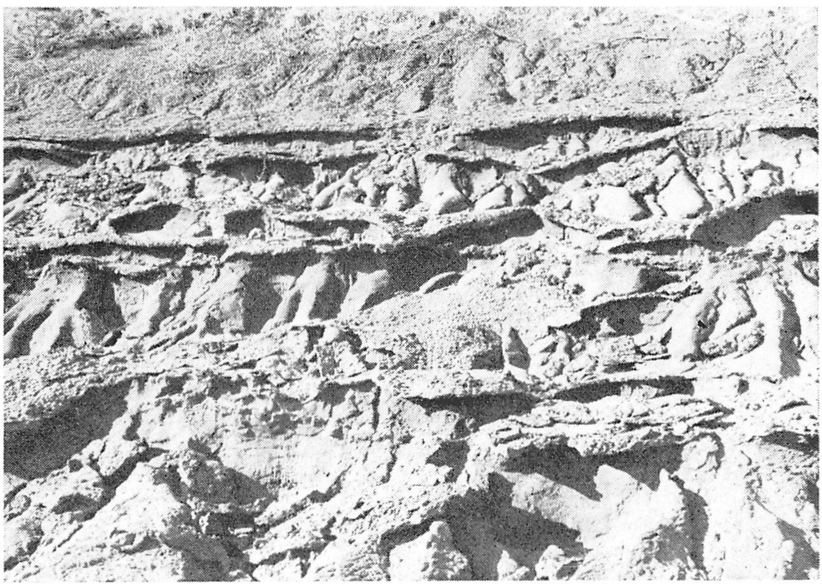


Figure 10.—Typical weathered Winona exposed in cut of State Highway 19 (Center NW.1/4, Sec.22, T.13 N., R.9 E.) 0.7 mile southeast of Zama. April 2, 1963.

ZILPHA FORMATION

The Zilpha formation crops out in a moderately broad, highly irregular, northwest-southeast belt through the southeastern, central, and northwestern parts of the County (Plate 1). The formation forms a bench topography west of the cuesta developed on the Winona formation. The terrane is characterized by undulating, flat-topped ridges and rounded hills of low to moderate relief.

The Zilpha formation overlies the Winona formation. Where well exposed, the Winona-Zilpha contact is more or less distinctly defined and is transitional (Figure 11). Generally the contact can be placed within a one to three foot interval.

Over much of the area, the top of the Winona formation is marked by a more or less discontinuous bed of knotty or knobby limonitic sandstone or sandy ironstone that at many places forms a distinctive ledge. This bed varies from less than a foot to as much as five feet, but more commonly it is two or three feet thick. It is commonly abundantly fossiliferous, containing poorly preserved molds and casts of fossils. Even where the overlying

Figure 11.—Winona-Zilpha contact exposed in cut of the road to Bucksnort Hill (SW.1/4, SE.1/4, Sec.8, T.16 N., R.6 E.) about a mile north-northwest of the junction of a road south. April 2, 1963.

Zilpha is badly weathered or is reduced to a clayey soil, this ledge is very useful in determining the contact. In the subsurface, a fossiliferous siderite bed of a foot to two and a half feet in thickness was encountered in a few of the Test Holes at the top of the Winona formation. At several other places a fossil shell bed was encountered at this horizon.

At most places, the basal few feet of the Zilpha formation consists of glauconitic sandy clay or clayey sand. In the southeastern half of the outcrop belt, the contact position must be determined with care, especially in poor exposures, because the lower 10 feet of the Zilpha is locally very glauconitic and sandy and silty and contains thin discontinuous siderite beds that form ledges. At places the weathered siderite beds closely resemble the limonitic sandstone or sandy ironstone at the top of the Winona. In the northwestern half of the outcrop belt, the lower sandy and silty, glauconitic facies of the Zilpha is replaced in large part by a clay facies, and the determination of the contact is more readily made.

Because the Winona-Zilpha contact is easily recognizable at many places at the surface and is readily picked on electrical logs, it is a very useful reference and mapping datum.

Exposures of Zilpha sediments are numerous, and many are excellent. Outcrops are commonly found in road cuts and ditches. Test Holes 1, 2, 3, 5, 10, 11, 12, 13, 14, 15, 17, 20, 21, and 23 and Core Holes 3 and 6 penetrated Zilpha strata.

The Zilpha formation consists chiefly of carbonaceous clay, clay shale, and silt with subordinate interbeds of glauconite and siderite. In Attala County the formation can be subdivided into three units — a lower Zama member (new name), a Middle clay member, and an Upper clay shale and silt member. Figure 14 shows the relationships of these three units.

The thickness of the Zilpha formation varies greatly over short distances along strike because of the erosional surface at its top. Along the main outcrop belt, the formation ranges from about 15 to as much as 105 feet or more in thickness, but averages about 40 feet thick. In the up dip direction, the Zilpha is eroded almost entirely at places, and as little as five feet or less of Zilpha materials may separate the Winona from the Kosciusko. On the basis of electrical logs, the formation increases in thickness down dip to an estimated 180 feet in southwestern Attala County.

ZAMA MEMBER*

A distinctive lithologic unit is recognizable at the base of the Zilpha formation in the southern half of its outcrop area in Attala County. It consists chiefly of relatively sand- and silt-free

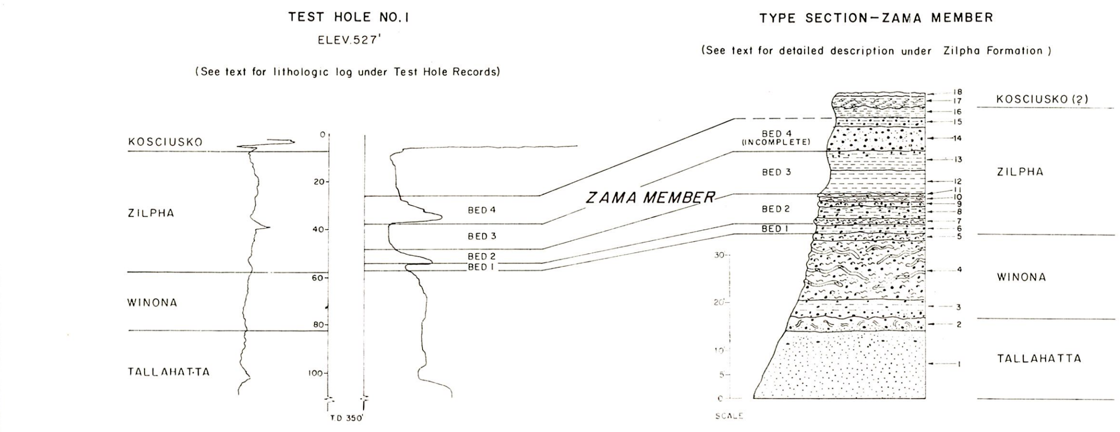
*Zama is not pre-empted as a stratigraphic name and has been reserved for the present usage (George V. Cohee, Chairman, Geologic Names Committee, U. S. Geological Survey, letter of March 12, 1963).

clay, glauconite, glauconitic silt, glauconitic sandy clay, glauconitic clayey sand, and concretionary siderite. This unit is herein named the Zama member for a small village in southeastern Attala County.

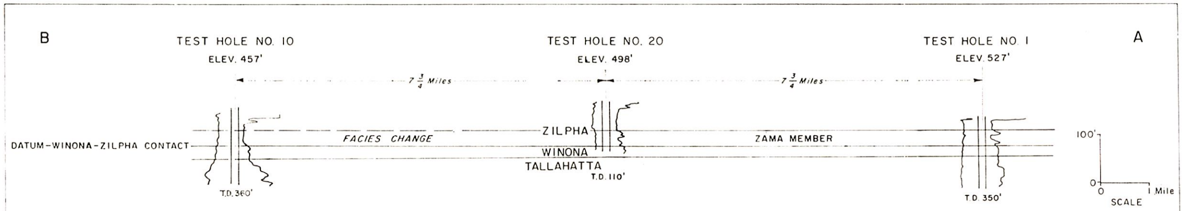
The Zama member includes all strata in the Zilpha formation above the top of the Winona formation and below the top of a prominent glauconite bed that defines the uppermost limits of the member. The type section for the Zama member is exposed in the cuts of State Highway 19 at the top of a high hill (SE.¼, NW.¼, Sec.22, T.13 N., R.9 E.) at a distance of about a mile southeast of the intersection of the road west to Zama.

Composite section in several cuts along State Highway 19 (SE.¼, NW.¼, Sec.22, T.13 N., R.9 E.) at a distance of 0.6 to 1.0 mile southeast of the intersection of the road west to Zama:

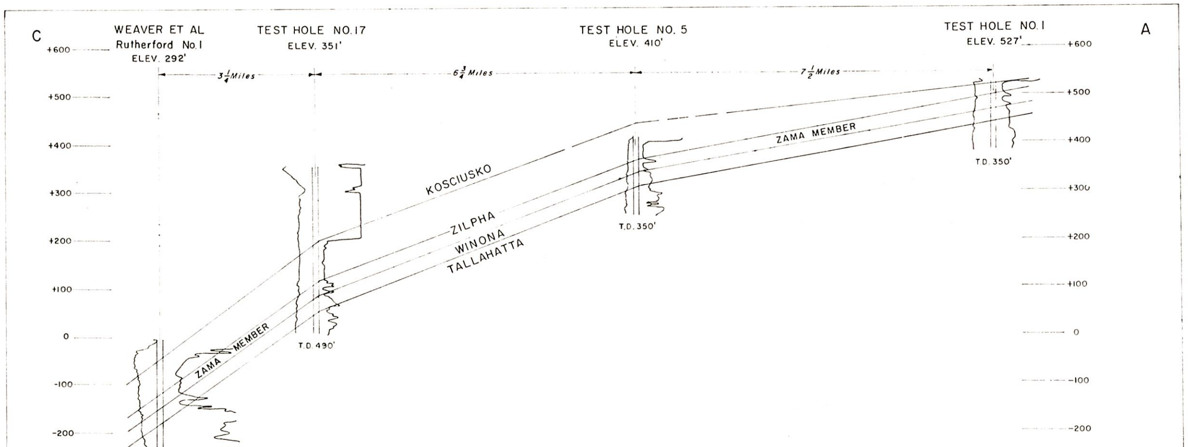
	Feet	Feet
Kosciusko formation (?)		3.0
18. Sand, red-brown, fine-grained, silty	0.5	
17. Limonitic claystone, yellow to yellow-brown to brown-black, fragmental; indurated equivalent of a yellow-brown clay; follows the contour of the hilltop	2.5	
Zilpha formation (Zama member)		26.0
16. Clay, light gray mottled red to purple, silty, sandy	2.0	
15. Clay, light-gray mottled red, glauconitic; probably residuum from weathered glauconite	2.0	
14. Glauconite, dark green-gray, sandy, clayey; contains thin discontinuous bed of soft white glauconitic siltstone	5.0	
13. Clay, dark-gray weathers brown-gray to gray, blocky, slightly silty; contains some laminae of silt and some pockets and small lenses of glauconite in upper part	4.0	
12. Clay, olive-gray to light-gray, subconchoidally fracturing; conspicuously laminated in part, but lamination discontinuous in cut	5.0	
11. Ironstone, yellow-brown to brown-black, concretionary; probably altered siderite; forms ledge; up to	0.5	
10. Clay, light green-gray to buff, sandy, glauconitic; contains many ironstone concretions (probably altered siderite)	1.0	



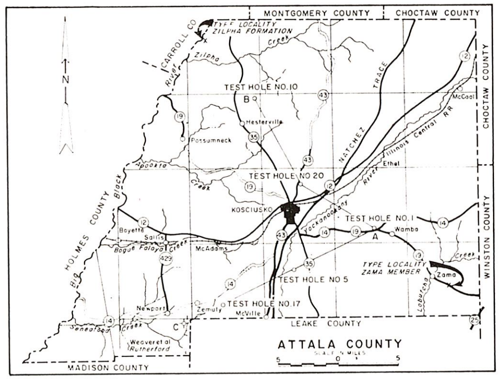
PHOTOGRAPH OF TYPE SECTION



STRATIGRAPHIC STRIKE SECTION



STRATIGRAPHIC—STRUCTURE DIP SECTION



CORRELATION OF THE ZAMA MEMBER

GEOLOGY BY WILLIAM S. PARKS
CARTOGRAPHY BY DAVID S. SHERARD

MARCH 1963

9. Limonitic sandstone, yellow-brown to dark red-brown, very glauconitic; contains many limonitic molds and casts of fossils; forms ledge	1.0	
8. Clay, light green-gray to buff, very sandy, glauconitic	2.5	
7. Limonitic silt, yellow-brown to dark red-brown, sandy, glauconitic; forms ledge	1.0	
6. Sand, light green-gray, very clayey, very glauconitic, coarse- to very coarse-grained	2.0	
Winona formation		16.5
5. Limonitic sandstone, yellow-brown, very glauconitic; contains limonitic molds and casts of fossils; forms weak ledge; up to	1.5	
4. Sand, green-gray to dark gray-green weathers yellow-brown to dark red-brown, fine- to coarse-grained, silty, rusty, very glauconitic; contains many fucoidal structures; limonitic molds and casts of fossils abundant in local concentration; contains several irregular layers of knobby ironstone up to a few inches thick where deeply weathered	12.5	
3. Sand, light-gray to green-gray weathers yellow-brown to red-brown, fine- to coarse-grained, silty, rusty, glauconitic to very glauconitic; base defined by thin, irregular layer of platy ironstone	3.5	
Tallahatta formation (Neshoba sand member)		17.0
2. Sand, light-gray to yellow weathers yellow-brown to purple-red to red-brown, fine- to coarse-grained, silty, sparingly glauconitic to glauconitic, sparingly micaceous; contains pellets and non-orientated tubes of light-gray clay and scattered grains of very coarse-grained sand	3.0	
1. Sand, light-gray to buff weathers yellow to orange-red to red-brown, fine-grained grading to fine- to medium-grained in upper part, sparingly micaceous; contains some clay inclusions and is locally sparingly glauconitic in upper few feet; badly weathered in lower portion of cut (start section in ditch at base of cut on southwest side of highway)	14.0	
Total section		63.5

Plate 2 shows the correlation of the type section of the Zama member with an electrical log of a key Test Hole and both down dip and along strike electrical log correlations from this Test Hole.

In the southeastern half of the Zilpha outcrop area in Attala County, four distinctive beds are recognizable in the Zama member — (1) a basal 2 or 3 feet of glauconitic sandy clay or clayey sand; (2) 6 to 8 feet of thin-bedded intercalated glauconitic sandy clay, glauconitic clayey sand, glauconite, glauconitic silt, and concretionary siderite; (3) 8 to 10 feet of gray to light-gray, subconchoidally fracturing clay and/or dark-gray to gray, blocky clay; (4) an upper 10 to 12 feet of dark green-gray glauconite and glauconitic silt with thin interbeds of concretionary siderite.

To the northwest along strike, the sandy and silty, glauconitic facies of the Zama member for the most part gives way to a clay facies, and the upper glauconite bed becomes lenticular and loses its distinctive character. In northwestern Attala County, the upper glauconite bed is not recognizable. Consequently, in the absence of this marker bed, the member loses its identity.

The Zama member was found to be fossiliferous at several localities. Locally the glauconite and siderite beds contain an abundant fauna. On the outcrop, the fossils are generally poorly preserved and are found as limonitic molds and casts in weathered materials.

Along the outcrop belt, the Zama member is consistently about 30 feet in thickness. Down dip the unit thickens at a relatively uniform rate to about 50 feet in extreme southwestern Attala County.

The Zama member was not studied in detail in areas other than Attala County during the present investigation. However, it was found to be recognizable at the surface in northeastern Leake County and as a distinctive unit on electrical logs of core holes and oil test wells drilled in southwestern Holmes County.

The Zama member was found to be especially important in the study of the economic geology of Attala County, because of its clay, siderite, and glauconite. Also the prominent glauconite bed at the top of the member proved to be an excellent reference and mapping datum for subsurface correlations in the southwestern half of the County. Oil companies working in the area have used the upper glauconite bed as a datum in structural mapping. It has been commonly referred to as the "top Tallahatta," or "Winona-Tallahatta."

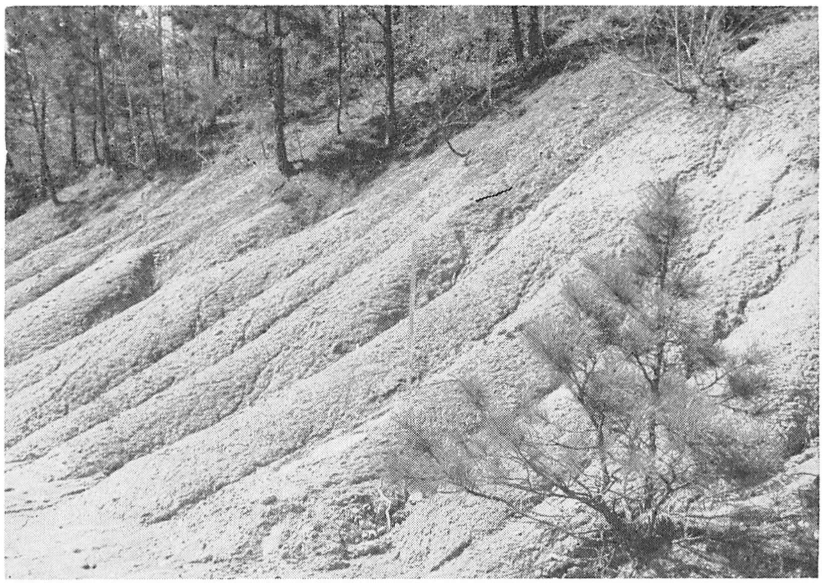


Figure 12.—Typical weathering Zilpha clay exposed in cut of State Highway 35 (NE.1/4, SW.1/4, Sec.5, T.14 N., R.7 E.) about 3 miles northwest of the intersection of State Highway 12 at Kosciusko. April 2, 1963.

MIDDLE CLAY MEMBER

The Middle clay member consists of relatively sand- and silt-free, blocky clay. The clay is dark-gray to dark brown-gray or brown-black when fresh, but it weathers brown-gray or chocolate-brown, then to gray or light-gray (Figure 12). The clay appears to be relatively uniform throughout, but locally it may contain a thin bed or pockets and laminae of silt and rarely a thin bed of glauconite and/or a thin discontinuous bed of concretionary siderite. Where the entire thickness is preserved, the Middle clay member is about 50 feet thick.

UPPER CLAY SHALE AND SILT MEMBER

The Upper clay shale and silt member is present only locally. At many places it was eroded by channeling during the deposition of basal Kosciusko sediments. Where present, the member consists of dark-gray to black weathering gray to light-gray or white, carbonaceous clay shales and silts (Figure 14). Locally the silty strata contain fossil plant remains.

At some localities where stratigraphic relations are not clear because of inadequate exposures and where basal Kosiusko sand contains a silt-clay facies, the upper Zilpha and the lower Kosciusko sediments are difficult to separate. Where present at the surface, the Upper clay shale and silt member ranges up to 20 feet or more in thickness.

Figure 13.—Zilpha-Kosciusko contact exposed in a cut of State Highway 35 (NW.1/4, NE.1/4, Sec.8, T.14 N., R.7 E.) about 2 miles northwest of the intersection of State Highway 12 at Kosciusko. April 2, 1963.

KOSCIUSKO FORMATION

The Kosciusko formation crops out in a broad, northwest-southeast belt across a large part of the southwestern half of the County (Plate 1). The terrane developed on the Kosciusko sediments is a sand and clay hills topography. The more prominent topographic features are a moderate to high relief cuesta formed on the lower sands along most of the northeastern limits of the outcrop belt, and a low to moderate relief terrane formed on the silt-clay facies in the area northwest of and south and southeast of McAdams.

The Kosciusko formation overlies the Zilpha formation. At most places the sediments of the two units contrast sharply. Commonly, Zilpha clays, clay shales, or silts are overlain by basal Kosciusko sands. Where well exposed, the contact is a sharply defined, irregular erosional surface (Figure 13). At several places, it is evident that the basal Kosciusko sand was deposited in channels eroded on Zilpha strata. At a few localities, the basal Kosciusko sands contain lenses of clay or silt or are replaced by a silt-clay facies, and these clayey and silty strata overlie the Upper clay shale and silt member of the Zilpha formation. At these places, startigraphic relationships are commonly uncertain because of inadequate exposures, and the strata of the upper Zilpha and the lower Kosciusko are difficult to separate.

Locally along strike layers of quartzitic rock are present associated with the Zilpha-Kosciusko contact. Everywhere examined, the rock overlies leached silts of the Upper clay shale and silt member of the Zilpha formation. Rarely is an outcrop found that shows the stratigraphic relationship of the quartzite clearly. The best exposure is in the new cuts of State Highway 43 (NE.¼, NE.¼, Sec.9, T.14 N., R.7 E.) 1.8 miles north of the intersection of State Highway 12 at Kosciusko. Here a 25 foot exposure shows three layers of quartzitic rock overlain by weathered basal Kosciusko sand and underlain by leached silts of the upper Zilpha. The stratigraphic relationships of the quartzitic rock as determined by out-crop information, Core Hole AE-6 and Test Hole 20 are shown in Figure 14. For other details concerning this rock refer to the sections on "Cave and Sink Hole Development" and "Quartzitic Rock."

Exposures of Kosciusko sands are numerous, and many are excellent, especially in fresh roadcuts and in topping pits. Relatively deep soils have developed on the silt-clay facies, and exposures of these sediments are few and generally poor. Test Holes 12, 13, 14, 16, 17, 21, 22, 23 and Core Holes 4 and 7 penetrated Kosciusko materials.

The Kosciusko formation is a heterogeneous body that consists chiefly of sand, silt, clay shale and clay and subordinate beds of quartzitic rock and lignite. The formation is predominantly sand with the silt-clay facies developed as lenticular bodies. The most persistant sand interval, which ranges from

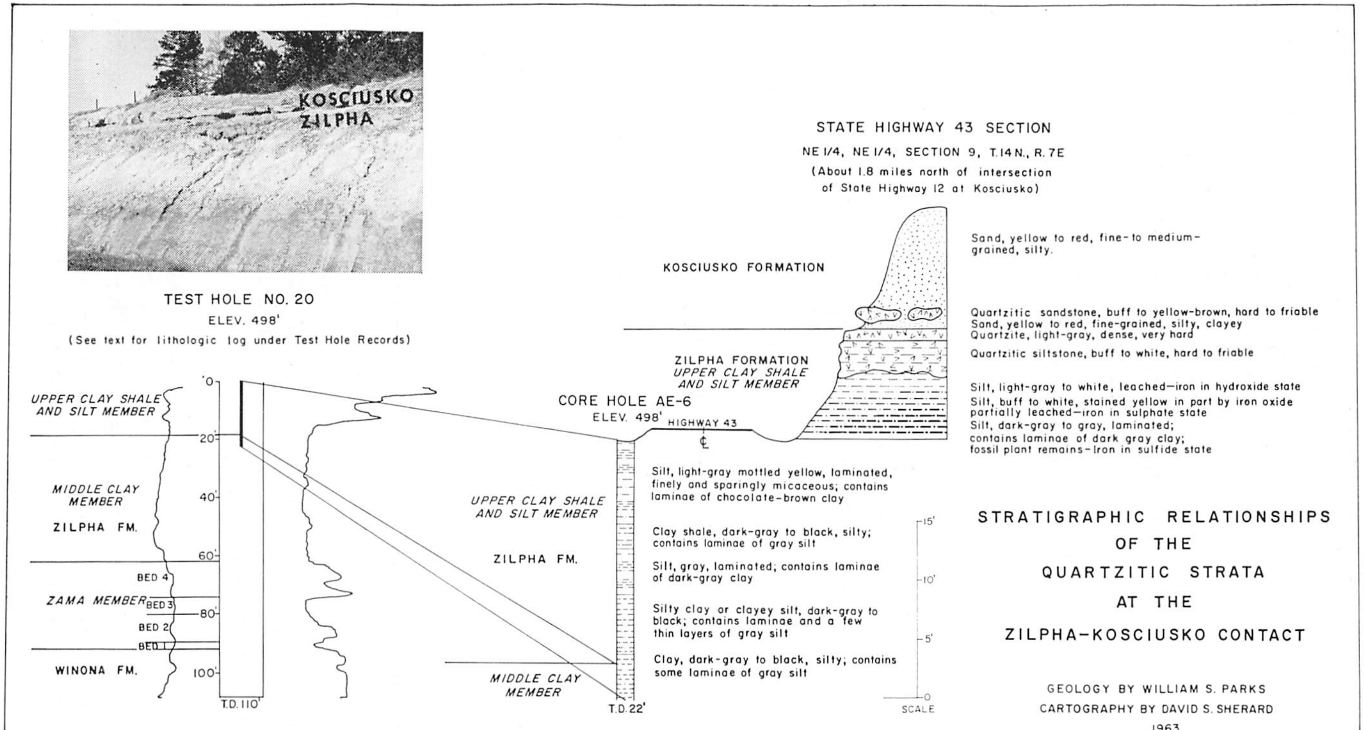


Figure 14.—Stratigraphic relationships of the quartzitic strata at the Zilpha-Kosciusko contact.

about 75 to 125 feet in thickness, is in the lower part of the formation. Upward in the section, the silt-clay facies becomes more prominent and at many places predominates over the sand facies, especially in the middle part of the Koscuisko. Locally, the silt-clay facies replaces almost the entire sand section from the top to the bottom of the formation. The transition from a sand facies to a silt-clay facies may take place within a distance of only a few miles.

The sands are gray or light-gray to buff or yellow weathering to yellow, red-yellow, orange-red, tan, yellow-brown, and red-brown. They are of a wide range of grain size, but most of those examined were fine- to medium-grained or medium- to coarse-grained. The sands may be either massive, level bedded, irregular bedded, or crossbedded. Clay is present as pellets, irregular inclusions, and partings. Locally, the sands are cemented into limonitic sandstone bodies.

The clays examined may be classed into several descriptive types — (1) light-gray or white to gray or brown-gray, slightly silty to silty, plastic clays; (2) light-gray to light-brown or brown-gray, relatively silt- and sand-free, plastic clays; (3) gray or brown-gray to dark blue-gray, silty clays; and (4) gray-brown to chocolate-brown, sandy and silt clays or clay shales. The silts are light-gray or gray to brown-gray and are both massive and laminated. The clays and silts are commonly interlensed or interbedded.

Besides the quartzitic rock at the Zilpha-Kosciusko contact, at least one outcrop of this type of stone was found at a higher stratigraphic position near the middle of the Kosciusko formation. This locality is on both sides of State Highway 12 (NE.¼, NE.¼, Sec.34, T.14 N., R.5 E.) 0.2 mile west of the intersection of the road north from Sallis.

Thin lignite beds are present locally associated with the clays and silts. The lignite is dark-brown to brown-black and is variably impure.

Although the position of the upper boundary of the Kosciusko is in doubt, the formation is estimated from electrical logs to range from 240 to 280 feet in thickness.

WAUTUBBEE FORMATION

The Wautubbee formation crops out in a moderately broad, irregular belt across the southwestern part of the County (Plate 1). The terrane developed on the formation is characterized by rolling hills of low to moderate relief.

The Wautubbee formation overlies the Kosciusko formation. The contact between the two units was recognized with some certainty at only one place — in the ditches of State Highway 429 (NW.¼, SE.¼, SE.¼, Sec.22, T.13 N., R.5 E.) 1.9 miles north of Newport. Here weathered, sandy clay shale of the lowermost Wautubbee overlies sand of the uppermost Kosciusko. The contact is slightly irregular and is defined by a thin layer of limonitic siltstone. For the purpose of completing the "Geologic Map," the Kosciusko-Wautubbee contact was projected across the County at a position above the more Kosciusko-like sands and below the carbonaceous clay shale lenses that resemble Wautubbee sediments. No doubt at places, some Kosciusko sediments are included with the Wautubbee and *vice versa.*

Exposures of Wautubbee strata are many, and a few are excellent. Outcrops are commonly found in the road cuts and ditches.

The Wautubbee formation consists chiefly of carbonaceous clay shales and clays, silts and non-glauconitic sands. The lower part of the formation is made up of interbedded and interlensed carbonaceous clay shales and clays, silts, and non-glauconitic sands. At places in the southeastern half of the outcrop belt, there are locally developed lenses, stringers, and pockets of sparingly glauconitic to glauconitic sand and lenses of sandy, glauconitic clay shale. The upper part of the formation consists of carbonaceous clay shales and clays with locally developed lenses of non-glauconitic sand.

The clay shales and clays are dark brown-gray or brown-black to chocolate-brown weathering tan to buff. They commonly have many interlaminae of silt and sand. The sands are light-gray to buff weathering yellow, yellow-orange, orange-red, and red. They are commonly micaceous and are massive to poorly cross-bedded.

No fossils were found in the Wautubbee during the present investigation, but it was reported that limonitic molds and casts of fossils are present locally.

Although the position of the lower contact is in some doubt, the formation is estimated from electric logs to range from 80 to 100 feet in thickness.

COCKFIELD FORMATION

The Cockfield formation crops out at the higher elevations in the extreme southwestern part of the County (Plate 1). The formation forms a deeply dissected sand hills topography.

The Cockfield formation overlies the Wautubbee formation. Where the contact between the two units is well exposed, the sediments of the formations contrast sharply. Basal Cockfield sands commonly overlie dark-gray or chocolate-brown clay shales and clays of the Wautubbee. The contact is a slightly irregular, erosional surface.

Exposures of Cockfield sands are numerous, but fresh outcrops are few. Gullies and road cuts commonly expose weathered, iron-stained sand. Fresh outcrops are found in freshly made excavations and in topping pits.

Only the basal part of the Cockfield formation is present in Attala County. That portion exposed consists chiefly of sand containing locally developed lenses of silt and silty clay. The sands are light-gray to buff when fresh, but weather rapidly to yellow, tan, yellow-orange, orange-red, and red-brown. They are fine- or fine- to medium- or medium-grained, sparingly micaceous to micaceous, and massive to highly cross-bedded. The silts and clays are light-gray or gray weathering to buff or white and may be both laminated or massive. Commonly the silts and clays are interbedded or interlensed.

Priddy[2] in his report on Madison County estimates the entire Cockfield formation to range from 350 to 400 feet in thickness. That portion of the formation exposed in Attala County ranges up to about 150 feet in thickness.

PLEISTOCENE AND RECENT DEPOSITS

Surficial materials that cover the bedrock in considerable areas were laid down or formed in relatively late geologic times as a part of the Pleistocene series and the Recent series of the Quaternary system. They include alluvium and terrace deposits, colluvium, loess, and soils. The distribution of these various materials was not mapped during the present survey.

The most prominent geologically of the surficial materials is the alluvium present beneath the flood plains of the streams. The flood plains or first bottoms, where well developed, are relatively broad, flat, low-lying areas. They are underlain by alluvial materials consisting of a more or less heterogeneous mixture of sand, silt, clay and fragmental rocks. Terraces or second bottoms associated with the larger streams represent the remnant of old flood plain surfaces in an earlier stage of stream development. The sediments underlying terraces are of the same general character as those under the first bottoms.

Colluvium, which consists of a heterogeneous mixture of bedrock materials, rock fragments, and soil, is present on the slopes of many of the hills as a result of various erosional features including landslide, soil creep, slope wash, and slump. These features are local in extent and are a part of present day erosional processes.

Loess is present locally as remnant pockets or as a thin veneer on the hill tops and ridge tops in the western and southwestern parts of the County. This material is a buff to light-brown, clayey and sandy silt.

Soil is present over most of the land surface except where it has been removed by erosion or excavation. Soil types vary from place to place. The development of their character in a region depends on the parent rock, the climate, the topography and drainage, and the vegetation.

STRUCTURE

The regional structure of the exposed bedrock strata is homoclinal. The beds strike generally north-northwest and northwest, and they dip to the west-southwest and southwest. The dip ranges from about 15 to 25 feet per mile in the northeastern half of the County. To the southwest the dip steepens, and it ranges from about 25 to 35 feet per mile in the southwestern half.

No conclusive surface evidences of major structure were found during the present survey. The Basic City claystone shows anomalous dip at a few places in the northeastern part of the County, but these irregularities appear to be local in extent and may be the result of slumping. Plate 3 is a structure map of the southwestern two-thirds of the County constructed with the top of the Winona formation as datum. This map shows several local structural anomalies in surface and near-surface beds.

ECONOMIC GEOLOGY

CLAY

Clay is one of the most abundant materials at the surface in Attala County. It is one of the more important potential mineral resources worthy of consideration for future development. Several types of clay that differ in mineralogical composition and physical properties are represented. Inasmuch as the detailed classification of clays is difficult and highly technical, for simplicity in this report, the clays are referred to by a general descriptive classification based on field observations.

Because the testing of materials in commercial laboratories is expensive and the funds available for this phase of the work are limited, emphasis is placed on those clays that are considered to be representative and are believed to exist in commercial quantities. It must be remembered that the exploratory and laboratory work conducted during this investigation is preliminary and that much more detailed work is needed before commercial development can actually take place.

The field work consisted of a study of clay exposures and the drilling of core holes in order to obtain samples for analysis. A total of seven core holes was drilled — 3 in Hatchetigbee clays, 2 in Zilpha clays, and 2 in Kosciusko clays. The records of the core holes are included in the section on "Ceramic Tests" for convenience in interpretation.

The ceramic tests were conducted by Thomas E. McCutcheon, Ceramic Engineer, in the laboratories at Georgia Institute of Technology. In conjunction with the testing, William H. Moore, staff geologist of the Mississippi Geological Survey, examined and described the residues from screen analyses; M. P. Ethredge, State Chemist, provided chemical analyses of three samples; and

Ernest E. Russell of the Department of Geology and Geography at Mississippi State University made X-ray diffractograms and analyses of five samples.

The clays studied during the present investigation are those in the Hatchetigbee, Zilpha and Kosciusko formations. Each of the formations is discussed as to manner of existence, variety, outcrops, and sampling of the clays.

The Hatchetigbee formation, which crops out in the northeast corner of the County, contains much clay (Plate 1). Generally the clays are interbedded with silt, lignite and sand. Individual beds are commonly lenticular and grade both laterally and vertically into silty and sandy materials. Certain of these clays are of high degrees of purity, but most are variously impure. Several descriptive types of Hatchetigbee clay are:

(1) dark-gray to black, slightly silty to silty, variably lignitic, plastic clays;

(2) gray or blue-gray to dark-gray, moderately silty to silty, plastic clays;

(3) light-gray, slightly silty to moderately silty, plastic clays;

(4) dark-gray to black, silty and sandy clays and clay shales; and

(5) dark-green to green, silty clays.

Because these clays characteristically develop a relatively deep soil cover, exposures are few and generally poor. At the lower elevations, they may be covered by a veneer of alluvium or terrace materials. The more prominent outcrops examined are:

(1) in the cut of a north-south road from McCool to State Highway 14 (SW.¼, SE.¼, Sec.25, T.15 N., R.9 E.) just south of the junction of a road west;

(2) in the cut of an east-west road (SE.¼, SW.¼, Sec.23, T.15 N., R.9 E.) 0.4 mile east of State Highway 411;

(3) in the ditch of an east-west road (SW.¼, NW.¼, Sec.14, T.16 N., R.9 E.) 0.95 mile west of State Highway 12;

(4) in the cut of an east-west segment of an unimproved road (NW.¼, SW.¼, Sec.6, T.16 N., R.9 E.) 0.25 mile west of the old Natchez Trace; and

(5) in the cut of an east-west segment of an unimproved road (SE.¼, NE.¼, Sec.2, T.16 N., R.8 E.) 1.65 miles west of the old Natchez Trace.

Core Holes AE-1, AE-2 and AE-5 were drilled in order to sample Hatchetigbee clays. Hatchetigbee type 1 and type 2 clays were most abundant in the holes. Because these clays were interbedded along with thin interbeds of silt and lignite, three composite samples — AE-1 (12-33′), AE-2 (12-32′) and AE-5 (18-36′) — were made for testing purposes. A fourth sample, AE-5 (4-10′), is of a Hatchetigbee type 3 clay.

The Zilpha formation, which crops out in a highly irregular, moderately broad, northwest-southeast belt through the central part of the County, consists predominantly of clay (Plate 1). In large part, the clay appears to be relatively uniform in many respects, except for the sandy and silty facies that are developed at certain levels. The variation in the clay seems to be mostly a matter of color difference which reflects the degree of weathering. In the subsurface, the clay is dark-gray to black or dark brown-gray, and on the surface it varies from light olive-gray or light-gray or gray to brown-gray or chocolate-brown. Relatively thick sections of clay in the middle part of the formation are relatively silt free to slightly silty, but may be silty locally or contain laminae or thin beds of silt. Three very general descriptive types recognized are:

(1) light olive-gray or light-gray to gray, slightly silty, subconchoidally fracturing clays;

(2) light-gray or gray to brown-gray or chocolate-brown, slightly silty, blocky, plastic clays; and

(3) light-gray or gray to dark-gray or black, variably carbonaceous, silty clays or clay shales.

Of these Zilpha clays, type 1 is commonly found in the lower Zama member, type 2 is in the Middle clay member and type 3 is in the Upper clay shale and silt member.

Exposures of Zilpha clays are many, and at places they are excellent. A few of these more prominent outcrops are:

(1) in the cut and ditch of State Highway 14 (NW.¼, SW.¼, Sec.26, T.14 N., R.8 E.) about one mile northeast of the junction of State Highways 14 and 19;

(2) in the cuts of State Highway 19 (SE.¼, NE.¼, & SW.¼, NE.¼, Sec.34, T.14 N., R.8 E.) from 0.1 to 0.6 mile east of the junction of State Highways 14 and 19;

(3) in the cuts of State Highway 35 (NW.¼, NE.¼; SW.¼, NE.¼ & NE.¼, SE.¼, Sec.8, T.14 N., R.7 E.) from about 1.5 to 2.0 miles north of the intersection of State Highway 12 at Kosciusko;

(4) in the cut and ditch of an east-west unimproved road (NE.¼, SE.¼, Sec.15, T.15 N., R.7 E.) 0.15 mile southwest of State Highway 43;

(5) in the cut of the road east-southeast from Hesterville (SE.¼, NE.¼, Sec.14, T.15 N., R.6 E.) 0.4 mile southeast of the community;

(6) in the pit of Magnet Cove Barium Corporation (SE.¼, Sec.2, T.15 N., R.6 E.) 0.2 mile east of State Highway 35 and at a distance of about two miles north of Hesterville;

(7) in the cuts of the road at Bucksnort Hill (NW.¼, SE.¼, Sec.8, T.16 N., R.6 E.) 1.4 miles northwest of the junction of a north-south road cross Zilpha Creek; and

(8) in the cut of State Highway 35 (NW.¼, NE.¼, Sec.10, T.16 N., R.6 E.) about 8.5 miles north of Hesterville.

Core Holes AE-3 and AE-6 were drilled in order to sample Zilpha clays. Sample AE-3 (6-28′) is a type 1 clay, and sample AE-6 (13-22′) is a type 3 clay. Because the middle part of the formation appears to be relatively uniform, four samples taken at 10-foot intervals between the depths of 20 to 60 feet in Test Hole 20 were selected to represent type 2 clays.*

The Kosciusko formation, which crops out in a broad, northwest-southeast belt across the southwest half of the County, contains clay at various levels (Plate 1). The clays are present in lenticular silt-clay bodies developed locally in the predominantly sand formation. Individual clay beds are commonly lenticular and are more or less local in extent. The silt-clay bodies appear to be best developed in a belt, extending northwest of and south and southeast of McAdams. This area is about

*These 4 samples were not tested. Ed.

2 miles wide and 10 miles long. Several descriptive types of Kosciusko clay are:

(1) light-gray or white to gray or brown-gray, slightly silty to silty, plastic clays;

(2) light-gray to light-brown or brown-gray, relatively silt- and sand-free, plastic clays;

(3) gray or brown gray to dark blue-gray, silty clays; and

(4) gray-brown to chocolate-brown, sandy and silty clays or clay shales.

Relatively deep soils are developed on the clays and silts, and exposures are few and generally poor. The more silty and clayey facies of the formation commonly support a low rolling topography that contrasts sharply with the moderate to high relief topography developed on the sand facies. Consequently, topography is an important tool to be used in prospecting. Because the clays rarely lend themselves to examination and because of their more or less local development, an extensive program of core hole prospecting would be necessary in order to locate clay beds and determine their extent. The more prominent exposures of Kosciusko clays examined are:

(1) in the cuts and ditches of State Highway 14 and a road south (NW.¼, SW.¼, & NE.¼, NW.¼, Sec.14, T.13 N., R.6 E.) about 4.5 miles northeast of Zemuly;

(2) in the pit of Tri-State Brick & Tile Company (NE.¼, NW.¼, Sec.22, T.13 N., R.6 E.) just north of State Highway 14 at a distance of 3.3 miles northeast of Zemuly;

(3) in the cuts and ditches of the main north-south farm-to-market road from State Highway 14 to McAdams (SE.¼, SW.¼, Sec.9 & NE.¼, NW.¼, Sec.16, T.13 N., R.6 E.) about 2.5 miles south of the community;

(4) in the cut of an east-northeast—west-southwest road (NW.¼, NE.¼, Sec.23, T.13 N., R.5 E.) 1.6 miles west of Joseph;

(5) in the cut of a north-northwest—south-southeast road (NE.¼, NE.¼, Sec.29, T.14 N., R.6 E.) 2.3 miles north-northwest of McAdams;

(6) in the cut of a north-south road (SW.¼, NW.¼, Sec.20, T.14 N., R.6 E.) 2.4 miles north of its junction with State Highway 12;

(7) in the cuts of a north-south road (NE.¼, SW.¼, Sec.13, T.14 N., R.6 E.) 0.1 mile south of and at Weeks;

(8) in the cuts of an east-west road and a north-south road (SW.¼, SW.¼, Sec.12, T.14 N., R.5 E.) about 0.2 mile west and 0.25 mile south of the junction of these roads;

(9) in the pit of Delta Brick and Tile Company (SE.¼, NW.¼, Sec.11, T.14 N., R.5 E.) about a half mile east of a north-south road and at a distance of about four miles due north of Sallis; and

(10) in the cut of a northeast-southwest road (NW.¼, NE.¼, Sec.17, T.14 N., R.5 E.) just northeast of the junction of a road southeast.

Core Holes AE-4 and AE-7 were drilled in order to sample Kosciusko clays. Sample AE-7 (5-9′; 13-23′) is a composite of a type 1 clay, and samples AE-4 (3-16′) and AE-7 (9-13′) are of a type 2 clay.

Other materials that may have ceramic possibilities but for various reasons are considered to be of doubtful importance and were not studied during the present investigation are:

(1) silts and sandy and silty clays and clay shales of the Tallahatta formation;

(2) chocolate-brown, sandy clays and clay shales of the Wautubbee formation;

(3) variously impure clay present as lenses in sand in the lower part of the Cockfield formation; and

(4) miscellaneous silty and clayey materials in the alluvium.

CLAY INDUSTRY

The clay industry in Attala County consists of a brick manufacturing company and of a plant in which clay is processed for use as an industrial foundry bonding clay. Also, two other brick companies have opened pits from which clay has been mined. Plate 4 shows the locations of the plant sites and of the various clay pits.

A brick manufacturing company at Kosciusko has made red-colored, common face brick for over a half century from local surficial clays. The plant was first established in 1902 by A. M. Storer.[3] In 1927 the operation was bought by C. A. Bell, and since 1935 it has been known as Bell Brick Yard. The plant is located between State Highway 12 and the Aberdeen Branch of the Illinois Central Railroad (SW.¼, SE.¼, Sec.6, T.14 N., R.7 E.) about 0.2 mile east of the intersection of State Highways 12 and 43. The surficial clays used in the operation have been dug from

Figure 15.—Delta Brick & Tile Company's clay pit (SE.1/4, NW.1/4, Sec.11, T.14 N., R.5 E.) about 4 miles due north of Sallis. April 2, 1963.

several different places at and near the plant. At present the clay is obtained from a pit near the Fairgrounds (NW.¼, SW.¼, Sec.15, T.14 N., R.7 E.). About four years ago the company added to production a limited quantity of light-colored brick in order to meet present demand. Light-burning clays were prospected in the Kosciusko formation, and a small pit was opened just north of the old Kosciusko to Durant road (SE.¼, SW.¼, Sec.18, T.14 N., R.6 E.), at a distance of about 9.5 miles west of the plant. The clay is light-gray to white in color and is moderately silty to silty, grading into silt below. The bed is only about 4 or 5 feet thick, and the extent of the deposit appears to be very limited.

In recent years several areas in the southeastern and western parts of the County have been prospected by various persons interested in developing the clay of the Kosciusko formation. As a result, two brick manufacturing companies from outside the County have opened pits.

Delta Brick & Tile Company strip mine clay from a pit located about a half mile east of a north-south road (SE.¼, NW.¼, Sec.11, T.14 N., R.5 E.) at a distance of about four miles due north of Sallis (Figure 15). The clay is light-gray to light-brown in color. It is relatively silt and sand free, becoming slightly silty to silty in the lower few feet and grading into silt below. Core Hole AE-4 was drilled through the clay. The impurity free clay is about 13 feet thick. The thickness of overburden varies considerably from place to place. This clay reportedly is being used in the manufacture of light-colored brick. It is a high quality material that is classed as a "ball clay."

A few years ago, Tri-State Brick & Tile Company strip mined clay from a small pit just north of State Highway 14 (NE.¼, NW.¼, Sec.22, T.13 N., R.6 E.) about 3.3 miles northeast of Zemuly. The clay is gray to light-gray in color and is in part mottled yellow to tan by iron oxide staining. It is slightly silty and slightly sandy, becoming more silty and sandy locally and grading into silt below. Nodules of calcium carbonate formed as a result of ground water leaching of the clay are scattered over the face of the exposed material. The clay bed is about nine feet in thickness, and overburden is a maximum of four feet thick. The deposit is not now being worked. The clay has been used reportedly in the manufacture of light-colored brick, but it did not prove entirely satisfactory because of the lime content.

In a pilot operation at Kosciusko, Magnet Cove Barium Corporation is producing an industrial foundry bonding clay. The plant is located adjacent to the Aberdeen Branch of the Illinois Central Railroad east of State Highway 35 by-pass (SW.¼, SW.¼, Sec.15, T.14 N., R.7 E.) (Figure 16). The crude material is a gray to light olive-gray, slightly silty, subconchoidally fracturing, montmorillonitic clay from the lower part of the Zilpha formation. Core Hole AE-3 was drilled through this bed. Cored and tested reserves are advertised to be a half million tons with an additional two million tons of unproven reserves being held. The average thickness of the deposit is advertised to be about 10 feet. Production began in 1958. The output for the first four years of production as reported by the Corporation[4] is:

Figure 16.—Magnet Cove Barium Corporation's plant at Kosciusko: (1) dry shed; (2) rotary kiln; (3) grinding, screening and sacking; (4) storage; (5) rail or truck shipping facilities. Photo provided by Industrial Development Corporation.

1958—10,158 short tons crude clay

1959—None

1960—21,580 short tons crude clay

1961— 4,514 short tons crude clay

The clay is strip mined during the summer months and trucked to a stockpile at the plant. The pit is located east of State Highway 35 (SE.¼, Sec.2, T.15 N., R.6 E.) about two miles north of Hesterville. The distance from pit to plant is about 11.5 miles. In processing, the clay is dried, ground, and sacked for shipment. Even though the clay is produced for use as a foundry bonding clay, a limited amount is utilized as a binder in feeds and as a filler in insecticides. The industrial foundry bonding clay is marketed as "southern bentonite" under the trade name "Southern Star."

SAND

Enormous quantities of quartz sand are present in Attala County. Unlimited supplies are available from the Tallahatta, Winona, Kosciusko, and Cockfield formations. The sands have a wide range of grain size — from fine-grained to coarse-grained. The chief impurities in most of the sands are clay, silt, and iron oxide. Other substances that are commonly present in all or in some of the sands include muscovite mica, glauconite, lignite, kaolinite, chert, and heavy minerals.

The uses of sand are many and they are varied. Commercial uses of sand in the United States as listed in the 1961 Minerals Yearbook include: (1) construction sand—building, paving, fill, and railroad ballast; and (2) industrial sand—glass, molding, grinding and polishing, blast sand, fire or furnace, ferrosilicon, filtration, and oil (formation fracturing). Each of these uses requires a sand of definite specifications, and commonly each user has his own standards within these specifications. Therefore, in a study of this type, the investigation of sands must be more or less generalized.

A preliminary study was made of the sands in the Kosciusko formation in order to determine generally their possibilities for use as glass sands. The Kosciusko sands were selected because of their apparent relative uniformity in grain size, their grain-size range, and their apparent lack of significant amounts of iron-containing substances such as glauconite and certain heavy minerals.

Twenty-seven samples from five drill holes (Test Holes 12, 13, 17, 21, and 23) were selected for mechanical analysis. Each sample represents a 10-foot interval and was collected by water circulation while drilling with a rotary drill. One hundred grams of each sample were screened using the 10, 20, 40, 60, 80, and 100 mesh screens. From the unscreened materials, six composite samples of near surface sands were selected for chemical analysis. Partial chemical analyses (percent SiO_2 and Fe_2O_3) were made by the Mississippi State Chemical Laboratory. The residues from the screen analyses of the six samples analysed chemically were examined with the aid of the microscope in order to determine the nature of the impurities. In the descriptions the abundance is indicated as follows: abundant (one-half or more of residue on screen) by (A); considerable amount (between one-tenth and one-half) by (C); small amount (less than one-tenth) by (S); and trace (a few grains) by (T).

The mechanical composition of glass sands should be generally within a grain-size range that will allow 100 percent of the sand to pass the 20 mesh screen and not over five percent to pass the 100 mesh screen. Other specifications of glass sands within these limits are determined by the individual user. Table 2 gives the mechanical analyses of 27 samples of Kosciusko sand. The bulk of most of the sands falls within the general size range for glass sand. The small percentages of coarse sand and/or clay and silt present in the sands can be removed by ordinary washing and screening methods.

Table 2

Mechanical Analyses of Kosciusko Sand Samples
by Mississippi Testing Laboratories

(percent retained)

Test Hole No.	Depth (feet)	Sieve sizes 10 mesh	20 mesh	40 mesh	60 mesh	80 mesh	100 mesh	Pan	Total
12	20-30	0.00	0.30	69.70	23.10	3.10	1.00	2.80	100.00
	30-40	0.00	1.50	66.60	19.00	8.00	3.60	1.30	100.00
	40-50	0.00	0.40	31.50	63.50	2.40	0.70	1.50	100.00
	50-60	0.00	0.40	39.70	50.50	7.00	0.80	1.60	100.00
	60-70	0.00	0.00	14.50	60.00	19.00	3.20	3.30	100.00
	70-80	0.00	0.00	32.20	59.40	6.40	0.80	1.20	100.00
13	40-50	0.00	2.00	71.00	19.80	3.30	2.00	1.90	100.00
	50-60	0.00	2.30	72.20	20.50	1.00	0.70	3.30	100.00
	60-70	0.00	0.90	28.50	64.80	3.00	0.30	2.50	100.00
17	20-30	0.00	0.00	3.80	35.70	41.20	7.40	11.90	100.00
	30-40	0.00	0.00	5.50	50.50	36.20	4.40	3.40	100.00
	40-50	0.00	0.00	35.70	30.20	23.60	4.00	6.50	100.00
	50-60	0.00	0.00	50.00	30.80	7.40	2.80	9.00	100.00
	60-70	0.00	0.00	54.20	40.30	3.70	0.70	1.10	100.00
	70-80	0.00	0.00	31.10	61.50	4.70	0.70	2.00	100.00
	80-90	0.00	0.10	18.00	75.00	4.20	0.50	2.20	100.00
	90-100	0.00	0.00	14.50	71.00	10.30	1.80	2.40	100.00

Table 2—(Continued)

Test Hole	Depth	Seive sizes							
No.	(feet)	10 mesh	20 mesh	40 mesh	60 mesh	80 mesh	100 mesh	Pan	Total
21	20-30	0.00	0.50	14.60	69.30	12.00	1.40	2.20	100.00
	30-40	0.00	1.80	10.00	68.50	15.70	1.50	2.50	100.00
	40-50	0.00	0.00	3.70	74.10	19.50	0.60	2.10	100.00
	50-60	0.00	5.00	16.70	59.40	9.50	4.10	5.30	100.00
23	10-20	0.00	1.00	7.30	38.40	36.70	7.80	8.80	100.00
	20-30	0.00	0.00	9.80	66.30	20.00	2.80	1.10	100.00
	30-40	0.00	0.00	53.00	33.40	9.50	2.00	2.10	100.00
	40-50	0.00	0.00	11.80	47.20	31.60	5.00	4.40	100.00
	50-60	0.00	0.00	1.30	50.60	41.00	4.50	2.60	100.00
	60-70	0.00	0.00	20.30	66.80	10.40	0.40	2.10	100.00

In the chemical composition of glass sands, the amounts of silica, iron oxide, and alumina are important. For glass manufacture the allowable percentages are generally: silica (SiO^2), not less than 95 percent; iron oxide (Fe_2O_3), not more than 1 percent; and alumina (Al_2O_3), not more than 4 percent. Tolerances of these compounds depend upon the type and quality of glass to be made.

Table 3 gives partial chemical analyses for six composite samples of Kosciusko sands. All of the samples were above the 95 percent minimum allowable silica. Iron oxide ranged from 0.65 to 0.11 percent. Most of the iron oxide is present as limonite stains on the quartz grains and as a secondary cementing material. Much of the iron oxide can be removed by washing and screening and, if necessary, by attrition scrubbing or acid leaching. The very small percentages of heavy minerals present in some of the sands contain insignificant amounts of iron oxide.

Table 3

Partial Chemical Analyses of Kosciusko Sand Samples
by Mississippi State Chemical Laboratory

Test Hole No.	Depth (feet)	SiO_2 (percent)	Fe_2O_3 (percent)	Total (percent)	Undet. (percent)
12	20-50	96.81	0.14	96.95	3.05
13	40-70	96.97	0.21	97.18	2.82
17	20-50	96.05	0.65	96.70	3.30
21	20-50	97.41	0.23	97.64	2.36
23	10-20	96.43	0.23	96.66	3.34
23	20-50	95.47	0.11	95.58	4.42

The sands were not analysed for alumina content, but for the most part any alumina present is in the form of clay or silt. Both clay and silt are also objectionable in glass sands, because they tend to cloud the glass. A large part of the clay and silt can be removed by screening or washing and, if necessary, by attrition scrubbing.

Although the results of this study are not conclusive in finding a particular glass sand for a particular use, it appears that with some beneficiation many of the sands can be made suitable for use in making amber glass and green glass. Possibly with further beneficiation, they can be made suitable for use in making the better grades of ordinary glass and flint glass.

The Kosciusko sands provide one of the major ground-water aquifers in Mississippi. The outcrop belt across the State, is of course, the catchment area for these fresh water reserves. In the hilly terrane commonly the water table is low, and consequently, it is in these areas where the oxidation of the iron contained in the sands is greatest. Springs are common flowing from the lower parts of the hills. In the valleys the water table is commonly high and is at or near the surface. This high water table would facilitate hydraulic mining and processing operations. At some places, barges could possibly work the sands in lakes formed by excavation of the surface materials to a level below the water table. Conversely, the sands in the hilly areas can be mined and transported to washing facilities elsewhere.

Test Hole 12 (20-30')

Sieve size (mesh)	Percent retained	Character of residue
20	0.30	Quartz (A), limonite stains in pitting; silt nodules (S) limonitic; clay nodules (T), white.
40	69.70	Quartz (A), limonite stains in pitting; clay nodules (S), white.
60	23.10	Quartz (A), limonite stains in pitting; clay nodules (S), white; kaolinite xls. (T).
80	3.10	Quartz (A), limonite stained in part; clay nodules (S), white; kaolinite xls. (S); lignite (T).
100	1.00	Quartz (A), limonite stained in part; clay nodules (S), white; lignite (T).
Pan	2.80	Silt and clay, limonite stained in part.

Test Hole 12 (30-40')

Sieve size (mesh)	Percent retained	Character of residue
20	1.50	Quartz (A), limonite stains in pitting; silt nodules (S), limonitic; quartz clusters (S), limonite cemented; clay nodules (T), dark gray.
40	66.60	Quartz (A), limonite stains in pitting; clay nodules (T), white; quartz clusters (T), limonite cemented.
60	19.00	Quartz (A), limonite stains in pitting; quartz clusters (S), limonite cemented; clay nodules (S), white.
80	8.00	Quartz (A), limonite stained in part; clay nodules (S), white, kaolinite xls. (S).
100	3.60	Quartz (A), limonite stained in part; clay nodules (S), white; lignite (S).
Pan	1.30	Silt and clay, limonite stained in part.

Test Hole 12 (40-50')

Sieve size (mesh)	Percent retained	Character of residue
20	0.40	Quartz (A), limonite stains in some pitting; silt nodules (T), limonitic; quartz clusters (T), limonite cemented; lignite (T).
40	31.50	Quartz (A), limonite stains in some pitting; clay nodules (S), white; obsidian (T); kaolinite xls. (T).
60	63.50	Quartz (A), limonite stains in some pitting; clay nodules (S), white; obsidian (T).
80	2.40	Quartz (A), limonite stained in part; clay nodules (S), white; obsidian (T); clay nodules (T), gray.
100	0.70	Quartz (A), limonite stained in part; clay nodules (S), white; limonite (S); lignite (T).
Pan	1.50	Silt and clay, limonite stained in part.

Test Hole 13 (40-50')

Sieve size (mesh)	Percent retained	Character of residue
20	2.00	Quartz (A), limonite stains in some pitting; clay nodules (C), white; quartz clusters (C), both limonite cemented and in clay matrix; muscovite mica (T).
40	71.00	Quartz (A), limonite stains in some pitting; clay nodules (T), white; chert (T).
60	19.80	Quartz (A), limonite stains in some pitting; clay nodules (S), white; chert (T).
80	3.30	Quartz (A), limonite stained in part; clay nodules (S), white; limonite (S); kaolinite xls. (T); obsidian (T); chert (T).
100	2.00	Quartz (A), limonite stained in part; clay nodules (S), white; limonite (S); lignite (S), muscovite mica (T), chert (T).
Pan	1.90	Silt and clay, limonite stained in part.

Test Hole 13 (50-60′)

Sieve size (mesh)	Percent retained	Character of residue
20	2.30	Quartz (A), slight limonite staining in some pitting; quartz clusters (S), both limonite cemented and in clay matrix; clay nodules (S), white; clay nodules (T), gray.
40	72.20	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; limonite (T).
60	20.50	Quartz (A), limonite stained in small part; clay nodules (S), white; muscovite mica (T); obsidian (T).
80	1.00	Quartz (A), limonite stained in part; clay nodules (S), white; limonite (S); muscovite mica (T).
100	0.70	Quartz (A), limonite stained in part; clay nodules (S); white; limonite (S); muscovite mica (T); lignite (T).
Pan	3.30	Silt and clay, limonite stained in part.

Test Hole 13 (60-70′)

Sieve size (mesh)	Percent retained	Character of residue
20	0.90	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; quartz clusters (S), limonite cemented.
40	28.50	Quartz (A), slight limonite staining in some pitting; clay nodules (T), white.
60	64.80	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; tourmaline (T); chert (T).
80	3.00	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; obsidian (T); limonite (T); lignite (T).
100	0.30	Quartz (A), limonite stained in small part; clay nodules (S), white; limonite (T); obsidian (T).
Pan	2.50	Silt and clay, limonite stained in small part.

Test Hole 17 (20-30')

Sieve size (mesh)	Percent retained	Character of residue
40	3.80	Quartz (A), slight limonite staining in some pitting; clay nodules (C), white; silt nodules (S); muscovite mica (T).
60	35.70	Quartz (A), limonite stained in small part; clay nodules (S), white; limonite (S); chert (T); muscovite mica (T); lignite (T).
80	41.20	Quartz (A), limonite stained in small part; clay nodules (S), white; limonite (S); lignite (T); muscovite mica (T).
100	7.40	Quartz (A), limonite stained in part; clay nodules (S), white; limonite (S); lignite (T).
Pan	11.90	Clay and silt, limonite stained in part.

Test Hole 17 (30-40')

Sieve size (mesh)	Percent retained	Character of residue
40	5.50	Quartz (A), slight limonite staining in some pitting; clay nodules (C), white; silt nodules (S), limonitic; limonite (S), quartz clusters (T), limonite cemented.
60	50.50	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; limonite (S); chert (S); muscovite mica (T); kaolinite xls. (T).
80	36.20	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; limonite (S), lignite (S); chert (S); tourmaline (T); obsidian (T).
100	4.40	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; limonite (S); heavy minerals (S); obsidian (T).
Pan	3.40	Clay and silt, limonite stained in part.

Test Hole 17 (40-50')

Sieve size (mesh)	Percent retained	Character of residue
40	35.70	Quartz (A), limonite stained in small part; clay nodules (S), white; limonite (S); silt nodules (S); quartz clusters (S), limonite cemented; chert (T); kaolinite xls. (T).
60	30.20	Quartz (A), limonite stained in small part; clay nodules (S), white; limonite (S); chert (S).
80	23.60	Quartz (A), limonite stained in small part; clay nodules (S), white; limonite (S); chert (S); muscovite mica (T).
100	4.00	Quartz (A), limonite stained in small part; clay nodules (S), white; limonite (S); lignite (S).
Pan	6.50	Clay and silt, limonite stained in part.

Test Hole 21 (20-30')

Sieve size (mesh)	Percent retained	Character of residue
20	0.50	Silt nodules (C), limonitic; quartz clusters (C), limonite cemented; quartz (S), limonite stained in part.
40	14.60	Quartz (A), limonite stained in part; quartz clusters (S), limonite cemented; clay nodules (S), white; chert (T); lignite (T).
60	69.30	Quartz (A), limonite stained in part; clay nodules (S), white; chert (S); kaolinite xls. (T).
80	12.00	Quartz (A), limonite stained in part; clay nodules (S), white; lignite (S); chert (S); kaolinite xls. (T); glauconite (T).
100	1.40	Quartz (A), limonite stained in part; limonite (S); lignite (S); glauconite (S); muscovite mica (T).
Pan	2.20	Silt and clay, limonite stained in part.

Test Hole 21 (30-40')

Sieve size (mesh)	Percent retained	Character of residue
20	1.80	Quartz (C), limonite stained in part; silt nodules (C), limonitic; clay nodules (C), white; quartz clusters (S), both limonite cemented and in clay matrix; muscovite mica (T).
40	10.00	Quartz (A), limonite staining in pitting; clay nodules (S), white; lignite (T); muscovite mica (T).
60	68.50	Quartz (A), limonite stained in small part; clay nodules (S), white; kaolinite xls. (T); muscovite mica (T).
80	15.70	Quartz (A), limonite stained in small part; clay nodules (S), white; lignite (S); muscovite mica (T).
100	1.50	Quartz (A), limonite stained in part; clay nodules (S), white; limonite (S); lignite (S).
Pan	2.50	Silt and clay, limonite stained in part.

Test Hole 21 (40-50')

Sieve size (mesh)	Percent retained	Character of residue
40	3.70	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; silt nodules (S), limonitic; quartz clusters (S), limonite cemented; chert (T).
60	74.10	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; heavy minerals (S); kaolinite xls. (T).
80	19.50	Quartz (A), slight limonite staining in some pitting; clay nodules (S), white; heavy minerals (S); kaolinite xls. (T).
100	0.60	Quartz (A), limonite stained in small part; clay nodules (S), white; heavy minerals (S); limonite (S).
Pan	2.10	Silt and clay, limonite stained in part.

Test Hole 23 (10-20′)

Sieve size (mesh)	Percent retained	Character of residue
20	1.00	Quartz clusters (A), in clay matrix.
40	7.30	Quartz (C); clay nodules (C), light-gray; quartz clusters (C), in clay matrix; silt nodules (S), limonitic; organic matter (S); clay nodules (T), white.
60	38.40	Quartz (A); limonite stained in small part; kaolinite xls. (S); organic matter (S); heavy minerals (T).
80	36.70	Quartz (A); limonite stained in small part; kaolinite xls. (S); organic matter (S); heavy minerals (T).
100	7.8	Quartz (A); limonite stained in small part; organic matter (S); kaolinite xls. (T); heavy minerals (T).
Pan	9.8	Clay and silt, light-gray.

Test Hole 23 (20-30′)

Sieve size (mesh)	Percent retained	Character of residue
40	9.80	Quartz (A), limonite stained in small part; clay nodules (S), light-gray; heavy minerals (T).
60	66.30	Quartz (A), limonite stained in small part; heavy minerals (S); kaolinite xls. (T); limonite (T).
80	20.00	Quartz (A), limonite stained in small part; heavy minerals (S).
100	2.80	Quartz (A), limonite stained in small part; heavy minerals (S).
Pan	1.10	Silt and clay, limonite stained in small part.

Test Hole 23 (30-40')

Sieve size (mesh)	Percent retained	Character of residue
40	53.00	Quartz (A), limonite stained in part; heavy minerals (S); quartz clusters (T), clay matrix; kaolinite xls. (T).
60	33.40	Quartz (A); limonite stained in part; heavy minerals (S); kaolinite xls. (T).
80	9.50	Quartz (A); limonite stained in part; heavy minerals (S); kaolinite xls. (T).
100	2.00	Quartz (A); limonite stained in part; heavy minerals (S); kaolinite xls. (T); limonite (T).
Pan	2.10	Silt and clay, limonite stained in part.

Test Hole 23 (40-50')

Sieve size (mesh)	Percent retained	Character of residue
40	11.80	Quartz (A), limonite stained in part; quartz clusters (S), limonite cemented; clay nodules (S), white; limonite (S), heavy minerals (T).
60	47.20	Quartz (A), limonite stained in small part; clay nodules (S), white; heavy minerals (S).
80	31.60	Quartz (A), limonite stained in small part; clay nodules (S), white; heavy minerals (S).
100	5.00	Quartz (A), limonite stained in part; clay nodules (S), white; heavy minerals (S).
Pan	4.40	Silt and clay, limonite stained in part.

SAND INDUSTRY

The greatest utilization of Attala County sands has been and is in road and highway construction as topping materials (Figure 17). Limited amounts of sand are used for local building purposes in concrete, mortar, and plaster.

Figure 17.—Mississippi State Highway Department topping pit (No. 5-544) located south of a segment of old State Highway 19 (NE.1/4, SE.1/4, Sec.12, T.14 N., R.6 E.) about 2.7 miles west-northwest of the junction of State Highway 35 Kosciusko. April 2, 1963.

Certain data concerning 39 topping pits prospected by the Mississippi State Highway Department in Attala County during the period from 1948 to 1961 are given in Table 4. The Highway Department pit numbers and project designations are included in order to provide reference to Department files. The general locations of the pits are shown on Plate 4.

During the exploration for the topping pits, several test holes were drilled on each prospect in order to obtain samples for testing. Mechanical analyses were made on the many samples taken. From these findings, an average analysis was calculated for usable material in each test hole, then the pit range and the pit average. In determining the pit range and pit average, each size classification is considered individually. The pit range is

TABLE 4
MISSISSIPPI STATE HIGHWAY DEPARTMENT TOPPING PITS

Location[2]	Pit Number	Project Number	Owner	Quantity[3] (M Cu. Yds.)	Date Est.	Useable Thickness (Feet)	Overburden (M Cu. Yds.)	Overburden Thickness (Feet)	Proposed[4] Use	Geologic[5] Unit	10 mesh[6] (percent passing)	40 mesh[6] (percent passing)	60 mesh[6] (percent passing)	270 mesh[6] (percent passing)	Silt[6] (percent)	Clay[6] (percent)	L. L.[6,7] (liquid limit)	P. I.[6] (plasticity index)
13N 4E 25 NW SW	5-554	S-0656(2)A	L. F. Burrell, Est.	7	2-56	15-19	1.6	1-5	SB,CB	Ec	100 100	100 100	92-98 96	17-31 24	6-9 12	9-13 12	N.P.-28	0-16
35 E SE	5-744	OS-0643(3)A	H. R. Billings	31	7-58	13-22	6.5	0-7	SB,CTCB	Ec	100 100	98-99 99	55-70 64	11-14 12	2-4 3	8-11 9	N.P.-25	0-9
36-- --	5-843	S-0656(3)A	A. H. & Inez McCrary	90	8-59	17-35	8.5	0-6	SB,SCB or CB	Ec	100 100	99-100 100	94-100 98	12-27 18	2-11 5	8-19 13	N.P.-38	0-22
13N 5E 3 NE SE	5-485	SP-429-5250(1)	Ernest Peeler	40	3-55	10-20	9.3	0-7	SB,CB	Ek	100 100	94-100 99	73-97 89	17-25 20	6-11 8	11-14 12	N.P.-29	0-18
22 NE	5-524	S-0643(1)A	L. C. Jenkins, Sr.	29	7-55	9-21	11.4	0-6	SB,CB	Ek	100 100	98-100 100	82-98 91	8-19 14	3-9 7	5-11 7	N.P.-29	0-14
13N 6E 36 SW	5-330	W.O. 3033	A. S. Blailock, Est.	30	8-53	20-25	3	0-5	SB,CB	Ek	100 100	82-92 87	51-66 58	13-26 18	7-16 10	6-12 8	N.P.-35	0-20
13N 7E 15 NE NE	5-76	SP-35-1037(1)	Tom Davis	15	3-48	0-8	0	0	SB,CB	Ek	100 100	96-98 97	56-70 64	4-5 4	2-4 3	1-2 1	N.P.	0
13N 9E 23 NW SE NE SW	5-663	F-026-1(6)	F. J. Black	56	----	-----	---	---	SB,SCB	Et	100 100	83-97 93	45-60 65	6-25 14	2-12 4	6-14 10	N.P.-33	0-17
14N 5E 1 SE	5-955	S-0642(7)A	Carolyn Flemington	50	2-61	10-30	29	0-10	SB,SCB or CB	Ek	100 100	95-99 98	65-83 76	14-34 19	7-19 10	6-15 9	N.P.-25	0-14
14N 6E 2 SW	5-841	S-0642(10)A	Lamar Colston	41	7-59	10-25	2.5	0-3	SB,SCB or CB	Ek	100 100	93-100 97	71-93 83	13-20 17	3-9 6	7-14 11	N.P.-30	0-15
12 SE	5-544	U-023-2(7)	C. D. Simms	30	1-56	14-20	6	0-5	SB,CB	Ek	100 100	83-97 95	37-58 45	11-20 16	5-13 8	6-11 8	N.P.-31	0-16
14N 7E 7 SW SW	5-800	U-018-2(3)	C. H. Green	24	2-59	12-20	4	0-5	SB,CB	Ek	100 100	99-100 100	84-95 92	16-29 21	4-14 8	11-18 14	N.P.-34	0-17
7 W SW	5-842	S-0642(8)A US-0642(9)A	J. D. Staggs	41	8-59	17-25	1.5	0-2	SB,SCB or CB	Ek	100 100	84-99 90	47-77 59	13-24 18	3-10 7	7-14 11	N.P.-30	0-13
8 SE NW SW NE	5-80(Ext.)	U-018-2(3)	J. N. Duncan	10	5-58	16-19	2	0-4	SB,CB	Ek	100 100	83-91 87	62-64 63	21-29 25	9-12 11	12-17 15	N.P.-27	0-14
25 NE NW	5-75	SP-35-1037(1)	Bill Davis	22	2-48	12-19	3.2	0-6	SB,CB	Ek	100 100	58-96 87	22-56 34	12-22 16	3-10 6	7-12 10	N.P.-27	0-13
25 SE SE	5-993	F-026-1(13)	G. D. Garrett	60	9-61	10-25	6	0-7	SB,CTCB	Ek	100 100	75-95 93	29-52 44	10-21 15	3-10 6	7-12 9	N.P.-27	0-16
14N 8E 25 NW	5-180	S-138(2)	T. D. Brown	40	9-50	6-20	6	0-5	SB,CB	Et	100 100	96-100 98	76-93 88	10-21 15	4-10 6	4-14 9	N.P.-34	0-18
33 NE NE	5-181	S-138(2)	C. T. Blanton	40	9-50	13-20	10	0-7	SB,CB	Ek	100 100	95-100 99	48-66 69	13-26 18	4-11 7	7-17 11	N.P.-31	0-15
33 NE NE	5-579	F-026-1(13)	Mattie Wheat Wheat Est.	27	12-56	9-22	14	0-12	SB,CTCB	Ek	100 100	58-100 91	18-93 71	5-75 15	1-57 6	2-24 9	N.P.-45	0-30
34 NW NW	5-624	F-026-1(12)	C. F. Blanton	33	12-56	0-19	10	0-8	SB,CB or CTCB	Ek	100 100	60-100 91	19-95 69	8-62 17	3-34 7	4-28 10	N.P.-27	0-14
34 NW	5-624(Ext.)	F-026-1(13)	Blanton Est.	20	7-58	13-22	6.5	0-7	SB,CTCB	Ek	100 100	93-100 97	43-94 69	9-22 16	2-8 5	7-13 11	N.P.-27	0-13
34 W	5-757	F-026-1(13)	Blanton Est.	32	9-58	12-25	2	0-2	SB,CTCB	Ek	100 100	67-98 90	25-86 63	7-21 14	3-10 5	4-12 9	N.P.-24	0-4
34 NW	5-758	F-026-1(13)	Blanton Est.	24	9-58	20-23	2.5	0-4	SB,CTCB	Ek	100 100	98-100 99	73-98 90	11-17 15	2-7 4	8-12 11	N.P.-28	0-17
14N 9E 24 SW NE	5-175	S-138(2)	S. J. Peeler	56	9-50	8-20	4	0-4	SB,CB	Et	100 100	86-99 95	32-80 75	10-38 15	2-15 7	4-23 8	N.P.-30	0-13
27 NE SW	5-179	S-138(2)	S. J. Cannon	30	9-50	7-20	2.5	0-4	SB,CB	Et	100 100	97-100 99	76-82 80	15-23 20	5-11 8	7-16 12	N.P.-34	0-13
29 NW SE	5-173	S-138(2)	S. J. Peeler	35	9-50	8-20	3.5	0-4	SB,CB	Et	100 100	81-96 90	34-70 60	11-21 15	3-9 6	6-12 9	N.P.-24	0-12
30 SW SW SE SW	5-577	F-026-1(2)	Sam Steel Hammond & Love	60	5-56	10-20	28.5	0-10	SB,CB	Et	100 100	87-99 94	35-95 66	5-69 13	1-51 5	2-24 8	N.P.-50	0-31
15N 5E 1 SW	5-321	S-0642(2)A	N. L. Melton	12	7-53	17-20	1	0-3	SB,CB	Ek	100 100	87-93 90	43-46 45	14-20 17	6-8 7	8-14 10	N.P.-31	0-16
1 SW SW	5-582	S-0642(3)A	N. L. Melton	45	6-56	15-30	8	0-10	SB,CB	Ek	100 100	80-98 88	34-81 48	6-68 14	2-45 6	4-23 8	N.P.-36	0-22
1 SW	5-939	S-0662(1)A	W. D. Brister N. L. Melton	75	11-60	13-25	9	0-10	SB,SCB or CB	Ek	100 100	84-98 93	36-65 51	9-28 17	5-12 8	4-17 9	N.P.-31	0-19
15N 6E 15 E NW	5-940	S-0662(1)A	C. F. Oakes	48	12-60	11-23	8	0-6	SB,SCB or CB	Ek	100 100	100 100	85-99 97	9-24 17	4-13 8	5-14 9	N.P.-32	0-17
15N 7E 10 NW NW	5-837	S-0519(3)A	S. J. Peeler	52	7-59	16-25	13	0-7	SB,SCB or CB	Et	100 100	92-97 95	61-76 69	10-18 14	4-9 5	6-11 8	N.P.-41	0-21
34 SW SW	5-699	S-0519(1)A	Sam Peeler	65	12-57	10-23	18	0-12	SB,CB	Ek	100 100	100 100	88-100 95	12-26 18	3-11 6	5-16 12	N.P.-30	0-16
15N 9E 2 SW 3 SE	5-447	W.O.-3254	D. M. Thompson	24	7-54	12-20	2	0-4	SB,CB	Et	100 100	69-99 85	28-81 60	10-28 20	5-18 13	3-10 7	N.P.-29	0-12
16N 6E 14 NE NW	5-161	F-023-2(2)	E. B. Trotter	50	5-50	9-20	21	0-11	SB,CB	Et	100 100	95-99 98	70-91 82	12-33 15	4-22 6	6-13 9	N.P.-43	0-29
14 NW NW	5-168	F-023-2(2)	G. A. Williams	45	5-50	10-16	31.4	0-11	SB,CB	Et	100 100	89-99 95	35-96 57	10-87 15	3-62 5	6-38 10	N.P.-48	0-32
16N 7E 25 SE NW SW NE	5-835	S-0519(4)A	Z. A. Wasson	41	7-59	20-30	2.5	0-1	SB,SCB or CB	Et	100 100	90-99 94	47-81 63	6-17 10	3-8 4	3-12 6	N.P.-30	0-10
35 E SE	5-849	S-0519(3)A	D. I. Forrester	99	9-59	8-25	7	0-5	SB,SCB or CB	Et	100 100	93-99 97	32-70 51	9-25 15	4-14 8	4-15 7	N.P.-39	0-19
16N 8E 9 SW NW	5-847	S-0519(4)A	W. W. Dendy	69	9-59	16-25	4	0-1	SB,SCB or CB	Et	100 100	87-100 96	60-97 84	7-21 11	3-13 6	1-9 5	N.P.-34	0-16

[1]Pits prospected during the period from 1948 to 1961; prospects in various stages of development; information compiled from Highway Department files.

[2]Township, Range, Section, Quarter.

[3]Estimated quantity available at time of prospect.

[4]SB-Sub-base; SCB-Soil cemented base; CB-Conventional base; CTCB-Cement treated conventional base.

[5]Et-Tallahatta; Ek-Kosciusko (Sparta); Ec-Cockfield.

[6]Upper numbers refer to pit range; lower number refers to pit average.

[7]N. P.-Non-plastic.

the lowest and the highest of the test hole averages, and the pit average is the total of the test hole averages divided by the number of holes.

The geologic distribution of the pits is — 13 in the Tallahatta formation, 23 in the Kosciusko formation, and 3 in the Cockfield formation. The total quantity of topping material prospected in the 39 pits is approximately 1,600,000 cubic yards. Based on an average, present day, cost of about seven cents a cubic yard paid by the Highway Department for topping material, this total quantity would represent a mineral resource value of about $112,000.

In summary of the basic available data for the 39 pits:

(1) the quantity of material prospected ranged from 7,000 to 99,000 cubic yards, but average about 41,000 cubic yards;

(2) the thickness of usable material ranged from 0 to 35 feet, but averaged about 17 feet;

(3) the quantity of overburden to be removed ranged from 0 to 31,400 cubic yards, but averaged about 8,000 cubic yards; and

(4) the thickness of overburden ranged from 0 to 12 feet, but averaged about 3 feet.

In addition to the topping pits worked by the Highway Department, there are many others that are worked by the Board of Supervisors for materials for use in secondary road construction.

QUARTZITIC ROCK

Large masses of quartzitic rock are present locally in Attala County. For many years the existence of the stone has been known by geologists. The first reference to this material is by Wailes[5] in 1854 in a report on the agriculture and geology of the State. Several later reports of the Mississippi Geological Survey call attention to or describe the rock.

The most prominent development of the quartzitic rock is in the basal part of the Kosciusko (Sparta) formation. Similar stone also is present in the Basic City member of the Tallahatta formation and at a higher stratigraphic level in the Kosciusko

(Sparta) formation, but the rock at these horizons is not described here inasmuch as it exists in insignificant quantities.

The basal Kosciusko (Sparta) quartzitic rock crops out in a discontinuous, relatively narrow belt extending generally northwest and south from Kosciusko (Plate 4). The stone is most commonly found near the tops of hills and on the hillsides. It is present (1) in nearly horizontal beds (*in situ*), (2) as masses of large, fragmental, remnant boulders, (3) as a local aggregation in colluvial materials, and, (4) as isolated boulders of various shapes and sizes scattered over the hillslopes.

The quartzitic rock is both siliceous sandstone and siliceous siltstone, the latter being most abundant. Some intervals are cemented into quartzite or, more properly, orthoquartzite, showing little of its original arenaceous texture. The stone is light-gray in color but is commonly stained buff to yellow on its surface by iron oxide. The rock varies in hardness from a case-hardened, friable, siliceous cemented sandstone or siltstone to a dense, steel-hard quartzite.

Relatively large quantities of this material are available at several places with little or no overburden. The stone is commonly in beds one to five feet in thickness.* The individual beds may consist of several layers of rock each a foot or more thick, separated by beds or partings of sand or silt. The hardness or degree of cementation commonly differs among the various layers and also within the same layer. The rocks are fractured extensively, forming blocks from a few feet to a few yards across.

The more important outcrops of the quartzitic rock observed during the present investigation are shown on Plate 4. On the basis of the exposures examined, three general regions in which the stone is best developed are:

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*Thicknesses of the rock are reported in the literature up to 31 feet—See Crider,[6] Logan,[7] and Lowe.[8] Later workers in this area have observed that it is likely that the measurement of these greater thicknesses were made from exposures showing tilted, slump blocks of rock or masses of remnant boulders. Consequently, such measured thicknesses are an exaggeration of the actual thickness of the rocks *in situ*. No thickness of this magnitude was found during the present investigation.

(1) Along State Highway 43 and in adjacent areas (NE.¼, Sec.9 and NW.¼, Sec.3, T.14 N., R.7 E.) from about 1.7 to 3.2 miles north of the junction of State Highway 12 at Kosciusko;

(2) Along an east-west road connecting State Highway 43 and State Highway 35 and in adjacent areas (SE.¼, Sec.27 and SE.¼, Sec.28, T.15 N., R.7 E.) from about 0.3 to 1.7 miles west-northwest of State Highway 43; and

(3) Along a northeast-southwest ridge accessible only by log roads (SE.¼, Sec.4 and SW.¼, Sec.3, T.16 N., R.6 E.) from a gravel segment of the old highway west at least a mile from State Highway 35.

In the past there have been a few attempts to utilize the quartzitic rock in road construction, but these ventures have been unsuccessful reportedly because of the high cost of quarrying and crushing the stone. Consequently, the aggregate from this rock is not desirable as a common road metal or as a seal aggregate because its hardness and sharp edges would cause excessive tire wear. Perhaps, with improved methods, costs could be reduced enough to make a competitive aggregate suitable for such uses as lower course materials in highway construction, as aggregate in Portland cement concrete, and as ballast in railroad construction.

Lowe[9] in 1920 in his report on road-making materials gives the results of a test made on a sample of quartzitic rock from Kosciusko. The testing was conducted by ". . . the Office of Public Roads of the Department of Agriculture at Washington. . ."

"Report on Sample of Road Material from Kosciusko,

Attala County, Mississippi. (6)

(See Page 50)

Material Sandstone

Determinations:

Specific gravity (weight per cubic foot)	162.00
Absorption per cubic foot	0.90
Per cent of wear	6.30
French coefficient of wear	6.30
Hardness	19.20
Toughness	5.00"

No other tests are available on the Attala County material. However, a recent test (Laboratory No. 432-201) was made by the Mississippi State Highway Department on a sample of similar quartzitic rock present in the Wilcox of Montgomery County (NE.¼, Sec.13, T.20 N., R.7 E.). This stone showed an abrasion loss of 21.20 percent (Los Angeles abrasion) and good soundness. According to Clark[10] of the Highway Department, these results show that the material meets specifications for the following uses:

(1) coarse stabilizer;

(2) coarse aggregate in Portland cement concrete;

(3) coarse aggregate in hot asphalt mixes;

(4) rip-rap

(5) coarse aggregate for use as cover aggregate.

Other than its potential uses as an aggregate, the rock is suitable for use as rip-rap on various earth works such as dams, levees, bridge foundations, etc. The stone is being used by the Highway Department to re-enforce the foundation of the bridge on State Highway 12 across the Big Black River at Durant.

Locally, the fragmental rock is used to a limited extent in rustic style construction in building retaining walls, patios, sidewalks, flower beds, rock gardens, chimneys, barbecue pits, etc. However, the material would not be satisfactory commercial building stone because of its fracture and its variability in cementation.

IRON RICH MATERIALS

Iron rich materials are present at many places along a relatively narrow, highly irregular belt across Attala County, extending from the southeast corner to the northwest corner. This belt coincides generally with the Winona-Zilpha contact as shown on Plate 1. These materials are found in the Winona and Zilpha formations as relatively thin, discontinuous beds. The iron minerals represented are the carbonate, siderite ($FeCO_3$), and the oxides, limonite ($2\ Fe_2O_3 \cdot 3H_2O$) and hematite (Fe_2O).

The iron rich materials in the Winona formation consist chiefly of irregular, thin beds and masses of knobby or knotty, concretionary, limonitic sandstone and sandy ironstone. These materials, although characteristically developed at many places along the outcrop belt, are mostly surface and near surface deposits formed as the result of ground water concentration of iron that is derived, at least in part, from weathering glauconite. Where present, the materials are best developed in the upper part of the formation — the most prominent bed being just below the Winona-Zilpha contact. At this horizon, there is a discontinuous bed of sandy ironstone or limonitic sandstone that on the outcrop forms a distinctive ledge and is recognizable at many places. This bed varies from less than a foot to as much as five feet in thickness, but is more commonly two to three feet thick. In the subsurface, siderite is commonly encountered at this horizon. This discontinuous siderite bed ranges from a foot to two and a half feet in thickness.

The iron rich material in the Zilpha formation consists of relatively thin, discontinuous beds of concretionary siderite. The unweathered or unoxidized siderite is light-gray to buff in color and is variably sandy and commonly highly glauconitic. The beds are generally associated with the sandy and silty facies of the formation. Some beds consist of siderite or sideritic clay mixed with or as a matrix in glauconitic sand. Consequently, the siderite-to-sand-and-clay ratio varies greatly. On the outcrop, the siderite alters rapidly to iron oxides. The altered siderite is commonly found as flattened, ellipsoidal concretions of limonitic claystone or ironstone, having centers of unaltered or partially altered siderite. It is also represented by irregular, thin, discontinuous beds of warty, concretionary, limonitic sandstone and sandy ironstone.

Although the siderite beds may be present locally at various levels throughout the Zilpha section, there are two distinctive intervals at which they are best developed — in the lower 10 feet of the formation and from about 25 to 30 feet above the Winona-Zilpha contact. The siderite is not always present in these intervals, but at some places there may be several beds in a particular interval. The siderite-bearing beds vary from less than a foot up to three feet or more in thickness, but are more commonly one to two feet thick.

An investigation of Attala County iron rich materials has been made as a part of a separate study on the potential iron ores of the State. This report is now in preparation by Marshall

K. Kern of the Mississippi Geological Economic and Topographical Survey. A total of 23 test holes was drilled, and many samples were taken for chemical analysis. The test hole locations are shown on Plate 4. Field notes, test hole records, and chemical analyses were made available to the writer in order that some general information concerning the Attala County materials could be released. The publication of the more specific data will await completion of the iron ore report.

The work was concerned primarily with the preliminary investigation of the iron rich materials in the upper Winona formation and in the lower Zilpha formation. In general, the study showed that the materials in the lower Zilpha formation are in more significant quantities and of better quality than those in the Winona formation and that the siderite beds in the Zilpha formation are best developed in north central Attala County, especially in the region east and southeast of Hesterville (Plate 4). Nine test holes (A-4 through A-12) were drilled in the Hesterville area. The more prominent siderite beds encountered in drilling averaged about 2 feet in thickness. Analyses show that the iron (Fe) content of the samples from these beds range from about 25 to 40 percent.

In summary, the Attala County study shows that the iron rich materials do not exist in significant quantities nor are they of sufficient quality to be of much importance at the present time. However, if the processing of potential Mississippi iron ores should become economically feasible in the future, these materials should receive further attention.

GLAUCONITE

Glauconite or greensand is abundant in the Winona formation and in the sandy and silty facies of the Zilpha formation. It is a granular mineral that is characteristically green to dark-green in color. According to hundreds of analyses, glauconite is, chemically, a very complex hydrated iron aluminum silicate which may contain variable, but small, amounts of manganese, magnesium, calcium, sodium, and potassium and traces of titanium, vanadium, and phosphorus.

The Winona formation, which consists in most part of highly glauconitic quartz sand and greensand, crops out in a narrow, highly irregular belt across Attala County (Plate 1). The Winona varies from 15 to 35 feet in thickness. At most places, exposures are characterized by rusty, dark brick-red sand containing irregular, thin beds and masses of limonitic sandstone and sandy ironstone. These iron rich materials are the result of ground water concentration of iron that is derived in part from weathering glauconite. Consequently, unweathered or unoxidized glauconite is rarely found at the surface, except in relatively deep, freshly made excavations. The ratio of glauconite to quartz sand is variable, but based on samples of fresh material obtained in the drilling of test holes, the percentage of glauconite is high. Thomas[11] states that the glauconite content of the Winona sands ranges from 10 to 90 percent.

At places, glauconite is very abundant in the sandy and silty facies of the Zilpha formation. The lower 10 feet of the formation, which is in part very sandy and silty in the southern part of the outcrop area, locally contains thin glauconite and glauconitic silt beds and highly glauconitic sandy clays and clayey sands. Also at a level about 18 to 20 feet above the Winona-Zilpha contact is a glauconite and glauconitic silt bed. Although this bed was observed at only a few places, its persistance in the subsurface suggests that it should be present at the surface in at least the southern half of the outcrop area where it was not removed prior to the deposition of the Kosciusko formation. To the northwest along strike, the bed loses its distinguishing characteristics and is not easily recognizable. This glauconite and glauconitic silt bed, where fully developed, varies from about 10 to 12 feet in thickness.

Glauconite is used as a zeolitic water softener and as a source of potassium for fertilizer. The 1961 Minerals Yearbook reports that domestic production of greensand (glauconite) is by three firms — one in Maryland and two in New Jersey. The reported average output of these open pit operations for the 5-year period, 1957-61, was about 5,600 tons valued at $197,000. About 73 percent of the quantity sold in 1961 was used as a soil conditioner, and the other 27 percent was used in water softening.

LIGNITE

Beds of brown-black lignite are present at various levels in that portion of the Hatchetigbee exposed in Attala County. Exposures, however, are relatively non-existant. Commonly the lignites at the outcrop have disintegrated on weathering or are concealed by soil creep, slope wash or slump.

The thickest lignite found exposed is a six-inch bed in the north ditch of the road southeast from McCool (NE.¼, SW.¼, SE.¼, Sec.35, T.16 N., R.9 E.), 0.2 mile south of the main east-west road through the town.

Test Holes 18 and 19 and Core Holes 1, 2, and 5 were drilled in the Hatchetigbee outcrop area. Lignite beds were encountered in several of the holes, but no significant thicknesses were found. The maximum thickness penetrated was 1.5 feet in Core Hole 2 at a depth of 10.7 feet. Most beds were less than a foot thick. However, in Test Hole 8, which was drilled in the Tallahatta outcrop area, lignite encountered in the Hatchetigbee formation at a depth of 81.5 feet was estimated from cuttings to be about 11.0 feet thick.

At places a thin streak of lignite or a "smut" may be the only evidence to indicate the presence of a thicker bed beneath a hill. Such evidence, however, is inconclusive without the drilling of test holes. The locations of several thin lignite streaks or "smuts" are:

(1) in the cut of an east-west road (SE.¼, SE.¼, SW.¼, Sec.25, T.15 N., R.9 E.) just west of the junction of a north-south road from McCool to State Highway 14;

(2) in the cut of an east-west road (NE.¼, SE.¼, SW.¼, Sec.23, T.15 N., R.9 E.) 0.3 mile east of its junction with State Highway 411;

(3) in the cut of a northeast-southwest road from McCool to Ethel (SE.¼, SE.¼, NE.¼, Sec.10, T.15 N., R.9 E.) 0.7 mile southwest of its junction with State Highway 411;

(4) in the cut of an east-west segment of an unimproved road (SE.¼, NE.¼, SE.¼, Sec.1, T.16 N., R.8 E.) 0.4 mile west of the old Natchez Trace; and

(5) in the road bed on an east-west segment of an unimproved road (SW.¼, SE.¼, NE.¼, Sec.2, T.16 N., R.8 E.) 1.65 miles west of the old Natchez Trace.

Thick near-surface lignite beds are reported to have been encountered in a few water wells. In most cases this type of

TABLE 5
TEST WELLS DRILLED FOR OIL AND GAS IN ATTALA COUNTY[1]

Location: Township	Range	Section	Quarter	Operator and Fee Name	Completion Date	Elevation[2] (Feet)	Total Depth[3] (Feet)	Stratigraphic Unit: Surface[4]	Stratigraphic Unit: Bottom[5]
12 N	5 E	1	C SW NE	Weaver et al. No. 1 Rutherford	1948	292	4510	Ek	Kt
13 N	5 E	33	C SE SE	Crosby No. 1 Allen	1941	290	4534	Ewa	Kt
13 N	6 E	4	C SE SW	Stanolind Oil & Gas Co. No. 1 Steed	1947	329	7108	Ek	P
13 N	6 E	28	C SW NE	Continental Oil Co. No. 1 Sudduth	1952	342	8018	Ek	P
14 N	5 E	28	NE NW NE	Erle P. Halliburton, Inc. No. 1 Hester	1944	318	5435	Ek	LK
14 N	6 E	12	SW NW SE	Roscoe No. 1 Sims	1944	456	4437	Ek	LK
14 N	7 E	3	C NW NE	Jackson & Spearman No. 1 Crosby	1940	528	5262	Ek	LK
14 N	9 E	5	C NE NE	Shell Oil Co. No. 1 Wheeless	1945	511	6217	Et	P
15 N	5 E	2	NW SE NW	Arkansas-Louisiana Pipeline Co. No. 1 Moore	1930	271	3772	Ez	Kt
15 N	6 E	29	NW NW SW	Hawkins et al. No. 1 Weeks	1940	353	5017	Ek	LK
15 N	9 E	5	NE	Home Oil Co. No. 1 Dill	1911	----	1900	Et	Ks
15 N	9 E	35	SE NE SE	Gulf Refining Co. No. 1 Peeler	1940	580	5030	Et	Jr
16 N	6 E	4	C NW NW	Hunt Oil Co. No. 1 Murphy	1943	281	5748	Et	P
16 N	6 E	4	SE NW NW	Justiss Mears Oil Co. et al. No. 1 Bingham	1951	286	2308	Et	Ks
16 N	9 E	29	NW NW SE	Jackson et al. No. 1 Federal Land Bank-Peeler	1940	496	4512	Et	LK

[1]Compiled from records in the files of the Mississippi Geological Survey Sample Library.
[2]Derrick floor elevation.
[3]Drillers total depth.
[4]Et-Tallahatta; Ez-Zilpha; Ek-Kosciusko; and Ewa-Wautubbee (See Geologic Map—Plate 1).
[5]P-Pennsylvanian; Jr-Jurassic; LK-Lower Cretaceous; Kt-Upper Cretaceous-Tuscaloosa; and Ks-Upper Cretaceous-Selma.

information has proven to be unreliable because in drilling or digging operations dark-colored lignitic clay containing thin lignite beds is commonly mistaken for a thick deposit of lignite by inexperienced persons.

Although no commercially promising lignite deposits were found during this survey, it must be pointed out that the Hatchetigbee formation covers approximately 45 square miles in northeastern Attala County. When and if lignite is mined in Mississippi as a mineral product, this should be considered a prospective area.

OIL AND GAS

To date, 15 wildcat test wells have been drilled in Attala County in search of oil and gas. All were abandoned as dry holes without reliable shows. Table 5 gives certain general data concerning these test wells.

The first well, completed in 1911, was the Home Oil Company No. 1 Dill. The well, located in the northeastern part of the County, reached a total depth of only 1,900 feet, where it bottomed in the Upper Cretaceous Selma. It probably was shallow of any possible oil- and gas-bearing beds in that area.

The greatest period of exploration was in the 1940's and early 1950's when 13 wells were drilled, scattered over the County on several different prospects.

The most recent well, completed in 1952, was the Continental Oil Company No. 1 Sudduth. This well, also the deepest, was located in the southwestern part. It reached a total depth of 8,018 feet, where it bottomed in Paleozoic rocks.

The oil and gas possibilities of Attala County are discussed in the report on "Subsurface Geology" by William H. Moore.

TEST HOLE RECORDS*

Test Hole 1

Location: Approximately 110 feet north of the center line of State Highway 14 (Center NE.1/4, NW.1/4, Sec. 34, T.14N., R.8E.) about 0.2 mile west of the junction of State Highways 14 and 19.

Elevation: 527 feet (altimeter) Date: May 29, 1962

Thickness	Depth	Description
		Kosciusko formation
6.0	6.0	Sand, orange, fine-grained, silty.
		Zilpha formation (Middle clay member)
7.5	13.5	Clay, gray to light-brown mottled red and yellow, slightly silty, plastic.
3.5	17.0	Clay, chocolate-brown, moderately silty, very finely micaceous.
1.0	18.0	Silt, yellow to light-brown, glauconitic, clayey, very finely micaceous.
8.0	26.0	Clay, chocolate-brown, moderately silty, very finely micaceous.
		Zilpha formation (Zama member)
4.5	30.5	Glauconite, dark green-gray, finely micaceous, silty, slightly sandy, sparingly fossilferous.
0.6	31.1	Siderite, light-gray to tan, hard, very glauconitic, slightly sandy, sparingly fossiliferous.
1.9	33.0	Glauconite, dark green-gray to black, silty, sandy.
0.5	33.5	Siderite, light-gray to tan, moderately hard, very glauconitic, slightly sandy.
4.0	37.5	Glauconite, dark green-gray to black, silty, sandy; contains some selenite crystals.
8.5	46.0	Clay, dark-gray, compact, slightly to moderately silty.
8.0	54.0	Glauconite or glauconitic silt, gray to gray-green, sandy, clayey, contains thin layers of siderite.
3.0	57.0	Sand, gray-green, very glauconitic, silty, clayey.
		Winona formation
2.0	59.0	Siderite, light-gray to tan, very glauconitic, sandy, fossiliferous.
23.0	82.0	Sand, green-gray, medium-grained, very glauconitic, silty, fossiliferous; contains several thin shell beds.
		Tallahatta formation (Neshoba sand member)
21.0	103.0	Sand, green-gray, fine-grained, glauconitic to sparingly glauconitic, silty; contains some clay mixed.
40.5	143.5	Sand, gray, fine-grained, sparingly and finely micaceous.
0.5	144.0	Clay shale, dark brown-gray.
10.0	154.0	Sand, gray, fine-grained, sparingly and finely micaceous.
		Tallahatta formation (Basic City shale member)
4.0	158.0	Clay shale, blue-gray, silty, sandy, lignitic, sparingly micaceous.
9.0	167.0	Clay shale, blue-gray, silty, sandy, lignitic, sparingly micaceous; contains thin layers of hard rock up to 6 inches thick.
22.0	189.0	Sand, gray, medium to coarse-grained; contains a small amount of lignite.
10.0	199.0	Clay shale, blue-gray, sparingly and finely micaceous, silty, sandy; contains thin layers of hard rock up to 2 inches thick.
15.0	214.0	Sand, light blue-gray, very fine-grained, silty, clayey.
23.0	237.0	Clay Shale, blue-gray, sparingly and finely micaceous; contains thin layers of hard rock up to 6 inches thick.

*All thicknesses and depths in feet.

		Tallahatta formation (Meridian sand member)
5.0	242.0	Clay shale, dark-brown, lignite, micaceous.
6.0	248.0	Sand, gray, medium to coarse-grained.
32.0	280.0	Sand, gray, fine to medium-grained, sparingly micaceous; contains some streaks of clay; and some relatively large flakes of muscovite mica.
		Hatchetigbee formation
22.0	302.0	Clay, dark green-gray, sparingly and finely micaceous, silty, sandy; contains a few thin rocks in upper part.
8.0	310.0	Sand, white, coarse-grained.
1.0	311.0	Lignite, brown-black, soft.
9.0	320.0	Sand, gray, medium-grained.
1.5	321.5	Lignite, brown-black, soft.
4.5	326.0	Sand, gray, fine-grained.
24.0	350.0	Clay, dark-gray, carbonaceous, silty, sandy.

Test Hole 2

Location: Approximately 40 feet north of the center of an east-west road and 25 feet east of the junction of a road northwest (NW.1/4, SE.1/4, SE.1/4, Sec.21, T.16N., R.7E.) 0.2 mile east of the road intersection at Oak Grove Church.

Elevation: 528 feet (altimeter) Date: June 1, 1962

Thickness	Depth	Description
5.0	5.0	Soil and subsoil—clay loam, brown, silty, sandy.
		Kosciusko formation
5.5	10.5	Sand, tan to white, very fine-grained, very silty, clayey.
1.0	11.5	Limonitic sandstone, tan to red-brown, soft to hard.
		Zilpha formation
2.5	14.0	Clay, gray mottled yellow and red, plastic, slightly silty.
6.0	20.0	Clay, gray to light-brown, silty, sandy, glauconitic, finely micaceous; contains streaks of yellow very glauconitic silty sand.
1.5	21.5	Clay, chocolate-brown, slightly silty.
5.5	27.0	Clay, gray to light-brown, silty, sandy, glauconitic; contains streaks of very glauconitic sandy silt and a thin streak of olive bentonitic clay.
		Winona formation
0.5	27.5	Limonitic sandstone, yellow to red-brown, glauconitic, moderately hard.
4.5	32.0	Sand, green-gray, fine to medium-grained, silty, very glauconitic.
18.0	50.0	Sand, green-gray, fine to medium-grained, glauconitic to very glauconitic.
		Tallahatta formation (Neshoba sand member)
4.0	54.0	Sand, buff to white, fine-grained, clayey; stained yellow in part with iron oxide.
0.5	54.5	Limonitic sandstone, yellow to brown-black, hard.
2.5	57.0	Sand, yellow to pink, fine-grained.
9.0	66.0	Sand, orange-red, medium to coarse-grained.
0.4	66.4	Limonitic sandstone, yellow to brown-black, moderately hard.
0.7	67.1	Sand, yellow to tan, medium-grained.
0.4	67.5	Limonitic sandstone, yellow to brown-black, moderately hard.
66.5	134.0	Sand, buff to white, fine-grained; contains streaks of silty white clay.

16.0	150.0	Sand, buff to tan, fine-grained; contains many streaks and much white clay mixed.
30.0	180.0	Sand, buff to tan, fine-grained.
10.0	190.0	Sand, buff to white, fine-grained.
4.0	194.0	Sand, buff to tan, fine-grained; contains a few streaks of white silty clay.
		Tallahatta formation (Basic City shale member)
11.0	205.0	Clay shale, blue-gray, silty, sandy, sparingly and finely micaceous; contains thin layers of hard rock up to 2 inches thick.
		Tallahatta formation (Meridian sand member)
14.0	219.0	Sand, gray, fine-grained; contains some gray clay.
11.0	230.0	Sand, brown-gray, fine-grained; contains some relatively large flakes of muscovite mica—lost circulation; could not run electrical log.

Test Hole 3

Location: Approximately 15 feet north of field road and 120 feet east-southeast of the center of the Old Natchez Trace (NW.1/4, NW.1/4, Sec.31, T.15N., R.8E). about 0.3 mile southwest of the junction of the Old Natchez Trace and a road north.

Elevation: 501 feet (altimeter) Date: June 12, 1962

Thickness	Depth	Description
2.0	2.0	Soil and subsoil—clay loam, tan to brown, sandy, silty.
		Zilpha formation
3.0	5.0	Clay, brown to red-brown, sandy, silty; contains some glauconite disseminated.
1.0	6.0	Clay, light-gray to buff, silty, sandy, very glauconitic.
2.0	8.0	Clay, gray, slightly silty, plastic.
4.0	12.0	Clay, gray to chocolate-brown, moderately silty.
9.0	21.0	Clay, chocolate-brown, compact, slightly to moderately silty.
2.5	23.5	Clay, gray, very sandy, very glauconitic; contains thin streaks of ironstone.
		Winona formation
2.0	25.5	Limonitic sandstone, tan to red-brown, moderately hard, very glauconitic.
10.5	36.0	Sand, green-gray, fine to meduim-grained, very glauconitic; contains some clay mixed.
9.5	45.5	Sand, orange-red, fine to medium-grained, glauconitic; contains thin layer of ironstone at top.
		Tallahatta formation (Neshoba sand member)
12.5	58.0	Sand, yellow to red, fine-grained; contains much light-gray clay mixed.
45.0	103.0	Sand, buff to tan, fine-grained, sparingly micaceous; contains streaks of light-gray and pink clay.
4.0	107.0	Clay shale, dark-gray to brown-black, very carbonaceous, micaceous.
16.0	123.0	Sand, buff to tan, fine-grained, silty; contains streaks of light-gray to pink clay.
29.0	152.0	Sand, tan to orange-red, medium-grained.
23.0	175.0	Sand, buff to tan, fine-grained, silty; contains streaks of light-gray to yellow clay.
		Tallahatta formation (Basic City shale member)
29.0	204.0	Clay shale, blue-gray, sandy, silty; contains thin layers of hard rock up to 10 inches thick.

		Tallahatta formation (Meridian sand member)
7.0	211.0	Sand, gray, fine-grained, sparingly micaceous; contains some lignite disseminated.
7.0	218.0	Clay shale, dark-gray, sandy.
23.0	241.0	Sand, gray, fine-grained, sparingly micaceous; contains some streaks of dark-gray clay.
		Hatchetigbee formation (?)
3.0	244.0	Clay, dark-gray, sandy.
46.0	290.0	Sand, gray to dark-gray, very fine-grained, silty, clayey; contains several thin lignite beds.

Test Hole 4

Location: In the front yard of an abandoned house approximately 20 feet southwest of the center of a northwest-southeast trending road (SW.1/4, SW.1/4, Sec.16, T.14N., R.9E.) 2.4 miles northwest of State Highway 14.

Elevation: 533 feet (altimeter) Date: June 13, 1962

Thickness	Depth	Description
1.0	1.0	Soil and subsoil—clay loam, light-gray to brown, silty, sandy.
		Tallahatta formation (Basic City shale member)
7.0	8.0	Clay, light-gray to buff, very sandy, silty, finely micaceous.
3.0	11.0	Siliceous siltstone, light-gray to buff, hard.
14.0	25.0	Clay shale, blue-gray, sandy, silty, very finely micaceous; contains several thin layers of hard rock up to 1.5 feet thick.
5.0	30.0	Sand, gray, fine-grained; contains some clay and finely disseminated lignite.
3.5	33.5	Clay shale, green-gray to dark-gray, silty, sandy, very finely micaceous.
0.8	34.3	Siliceous siltstone, light-gray to buff, hard.
1.7	36.0	Sand, gray, fine-grained; contains thin streaks of dark-gray clay and lignite.
29.0	65.0	Clay shale, dark green-gray, silty, sandy, very finely micaceous; contains several thin layers of hard rock up to 10 inches thick.
		Tallahatta formation (Meridian sand member)
4.0	69.0	Clay shale, brown-black, sandy, silty, very carbonaceous, very micaceous.
24.0	93.0	Sand, gray, medium-grained; contains some finely disseminated lignite.
		Hatchetigbee formation
3.0	96.0	Clay, dark green-gray, slightly sandy, finely micaceous.
20.0	116.0	Clay, dark green-gray, silty, sandy, very finely micaceous; contains streaks of fine sand.
9.0	125.0	Clay, dark-gray to brown-black, silty, sandy, very finely micaceous, very carbonaceous.
25.0	150.0	Sand, gray to dark-gray, very fine-grained, silty, very micaceous, carbonaceous; contains numerous large flakes of muscovite mica and several thin lignite beds.

Test Hole 5

Location: At north edge of pine grove in pasture about 150 feet north of the center of an east-west trending road (NW.1/4, NE.1/4, Sec.16, T.13N., R.7E.) 1.3 miles west of State Highway 35.

Elevation: 410 feet (altimeter) Date: June 15, 1962

Thickness	Depth	Description
5.0	5.0	Soil and subsoil—clay loam, tan, sandy, silty.
3.0	8.0	Terrace deposit—sand, buff to tan, very silty, very clayey.

		Zilpha formation (Middle clay member)
6.5	14.5	Clay, gray to chocolate-brown, slightly to moderately silty.
1.5	16.0	Clay, chocolate-brown, slightly silty.
28.0	44.0	Clay, dark-gray, slightly to moderately silty; contains thin streak of glauconite.
		Zilpha formation (Zama member)
6.0	50.0	Glauconite, dark green-gray, silty, sandy, sparingly fossiliferous; contains thin layers of siderite.
4.0	54.0	Silt, green-gray, finely glauconitic.
10.0	64.0	Clay, dark-gray, moderately silty, compact.
3.0	67.0	Glauconite, dark green-gray, silty, sandy; contains thin layers of siderite.
1.0	68.0	Siderite, buff, hard, glauconitic.
4.0	72.0	Glauconite, dark green-gray, silty, clayey, sandy, sparingly fossiliferous.
		Winona formation
30.0	102.0	Sand, green-gray, fine to medium-grained, glauconitic to very glauconitic; fossiliferous; contains several thin shell beds.
		Tallahatta formation (Neshoba sand member)
4.0	106.0	Clay shale, dark-gray sandy.
36.0	142.0	Sand, gray, fine-grained, sparingly micaceous, sparingly glauconitic.
2.5	144.5	Clay shale, dark-gray sandy.
29.5	174.0	Sand, gray, fine to medium-grained, sparingly micaceous, sparingly glauconitic.
		Tallahatta formation (Basic City shale member)
22.0	196.0	Sand, green-gray, fine-grained, micaceous, silty; contains streaks of sandy clay.
23.0	219.0	Clay shale, blue-gray, silty, finely micaceous; contains thin layers of hard rock up to 14 inches thick.
18.0	237.0	Sand, gray, fine-grained, sparingly micaceous; contains a few streaks of clay.
17.0	254.0	Clay shale, blue-gray to green-gray, finely micaceous; contains thin layers of hard rock up to 8 inches thick.
		Tallahatta formation (Meridian sand member)
37.5	291.5	Sand, gray, medium to very coarse-grained, micaceous; contains some streaks of dark-gray clay.
2.0	293.5	Clay shale, dark green-gray, very silty.
30.5	324.0	Sand, gray, fine-grained; contains thin bed of lignite.
		Hatchetigbee formation (?)
6.0	330.0	Clay, dark-gray, silty, finely micaceous; contains thin bed of lignite at top.
20.0	350.0	Sand, gray, fine to medium-grained, micaceous; contains a few streaks of dark-gray clay and lignite.

Test Hole 6

Location: At top of hill about 50 feet north of turn-out and 75 feet east of center of road (NE.1/4, SE.1/4, Sec.10, T.16N., R.8E.) 0.2 mile south of the junction of a road east.

Elevation: 523 feet (altimeter) Date: July 15, 1962

Thickness	Depth	Description
		Tallahatta formation
2.5	2.5	Sand, red-brown, silty clayey.
26.5	29.0	Sand, tan to red-brown, medium-grained, very sparingly glauconitic; stained with iron oxide; contains some light-gray to pink clay

15.5	44.5	Sand, tan to buff, medium-grained; contains some white to purple clay.
2.0	46.5	Clay light-gray mottled purple-red, plastic.
19.5	66.0	Sand, tan, fine to medium-grained, sparingly micaceous; some streaks of silty clayey fine sand.
6.0	72.0	Clay shale, dark-gray to black, finely and very micaceous, carbonaceous; contains thin streak of lignite.
14.5	86.5	Sand, gray, fine-grained, finely and very micaceous; contains some lignite.
		Hatchetigbee formation (?)
5.5	92.0	Clay, dark-gray, silty, finely micaceous.
27.0	119.0	Sand, gray, fine-grained, silty, very micaceous; contains some relatively large flakes of muscovite mica and some lignite.
2.5	121.5	Clay shale, dark-gray to black, very micaceous, carbonaceous.
6.5	128.0	Sand, gray, fine-grained, very micaceous.
18.5	146.5	Sand, gray to dark-gray, fine-grained, micaceous, clayey.
13.5	160.0	Clay, light-gray to gray, plastic.

Test Hole 7

Location: Approximately 35 feet east of the center of the north-south road to Oak Ridge Church (NW.1/4, NW.1/4, Sec.20, T.16N., R.8E.) about half-way between the junctions of a road northeast and a road west.

Elevation: 464 feet (altimeter) Date: July 19, 1962

Thickness	Depth	Description
2.5	2.5	Soil and subsoil—red-brown, silty.
		Tallahatta formation (Neshoba sand member)
7.5	10.0	Sand, orange-red, medium to coarse-grained, micaceous; contains streak of light-gray to purple clay and some ironstone mixed.
20.0	30.0	Sand, buff, fine-grained, micaceous; contains streaks of white to tan clay.
10.0	40.0	Sand, buff, medium-grained, micaceous.
6.0	46.0	Sand, buff to yellow, medium-grained, micaceous.
		Tallahatta formation (Basic City shale member)
2.0	48.0	Clay shale, blue-gray, silty, sandy, micaceous; contains some finely disseminated lignite.
0.5	48.5	Siliceous siltstone, buff, moderately hard.
21.0	69.5	Sand, buff to yellow, fine to medium-grained; contains some thin streaks of white clay in upper part and streaks of silty, clayey, micaceous, glauconitic, fine sand in lower part.
9.5	79.0	Silt, light-gray to buff, clayey, sandy micaceous; stained in part with iron oxide.
		Tallahatta formation (Meridian sand member)
12.5	91.5	Sand, buff, medium to coarse-grained.
1.5	93.0	Clay shale, gray to dark-gray, micaceous; contains some lignite.
27.0	120.0	Sand, gray, fine to medium-grained, micaceous; contains some streaks of gray clay and some relatively large flakes of muscovite mica.
		Hatchetigbee formation (?)
22.0	142.0	Clay, gray to dark-gray, silty, micaceous, lignitic.
4.0	146.0	Sand, gray medium to coarse-grained.
5.0	151.0	Clay, dark-gray to black, slightly silty, plastic.
9.0	160.0	Sand, gray, fine-grained, micaceous.
40.0	200.0	Clay, light-gray to gray, silty, sandy, finely micaceous.
70.0	270.0	Clay, gray to dark-gray, sandy, silty, finely micaceous; contains layers of silt and silty fine sand and a few thin beds of lignite.

Test Hole 8

Location: In center of log road 0.05 mile west of the farm road junction west of house (NE.1/4, NE.1/4, Sec.16, T.16N., R.8E.).

Elevation: 432 feet (altimeter) Date: July 22, 1962

Thickness	Depth	Description
2.0	2.0	Soil and subsoil—silt, red-brown to tan, clayey, micaceous.
		Tallahatta formation (Basic City shale member)
8.0	10.0	Silt, white to buff mottled yellow to orange-red, micaceous; contains laminae of gray clay and a few thin layers of siliceous siltstone up to 4 inches thick.
26.5	81.5	Clay, dark-gray, silty, sandy, micaceous; contains several thin layers of light-gray micaceous silt and a few thin layers of siliceous siltstone up to 4 inches thick.
17.0	38.0	Clay shale, gray to dark-gray, lignitic; contains many laminae and several thin layers of light-gray micaceous silt.
		Tallahatta formation (Meridian sand member)
12.0	50.0	Sand, gray, fine-grained, micaceous.
5.0	55.0	Sand, gray, coarse-grained, micaceous; contains thin bed of lignite.
		Hatchetigbee formation
26.5	81.5	Clay, dark-gray, silty, sandy, micaceous; contains several thin streaks of lignite.
11.0	92.5	Lignite, brown-black, soft.
28.5	121.0	Clay, dark-gray to black, plastic, slightly silty to silty, finely micaceous; contains several thin beds of lignite.
5.0	126.0	Sand, gray, fine to medium-grained, silty, micaceous.
6.0	132.0	Clay, dark-gray to black, plastic, slightly silty, lignitic.
6.0	138.0	Sand, gray, fine-grained, silty, micaceous.
12.0	150.0	Clay, gray to dark-gray, slightly silty, plastic, lignitic.

Test Hole 9

Location: On the inside of a curve about 60 feet east of the center of a north-south road (center SW.1/4, Sec.27, T.16N., R.7E.) 0.3 mile north of the east-west road from Shady Grove Community to New Salem Church.

Elevation: 412 feet (altimeter) Date: July 24, 1962

Thickness	Depth	Description
2.5	2.5	Soil and subsoil, clay loam, red-brown, silty, sandy.
		Tallahatta formation (Neshoba sand member)
5.5	8.0	Sand, buff to tan, fine-grained.
4.0	12.0	Sand, light-gray, very fine-grained
3.0	15.0	Sand, buff to yellow, fine to medium-grained, silty clayey.
4.0	19.0	Clay, dark-gray, slightly silty, plastic, finely micaceous.
1.5	20.5	Clay, light-gray mottled yellow to tan, silty, sandy, finely micaceous.
28.5	49.0	Sand, buff to tan, medium to coarse-grained, micaceous.
		Tallahatta formation (Basic City shale member)
7.0	56.0	Clay, brown-black, slightly silty, plastic, finely micaceous.
38.0	94.0	Clay shale, blue-gray, silty, sandy, micaceous; contains several thin layers of hard rock up to 12 inches thick.
		Tallahatta formation (Meridian sand member)
24.0	118.0	Sand, gray, fine to medium-grained, micaceous.

		Hatchetigbee formation (?)
16.0	134.0	Clay, gray to dark-gray, silty, sandy, finely micaceous; contains thin beds of lignite.
52.0	186.0	Sand, gray, fine-grained, micaceous; contains thin beds of dark-gray clay shale and lignite.
114.0	300.0	Clay, light-gray to gray, slightly silty to moderately silty, plastic.

Test Hole 10

Location: Approximately 35 feet southwest of the center of a northwest-southeast segment of the road to Sand Hill Church (SE.1/4, SW.1/4, NE.1/4, Sec.1, T.15N., R.6E.) 0.4 mile southeast of an unimproved road northeast.

Elevation: 457 feet (altimeter) Date: July 27, 1962

Thickness	Depth	Description
3.0	3.0	Soil and subsoil—sandy loam, brown, silty, clayey.
		Kosciusko formation
12.0	15.0	Sand, tan, to red-brown, fine to medium-grained, silty.
3.0	18.0	Clay, white mottled yellow to tan, silty, sandy, plastic.
7.0	25.0	Sand, gray, fine-grained, finely micaceous.
		Zilpha formation
33.0	58.0	Clay, dark-gray, slightly silty to silty, finely micaceous.
14.0	72.0	Clay, dark-gray, silty, sandy, fossiliferous; contains streaks of glauconite and a few thin layers of siderite.
		Winona formation
10.0	82.0	Sand, green-gray, fine to medium-grained, very glaucontic, fossiliferous.
20.0	102.0	Sand, green-gray, medium to coarse-grained, very glauconitic, fossiliferous; contains thin shell bed.
		Tallahatta formation (Neshoba sand member)
9.0	111.0	Sand, yellow-tan, fine to medium-grained, sparingly glauconitic.
14.0	125.0	Sand, yellow-tan, medium to coarse-grained.
50.0	175.0	Sand, tan to orange-red, medium to coarse-grained, sparingly micaceous; contains streaks of white to purple clay.
7.0	182.0	Sand, gray to gray-tan, fine-grained.
		Tallahatta formation (Basic City shale member)
10.0	192.0	Clay shale, blue-gray, sandy, silty; contains a few thin layers of hard rock up a few inches thick.
49.0	241.0	Sand, gray to gray-tan, fine-grained, finely micaceous; contains many streaks of clay shale and several thin layers of hard rock up to 8 inches thick.
7.0	248.0	Clay shale, blue-gray to dark-gray, sandy, silty; contains several thin layers of hard rock up to 6 inches thick.
26.5	274.5	Sand, gray to tan, fine to medium-grained, silty.
		Tallahatta formation (Meridian sand member)
23.5	298.0	Sand, gray to tan, medium to coarse-grained; contains streaks of dark green-gray clay shale.
44.0	342.0	Sand and clay shale interbedded.
		Hatchetigbee formation
18.0	360.0	Sand, gray to gray-tan, fine-grained, finely micaceous.

Test Hole 11

Location: In bed of dim road approximately 35 feet north of the center of the west and west-northwest road from Hesterville to Possumneck (NW.1/4, SE.1/4, SW.1/4, Sec.9, T.15N., R.6E.) 0.1 mile east of the junction of a road north.

Elevation: 384 feet (altimeter) Date: August 1, 1962

Thickness	Depth	Description
		Zilpha formation
3.0	3.0	Clay, light-gray to tan, silty, sandy.
4.0	7.0	Clay, buff to tan, silty, sandy.
0.3	7.3	Ironstone, yellow to red-brown, hard.
6.7	14.0	Silt, buff to tan, clayey, sandy, glauconitic; stained yellow in part with iron oxide.
5.0	19.0	Clay, chocolate, slightly silty.
17.0	36.0	Clay, dark-gray, slightly silty, compact.
0.3	36.3	Siderite, gray, moderately hard, glauconitic.
3.2	39.5	Clay, dark-gray, silty, sandy glauconitic.
		Winona formation
5.5	45.0	Sand, green-gray, medium to coarse-grained, very glauconitic, fossiliferous; contains thin layers of siderite.
27.0	72.0	Sand, green-gray, medium to coarse-grained, very glauconitic; contains several thin shell beds.
4.0	76.0	Sand, dark green-gray, medium to coarse-grained, silty, clayey, glauconitic.
		Tallahatta formation (Neshoba sand member)
18.0	94.0	Sand, green-gray, fine to coarse-grained, glauconitic (?)
11.0	105.0	Sand, green-gray, fine-grained, silty, clayey, finely micaceous.
62.0	167.0	Sand, gray, fine to medium-grained, sparingly micaceous.
2.0	169.0	Clay shale, dark-gray, slightly silty.
4.0	173.0	Sand, gray, fine to medium-grained, sparingly micaceous.
4.0	177.0	Clay shale, dark-gray to brown-black, silty, sandy, finely micaceous.
7.0	184.0	Sand, gray, fine-grained.
		Tallahatta formation (Basic City shale member)
10.0	194.0	Clay shale, dark-gray, silty, sandy, finely micaceous; contains thin layers of hard rock up to 10 inches thick.
13.0	207.0	Sand, gray, fine to medium-grained, sparingly micaceous.
19.0	226.0	Clay shale, blue-gray, silty, sandy, finely micaceous; contains thin layers hard rock up to 3 inches thick.
19.0	245.0	Sand, gray to green-gray, fine to medium-grained, silty, clayey; contains several thin layers of hard rock.
3.0	248.0	Clay shale, blue-gray, sandy, silty, micaceous; contains several thin layers of hard rock.
		Tallahatta formation (Meridian sand member)
12.0	260.0	Sand, green-gray to dark-gray, fine to medium-grained; contains many streaks of clay shale and many thin layers of hard rock up to a few inches thick.
10.0	270.0	Sand, gray, medium to coarse-grained.
7.0	277.0	Sand, gray, fine to medium-grained, sparingly micaceous; contains thin streaks of dark-gray clay and a thin streak of lignite.
13.0	290.0	Sand, gray, fine to medium-grained, sparingly micaceous; contains a few streaks of clay shale and some lignite.
12.0	302.0	Sand, gray, medium to coarse-grained; contains streaks of clay shale and some lignite.

		Hatchetigbee formation
3.0	305.0	Clay, dark-gray, silty, finely micaceous.
40.0	345.0	Sand, gray, fine to medium-grained, micaceous.
15.0	360.0	Clay shale, black, silty, sandy, very micaceous.

Test Hole 12

Location: In center of dim road at edge of power line right-of-way about 50 feet east of center of north-south road (SW.1/4, NE.1/4, Sec.23, T.15N., R.5E.) 0.35 mile south of the junction of road southeast.

Elevation: 352 feet (altimeter) Date: August 2, 1962

Thickness	Depth	Description
10.0	10.0	Loess (?)—clay loam, buff to tan, silty.
		Kosciusko formation
10.0	20.0	Sand, orange-red, fine-grained, silty, clayey.
63.0	83.0	Sand, light-gray to buff, coarse to very coarse-grained.
		Zilpha formation (Middle clay member)
25.0	108.0	Clay, dark-gray, lignitic.
		Zilpha formation (Zama member)
14.0	122.0	Glauconite or glauconitic silt, dark green-gray, sandy; contains several thin layers of hard rock (siderite?) up to 4 inches thick
18.0	140.0	Clay, dark-gray to black, slightly silty, finely micaceous.
16.0	156.0	Clay, dark-gray to black, finely micaceous; contains streaks of glauconite or glauconitic silt.
		Winona formation
2.0	158.0	Fossil shell bed.
30.0	188.0	Sand, dark gray-green, fine to coarse-grained, very glauconitic; contains several thin shell beds.
		Tallahatta formation (Neshoba sand member)
28.0	216.0	Sand, gray, fine to medium-grained.
5.0	221.0	Clay shale, dark-gray, silty.
43.0	264.0	Sand, gray, fine to medium-grained, sparingly micaceous; contains a few streaks of clay shale.
		Tallahatta formation (Basic City shale member)
24.0	288.0	Sand, gray, very fine-grained, silty, micaceous; contains streak of dark green-gray, micaceous clay shale.
9.0	297.0	Sand, gray, fine to coarse-grained; contains thin layer of hard rock in upper part.
23.0	320.0	Clay shale, blue-gray, finely micaceous, silty, sandy; contains several thin layers of hard rock up to 3 inches thick.

Test Hole 13

Location: On west edge of access road at approximately the sand-clay contact near the west corner of Delta Brick and Tile Company's clay pit (SE.1/4, NW.1/4, Sec.11, T.14N., R.5E.).

Elevation: 360 feet (altimeter) Date: August 7, 1962

Thickness	Depth	Description
		Kosciusko formation
18.0	18.0	Clay, light-gray to white, plastic.
22.0	40.0	Silt, light-gray to buff, sandy.
30.0	70.0	Sand, light-gray to buff, medium to coarse-grained.
30.0	100.0	Sand, light-gray to buff, medium-grained.
51.0	151.0	Sand, light-gray to buff, fine to medium-grained.

		Zilpha formation (Middle clay member)
30.5	181.5	Clay, dark-gray, sparingly lignitic (?).
		Zilpha formation (Zama member)
1.0	182.5	Siderite, buff to tan, moderately hard, sparingly glauconitic.
1.5	184.0	Clay, dark-gray, sparingly glauconitic.
1.0	185.0	Siderite, buff to tan, moderately hard, sparingly glauconitic.
18.0	203.0	Clay, dark-gray, finely micaceous.
4.0	207.0	Glauconitic clay and glauconitic silt, green-gray, sandy.
4.0	211.0	Siderite, buff to tan, moderately hard, glauconitic.
4.0	215.0	Clay, dark-gray, glauconitic.
4.0	219.0	Siderite, buff to tan, moderately hard, glauconitic.
6.0	225.0	Clay, dark-gray, glauconitic.
		Winona formation
25.0	250.0	Sand, gray-green, fine to coarse-grained, very glauconitic, fossiliferous; contains a few thin shell beds.
		Tallahatta formation (Neshoba sand member)
27.0	277.0	Sand, fine to medium-grained, glauconitic (?).
13.0	290.0	Clay shale, dark-gray.

Test Hole 14

Location: On flat near south edge of small creek branch about 100 feet southeast of the center line of U. S. Highway 51 (SE.1/4, SW.1/4, NW.1/4, Sec.31, T.15N., R.5E.), about 0.55 mile southwest of the junction of a road west—Holmes County.

Elevation: 288 feet (altimeter) Date: August 9, 1962

Thickness	Depth	Description
2.0	2.0	Soil and subsoil—clay loam, tan, sandy, silty.
		Kosciusko formation
5.5	7.5	Clay, light-gray mottled pink to red, silty.
24.5	32.0	Sand, tan to yellow-tan, fine-grained, sparingly micaceous.
20.0	52.0	Sand, light-gray to tan, fine-grained, micaceous; contains streaks of white silty clay.
36.0	88.0	Sand, light-gray to buff, fine to medium-grained.
6.0	94.0	Sand, light-gray to buff, coarse to very coarse-grained.
29.0	123.0	Sand, light-gray to buff, fine to medium-grained.
3.0	126.0	Sand, light-gray to buff, coarse-grained.
		Zilpha formation (Middle clay member)
24.0	150.0	Clay, dark-gray, slightly silty to silty, finely micaceous.
14.0	164.0	Clay, dark-gray, slightly silty, finely micaceous.
		Zilpha formation (Zama member)
10.0	174.0	Clay, dark-gray, silty, sandy, finely micaceous; contains streaks of glauconite or glauconitic silt and several thin layers of siderite up to 2 inches thick.
18.0	192.0	Clay, dark-gray, slightly silty, finely micaceous.
14.0	206.0	Clay, dark-gray, silty, sandy, finely micaceous; contains streaks of glauconite or glauconitic silt and several thin layers of siderite up to 3 inches thick.
4.0	210.0	Clay, dark-gray, slightly silty, finely micaceous.
		Winona formation
1.0	211.0	Fossil shell bed.
21.0	232.0	Sand, dark gray-green, medium to coarse-grained, very glauconitic; contains several thin shell beds.

10.0	242.0	Sand, dark green-gray, fine to medium-grained, very glauconitic, silty.
7.0	249.0	Sand, green-gray, fine to medium-grained, glauconitic.
11.0	260.0	Sand, green-gray, fine to medium-grained; contains some gray clay.
		Tallahatta formation (Neshoba sand member)
4.0	264.0	Clay shale, green-gray, silty, sandy; contains several thin layers of hard rock up to 2 inches thick.
48.0	312.0	Sand, green-gray, fine to medium-grained; contains some streaks of clay.
34.0	346.0	Sand, green-gray to dark green-gray, fine-grained, silty; contains some very silty layers and some streaks of clay.
12.0	358.0	Sand, gray, medium to coarse-grained, sparingly glauconitic.
		Tallahatta formation (Basic City shale member)
12.0	370.0	Sand, green-gray, fine-grained, micaceous; contains thin beds of clay shale and several thin layers of hard rock up to 5 inches thick.
11.0	381.0	Clay shale, blue-gray, micaceous; contains many thin layers or hard rock up to 5 inches thick.
63.0	444.0	Sand and clay shale interbedded; contains many thin layers of hard rock up to 5 inches thick.
		Tallahatta formation (Meridian sand member)
11.0	455.0	Sand, gray, fine to medium-grained.
7.0	462.0	Clay shale, dark green-gray to dark-gray; contains thin layers of hard rock up to 2 inches thick.
18.0	480.0	Sand, gray, medium to coarse-grained.

Test Hole 15

Location: In pasture near the southwest end of pond at the west end of earth dam (NE.1/4, SW.1/4, Sec.18, T.15N., R.6E.) 0.2 mile south of cattle gap at junction of east-west private road and northeast-southwest road from Possumneck.

Elevation: 315 feet (altimeter) Date: August 10, 1962

Thickness	Depth	Description
2.0	2.0	Soil and subsoil—clay loam, tan, silty, sandy.
		Terrace deposit
13.0	15.0	Silt, light-gray to tan, very sandy, clayey.
7.0	22.0	Sand, buff to tan, very coarse-grained, gravelly.
		Zilpha formation
1.0	23.0	Clay, light-gray to brown-gray, silty.
3.0	26.0	Clay, gray to dark-gray, silty, finely micaceous.
9.0	35.0	Clay, dark-gray, slightly silty.
7.0	42.0	Clay, dark-gray; contains thin interbeds of glauconite or glauconitic silt and several thin layers of siderite up to 4 inches thick.
		Winona formation
1.0	43.0	Shell bed, moderately hard.
18.0	61.0	Sand, gray-green, fine to coarse-grained, silty, very glauconitic, fossiliferous; contains several thin shell beds.
8.0	69.0	Sand, gray-green, fine to very coarse-grained, silty, very glauconitic, fossiliferous.

		Tallahatta formation (Neshoba sand member)
11.0	80.0	Sand, green-gray, very fine-grained, silty, clayey, finely micaceous.
16.0	96.0	Sand, green-gray, fine-grained, silty, finely micaceous.
9.0	105.0	Sand, green-gray, very fine-grained, silty, clayey, finely micaceous.
15.0	120.0	Sand, green-gray, fine-grained, silty, finely micaceous.

Test Hole 16

Location: In small group of pine trees in clearing on side of hill about 150 feet west of the south end of pond (SW.1/4, NE.1/4, NE.1/4, Sec.7, T.14N., R.7E.)—Holmes County.

Elevation: 389 feet (altimeter) Date: August 14, 1962

Thickness	Depth	Description
6.0	6.0	Soil and subsoil—clay loam, tan, silty.
		Cockfield formation
8.0	14.0	Sand, tan to red-brown, fine to medium-grained, silty; contains some streaks of clay.
6.0	20.0	Sand, tan, fine to medium-grained, silty.
8.0	28.0	Sand, tan to orange-red, fine to medium-grained; contains some ferruginous material mixed.
5.0	33.0	Clay, white mottled yellow to purple, silty, sandy.
15.0	48.0	Sand, buff to tan, very fine-grained, micaceous; contains some streaks of white clay.
12.0	60.0	Sand, brown-gray, very fine-grained, micaceous.
12.0	72.0	Sand, gray, fine to medium-grained, micaceous; contains streaks of lignite and gray clay.
4.0	76.0	Clay, gray; contains some streaks of lignite.
14.0	90.0	Sand, gray to brown-gray, fine to medium-grained; contains streaks of dark-gray clay.
16.0	106.0	Sand, gray to brown-gray, fine-grained; contains streaks of dark-gray clay and some lignite.
		Wautubbee formation
12.0	118.0	Clay, dark-gray, silty, sandy; contains some streaks of lignite.
8.0	126.0	Sand, gray, fine-grained; contains some streaks of dark-gray clay and lignite.
6.0	132.0	Clay, dark-gray, silty, sandy, lignitic.
58.0	190.0	Sand, gray, fine to medium-grained; contains many streaks of dark-gray clay and some lignite.
5.0	195.0	Clay, dark-gray, sandy; contains streaks of lignite.
17.0	212.0	Sand, gray, fine to medium-grained; contains some dark-gray clay and lignite.
		Kosciusko formation
17.0	229.0	Clay, gray; contains streaks of lignite.
75.0	304.0	Sand, gray, medium to coarse-grained.
41.0	345.0	Clay, gray, silty, sandy.
25.0	370.0	Sand, gray to brown-gray, fine-grained; contains a few thin beds of clay.
62.0	432.0	Sand, gray to brown-gray, fine to medium-grained.
21.0	453.0	Sand, gray, medium-grained; some thin beds of gray clay.
37.0	490.0	*Zilpha formation* (?)
		Clay—poor contaminated samples.

Test Hole 17

Location: Approximately 87 feet west of the center of north-south segment of gravel road and 92 feet north of the center of unimproved road west (SW.1/4, SE.1/4, Sec.28, T.13N., R.6E.), about 0.85 mile south of State Highway 14.

Elevation: 351 feet (altimeter) Date: August 16, 1962

Thickness	Depth	Description
5.0	5.0	Soil and subsoil—clay loam, tan to buff, silty, sandy.
		Kosciusko formation
18.0	23.0	Sand, fine-grained, silty.
22.0	45.0	Sand, buff, fine to medium-grained; contains some streaks of white clay.
11.0	56.0	Sand, buff, medium to coarse-grained; contains some streaks of white clay.
44.0	100.0	Sand, buff, medium to coarse-grained.
56.0	156.0	Sand, buff, fine to medium-grained.
		Zilpha formation (Upper clay shale and silt member)
22.0	178.0	Clay, gray, silty, sandy, finely micaceous.
		Zilpha formation (Middle clay member)
62.0	240.0	Clay, gray to dark-gray, slightly to moderately silty.
		Zilpha formation (Zama member)
13.0	253.0	Glauconite or glauconitic silt, gray-green, sandy, fossiliferous; contains thin layer of siderite four inches thick.
8.0	261.0	Clay, gray to dark-gray, slightly silty.
8.0	269.0	Glauconite or glauconitic silt, gray-green, sandy.
3.0	272.0	Clay, gray to dark-gray, silty.
		Winona formation
21.0	293.0	Sand, gray-green, fine to medium-grained, silty, very glauconitic, fossiliferous; contains several thin shell beds.
15.0	308.0	Sand, gray-green, fine to medium-grained, very glauconitic, very silty, fossiliferous; contains several thin shell beds.
		Tallahatta formation (Neshoba member)
42.0	350.0	Sand, green-gray, fine to medium-grained, glauconitic (?); contains some silty layers.
12.0	362.0	Sand, gray, fine to medium-grained; contains several thin layers of hard rock up to 3 inches thick and some streaks of clay.
		Tallahatta formation (Basic City shale member)
128.0	490.0	Clay shale, blue-gray, sandy, silty; contains streaks and thin beds of sand and many thin layers of hard rock up to 4 inches thick; rock at 368 feet 2 feet thick.

Test Hole 18

Location: In bed of dim ridge road approximately 0.05 mile northwest of east-west gravel road (SW.1/4, NW.1/4, Sec.14, T.16N., R.9E.), about 0.95 mile west of State Highway 12.

Elevation: 511 feet (altimeter) Date: October 24, 1962

Thickness	Depth	Description
2.5	2.5	Soil and subsoil—clay loam, tan to brown, silty sandy.
		Hatchetigbee formation
7.5	10.0	Clay, light-gray mottled yellow to red, slightly silty to silty, plastic.

7.5	17.5	Silt, light-gray mottled yellow to red, clayey.
3.0	20.5	Clay, dark-gray to black, slightly silty to moderately silty, plastic, carbonaceous.
5.0	25.5	Clay, gray, slightly silty to silty, plastic; contains a few thin layers of silt.
16.5	42.0	Clay, gray to green-gray, slightly to moderately silty, plastic; contains thin streak of lignite.
6.0	48.0	Clay, blue-gray to green, silty.
4.0	52.0	Silt, green, clayey.
8.0	60.0	Clay, green-gray to dark-gray, moderately silty to silty, plastic.
5.0	65.0	Clay, light blue-green, slightly silty, plastic.
22.0	87.0	Clay, green-gray to dark-gray, silty.
13.0	100.0	Silt, green-gray, variably clayey.

Test Hole 19

Location: In old road bed approximately 20 feet north of the center of east-west trending road (NW.1/4, NE.1/4, SW.1/4, Sec.1, T.15N., R.9E.), 140 feet east of the junction of an northwest-southeast trending road to McCool.

Elevation: 514 feet (altimeter) Date: October 25, 1962

Thickness	Depth	Description
		Hatchetigbee formation
2.0	2.0	Silt, buff to tan, clayey.
26.0	28.0	Silt, light-gray to buff, mottled red in part, variably clayey.
20.0	48.0	Silt, light-gray to buff, sandy.
2.0	50.0	Clay, gray, moderately silty, plastic.
4.0	54.0	Silt, gray, clayey.
3.0	57.0	Clay, gray, moderately silty, plastic.
3.0	60.0	Silt, gray, clayey.
3.0	63.0	Clay, gray to dark green-gray, moderately silty, plastic.
0.5	63.5	Lignite, brown-black, soft, clayey.
6.5	70.0	Clay, dark green-gray, moderately silty, plastic.
1.0	71.0	Lignite, brown-black, soft.
3.0	74.0	Clay, dark gray-brown, slightly silty, plastic, lignitic.
6.0	80.0	Clay, dark green-gray, silty, plastic.
0.5	80.5	Lignite, brown-black, soft, clayey.
10.5	91.0	Clay, dark green-gray, silty plastic.
9.0	100.0	Silt, dark green-gray, finely micaceous, slightly sandy.

Test Hole 20

Location: In ditch below quartzite ledge on east side of State Highway 43 (NE.1/4, NE.1/4, Sec.9, T.14N., R.7E.) 1.8 miles north of the intersection of State Highway 12 at Kosciusko.

Elevation: 498 feet (altimeter) Date: October 26, 1962

Thickness	Depth	Description
		Zilpha formation (Upper clay shale and silt member)
8.0	8.0	Silt, light-gray mottled yellow, clayey, finely micaceous.
2.0	10.0	Clay, dark-gray, silty.
4.0	14.0	Silt, gray, clayey.
		Zilpha formation (Middle clay member)
4.0	18.0	Clay, dark-gray, silty.
31.0	49.0	Clay, dark-gray, slightly silty to silty.
2.0	51.0	Glauconitic clay, dark green-gray, silty.
12.0	63.0	Clay, dark-gray, slightly silty to silty.

		Zilpha formation (Zama member)
11.0	74.0	Glauconitic clay, glauconite and siderite interbedded.
8.0	82.0	Clay, brown-gray, slightly silty to silty.
7.5	89.5	Glauconitic clay, glauconite, and light-green clay; contains a few thin interbeds of siderite and a thin shell bed.
2.5	92.0	Clay, light-green, very sandy, very glauconitic.
		Winona formation
18.0	110.0	Sand, green-gray, fine to medium-grained, silty, very glauconitic, fossiliferous.

Test Hole 21

Location: On top of hill in pasture approximately 500 feet due south of curve in east-west gravel road (SW.1/4, NW.1/4, Sec.16, T.13N., R.6E.) 0.25 miles west of the junction of this road and the main north-south farm-to-market road to McAdams.

Elevation: 372 feet (altimeter) Date: October 30, 1962

Thickness	Depth	Description
2.5	2.5	Soil and subsoil—clay loam, brown to red-brown, silty sandy.
		Kosciusko formation
5.0	7.5	Clay, red-brown, very silty, very sandy.
10.5	18.0	Sand, orange-red, medium-grained, silty.
38.0	56.0	Sand, buff to tan, medium-grained; contains some very coarse-grained sand in lower part.
		Zilpha formation (Upper clay shale and silt member)
35.0	91.0	Gray silt and clay interbedded; finely lignitic.
		Zilpha formation (Middle clay member)
23.0	114.0	Clay, dark green-gray to dark-gray, silty to very silty.
17.0	131.0	Clay, dark green-gray to dark-gray, slightly silty, compact.
		Zilpha formation (Zama member)
0.5	131.5	Siderite, buff, hard, glauconitic.
3.5	135.0	Glauconitic clay and glauconite, dark-green, silty.
5.0	140.0	Clay, dark green-gray, silty.

Test Hole 22

Location: Approximately 15 feet west of the center of the road north from Sallis (NE.1/4, NE.1/4, Sec.34, T.14N., R.5E.).

Elevation: 314 feet (altimeter) Date: November 2, 1962

Thickness	Depth	Description
4.0	4.0	Soil and subsoil—sandy loam, red-brown, silty.
		Kosciusko formation
1.5	5.5	Sand, red-brown; contains several thin layers of limonitic sandstone.
14.5	20.0	Clay, light-gray, slightly silty to very silty.
18.5	38.5	Clay, light-gray to brown-gray, moderately silty to very silty.
3.0	41.5	Clay, dark-gray, silty.
13.0	54.5	Sand, gray, very fine-grained; contains thin bed of lignite.
16.5	71.0	Sand, buff to tan, medium to coarse-grained; contains streaks of white clay
21.0	92.0	Sand, light-gray, medium to coarse-grained.
36.0	128.0	Sand, buff to tan, medium-grained; contains many thin streaks of dark-gray clay.

12.0	140.0	Sand, light-gray to buff, medium-grained; finely lignitic.
10.0	150.0	Sand, gray, medium-grained, finely lignitic; contains several streaks of dark-gray clay.

Test Hole 23

Location: Near edge of Bogue Falaya Creek approximately 120 feet west of the center of north-south road (SE.1/4, NE.1/4, Sec.36, T.14N., R.5E.) 0.25 mile south of the State Highway 12.

Elevation: 285 feet (altimeter) Date: November 5, 1962

Thickness	Depth	Description
6.0	6.0	Alluvium—sand, brown, silty; contains organic matter.
12.0	18.0	Sand, light-gray, fine to medium-grained; contains streaks of gray clay.
		Kosciusko formation
6.0	24.0	Sand, light-gray, medium-grained.
40.0	64.0	Sand, buff to red-yellow, fine to coarse-grained; contains numerous blebs of white clay and some streaks of light-gray clay.
4.0	68.0	Sand, yellow to red-yellow, fine to coarse-grained.
		Zilpha formation
12.0	80.0	Clay, dark-gray to brown-gray, slightly silty to silty.

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ATTALA COUNTY CERAMIC TESTS

THOMAS E. McCUTCHEON[1]

ABSTRACT

Routine ceramic tests were run in the laboratories of the School of Ceramic Engineering at Georgia Institute of Technology on nine clay samples from Attala County. The samples had been selected because of the abundance of material and for the purpose of representing types of clays or clayey materials present in Attala County.

The results of these tests, preliminary in nature, indicate industrial possibilities for a wide variety of products. Some of the silty clays may be used for the manufacture of artificial aggregates. Other clays may be used as ceramic bonds in the manufacture of sewer pipe, brick or other heavy clay products. Some of the clays may be used as bonds in foundry molding sands. Clay lenses in the Kosciusko formation have been determined to be ball clays. Samples have indicated that they are useful in the manufacture of high-grade ceramic products including light-burning pottery.

INTRODUCTION

In previous county bulletins to which the writer has contributed, the clays tested were grouped according to the physical properties characterizing them. In most of these reports a great many samples were secured and tested, but in the present survey in the interest of economy the samples were selected by the field geologist with a view to the thorough examination of types of material represented in the County. Therefore, in this report the format has been changed so that each clay submitted is treated as a unit with the core hole logs, the screen analyses, the chemical analyses, the X-ray diffraction analyses, the physical properties in the unburned state, the pyrophysical properties, comments, and possibilities for utilization, all being included under the discussion of each clay sample. This gives a greater continuity and easier reference to the data determined on each of the nine clays.

Nine samples were submitted for complete routine ceramic study. These samples were prepared and tested in the laboratories of the School of Ceramic Engineering, Georgia Institute of Technology, Atlanta, Georgia. About half of each sample was saved and put in storage of the Mississippi Survey for future study.

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[1]Consulting Ceramic Engineer, 69 E. Lake Terrace, S. E., Atlanta, Georiga.

SAMPLING OF ATTALA COUNTY CLAYS

Core Hole Number	Sample Depths (feet)	Thickness (feet)	Stratigraphic Unit
AE-1	12-33	21	Hatchetigbee formation
AE-2	12-32	20	Hatchetigbee formation
AE-3	6-28	22	Zilpha formation (Zama member)
AE-4	3-16	13	Kosciusko formation
AE-5	4-10	6	Hatchetigbee formation
AE-5	18-38	20	Hatchetigbee formation
AE-6	13-22	9	Zilpha formation
AE-7	9-13	4	Kosciusko formation
AE-7	5-9; 13-23	14	Kosciusko formation

In regard to the descriptions of the residues from screen analyses the following abbreviations have been used: (A), abundant, 1/2 or more of residue on screen; (C), considerable amount, between 1/10 and 1/2 of residue on screen; (S), small amount, less than 1/10 of residue on screen; and (T), trace, only a few grains noted of residue on screen.

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In this report the core hole log records were kept and furnished by Mr. William S. Parks, the descriptions of the screen analyses were written by Mr. William H. Moore, the chemical analyses were prepared by the Mississippi State Chemical Laboratory through the courtesy of Dr. M. P. Etheredge, State Chemist, and the X-ray diffractogram analyses were made by Professor Ernest E. Russell of the Department of Geology and Geography, Mississippi State University.

CORE HOLE AE-1

Location: In bed of dim log road about 25 feet south of the center of an east-west segment of an unimproved road (NW.¼, SW.¼, Sec.6, T.16 N., R.9 E.) approximately 0.2 mile west of the old Natchez Trace.
Elevation: 478 feet (altimeter) Date: July 17, 1962

Thickness (feet)	Depth (feet)	Description of strata
1.0	1.0	Soil, clay loam, red-brown, silty, sandy
		Hatchetigbee formation
4.0	5.0	Silt, light-gray streaked tan to red-brown, very micaceous; contains laminae of fine white sand and tan clay
1.5	6.5	Clay, light-gray mottled yellow to tan, silty
0.5	7.0	Clay, gray, plastic, slightly silty
1.0	8.0	Clay, chocolate, silty, lignitic
1.5	9.5	Clay, gray, silty, lignitic
2.5	12.0	Sand, light-gray mottled yellow to tan, very fine-grained, sparingly micaceous
1.0	13.0	Clay, black, silty, lignitic, micaceous, contains light-gray silt along plant stem impressions
2.0	15.0	Clay, brown-black to black, slightly silty, lignitic, plastic; contains some small nodules of pyrite
1.5	16.5	Clay, gray to dark-gray, moderately silty, plastic; contains streak of very lignitic clay
2.0	18.5	Clay, black, silty, very lignitic; contains some coatings of pyrite
7.5	26.0	Clay, brown-black to black, slightly silty, lignitic, plastic
2.0	28.0	Clay, black, slightly silty, plastic; contains thin streaks of lignite
5.0	33.0	Clay, dark-gray to brown-black, slightly silty, lignitic, plastic; contains some coatings of pyrite
4.0	37.0	Silt, gray, laminated.

SCREEN ANALYSIS

Sample AE-1 (12-33′)

Seive size (mesh)	Percent retained	Character of residue
20	0.0	
60	0.5	Lignite (C); pyrite (C); quartz (S).
100	0.5	Lignite (A); quartz (C); pyrite (C); muscovite (S).
250	2.0	Muscovite (C); lignite (C); quartz (C); pyrite (S).
Pan	97.0	Clay (A); quartz (C); lignite (S); muscovite (S).

Physical Properties in the Unburned State

Sample AE-1 (12-33′)

Water of plasticity: dry basis 29.2%; wet basis, 22.1%.
Linear drying shrinkage: 5.6%.
Modulus of rupture: 505 lbs./sq. in.
Plasticity and extrusion behavior: good.
Drying and warpage behavior: fair.
Color: dark gray when dry, black when wet.

Pyrophysical Properties

Sample AE-1 (12-33′)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
07	1803	6.3	25.6	1350	Salmon, pitted
04	1940	10.7	14.8	1820	Pink, pitted
02	2048	11.5	13.4	2000	Pink, steel hard, pitted
2	2088	12.0	11.4	3080	Pink, steel hard, pitted
3	2134	11.2	10.5	2290	Pink, steel hard, pitted
5	2185	11.6	13.0	2480	Grayish pink, steel hard, pitted
10	2381	11.8	16.2	1605	Buff, steel hard, bloated, pitted

COMMENTS

The clay, Sample AE-1 (12-33′), is fine-grained but does contain some coarse particles of pyrite. The pyrite accounts for the surface pitting of the burned test pieces. Other accessory minerals are of minor importance.

The plastic properties are very good for any type of extrusion and there is adequate strength to allow for the addition of less strong, non-plastic materials such as silt or sand and grog to compensate for the slightly over normal shrinkage relative to making heavy clay products.

Evidence of soluble salts, probably from the oxidation of pyrite, are noted on test pieces.

On firing the clay sample, steel hardness develops at Cone 02 or 2048°F. There is small alteration in the burning behavior of the clay through Cone 5 or 2185°F, which allows a commercial range in temperature of 137°F. The color remains constant except at Cone 5 where the soluble salts produce a gray cast on the surface. At Cone 10 the clay is overburned. Fired strength within the firing range of the sample is adequate for most heavy clay products.

POSSIBILITIES FOR UTILIZATION

Sample AE-1 (12-33′), representing a composite of 21 feet of strata, is basic relative to the area. The addition of silt and a finer grinding to reduce the particle size of the pyrite would render the sample suitable for producing a beautiful pink face brick. The clay is also suitable for common brick and fireproofing tile.

A test was made on the clay for use as a lightweight aggregate. The clay seems to be too refractory for this use.

CORE HOLE AE-2

Location: In bed of an east-west segment of an unimproved road in flat about half way between creek branch and top of hill (SE.¼, NE.¼, Sec.2, T.16 N., R.8 E.) approximately 1.6 miles west of the old Natchez Trace.

Elevation: 431 feet (altimeter) Date: July 18, 1962

Thickness (feet)	Depth (feet)	Description of strata
		Hatchetigbee formation
2.0	2.0	Sand, tan, fine-grained, silty, clayey, micaceous
5.0	7.0	Silt, light-gray mottled yellow to tan, sandy, clayey, finely micaceous
1.0	8.0	Clay, gray to dark-gray, slightly silty, plastic, lignitic
0.7	8.7	Silt, chocolate mottled light-gray, clayey, finely micaceous, lignitic
0.8	9.5	Lignite, brown-black, silty, clayey; contains coatings of pyrite
1.2	10.7	Clay, dark-gray to black, slightly silty, plastic, lignitic
1.5	12.2	Lignite, brown-black
12.3	24.5	Clay, dark-gray, slightly silty, plastic, sparingly lignitic
10.5	35.0	Clay, gray to dark-gray, slightly silty, plastic; contains many thin laminae of light-gray silt and a few streaks of lignite
3.0	38.0	Silt, light-gray, sparingly lignitic.

SCREEN ANALYSIS

Sample AE-2 (12-32′)

Seive size (mesh)	Percent retained	Character of residue
20	0.0	
60	0.5	Clay nodules (C); pyrite (C); lignite (C); quartz (T).
100	0.5	Clay (C); lignite (C); pyrite (C); quartz (C); muscovite (S); siderite (T).
250	1.5	Clay (C); lignite (C); quartz (C); muscovite (C); pyrite (C).
Pan	97.5	Clay (C); quartz (C); pyrite (C); lignite (S).

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample AE-2 (12-32′)

Water of plasticity: dry basis 33.6%; wet basis 25.2%.
Linear drying shrinkage: 7.5%.
Modulus of rupture: 624 lbs./sq. in.
Plasticity and extrusion behavior: good.
Drying and warpage behavior: poor.
Color: dark gray when dry; black, when wet.

PYROPHYSICAL PROPERTIES

Sample AE-2 (12-32′)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
07	1803	8.3	18.9	913	Salmon
04	1940	13.2	10.7	1600	Light red
02	2048	13.3	8.3	1350	Red, steel hard
2	2088	13.9	6.7	1250	Red, steel hard
3	2134	11.5	5.8	cracked	Red, steel hard
5	2185	cracked	cracked	cracked	Red, bloated, cracked
10	2381	bloated	bloated	bloated	Brown, bloated

COMMENTS

The clay, Sample AE-2 (12-32′), representing 20 feet of strata, does not have very satisfactory properties for use in heavy clay products because of excessive drying shrinkage. This probably could be modified by blending with non-plastic materials, such as sand, silt and grog. The clay is very carbonaceous and would require careful burning. The clay was tested for lightweight aggregate and produced satisfactory results.

POSSIBILITIES FOR UTILIZATION

Although it is possible to produce brick and related clay products from the clay, Sample AE-2 (12-32′), it is not likely that this will develop because of the availability of better suited clays in the County.

The most interesting possibility for the clay is for use in the production of lightweight aggregate. The clay begins to bloat at Cone 5, 2185°F and has expanded at 2200°F to a mass having a specific gravity less than that of water. The bloated clay will float in water. It would be worthwhile to investigate further.

CORE HOLE AE-3

Location: In small pine grove at top of hill on west side of Magnet Cove Barium Corporation's clay pit about 60 feet northwest of curve in access road (SW.¼, SW.¼, Sec.2, T.15 N., R.6 E.), approximately 0.2 mile east of State Highway 35.

Elevation: 397 feet (altimeter) Date: July 30, 1962

Thickness (feet)	Depth (feet)	Description of strata
1.0	1.0	Soil, clay loam, tan to light-brown, slightly silty
2.5	3.5	Clay, white to tan, sandy, silty.
		Zilpha formation (Zama member)
1.5	5.0	Clay, brick-red mottled yellow to tan, sandy, sparingly glauconitic to glauconitic
1.0	6.0	Clay, gray mottled yellow to red, sandy, finely micaceous, glauconitic; contains streaks and pockets of very glauconitic fine sand
7.0	13.0	Clay, light olive-gray, slightly silty, slightly sandy; contains some iron oxide splotches and stains along joints and fractures; soft to moderately hard with harder clay having subconchoidal fracture
10.5	23.5	Clay, gray to light olive-gray, slightly sandy, subconchoidal fracture; contains some iron oxide stains along joints and fractures; moderately hard with a few softer streaks
4.5	28.0	Clay, gray to light olive-gray, subconchoidal fracture; contains streaks and small pockets of fine sand; some iron oxide stains along joints and fractures; moderately hard with a few softer streaks

3.0	31.0	Clay, gray to light olive-gray, sandy, glauconitic to very glauconitic; contains a thin layer of ironstone
1.0	32.0	Clay, dark-gray to gray, sandy, glauconitic to very glauconitic.
		Winona formation
10.0	42.0	Sand, dark green-gray to brown, fine- to medium-grained, very glauconitic, sparingly fossiliferous; contains several thin layers of limonitic sandstone.

SCREEN ANALYSIS

Sample AE-3 (6-28')

Seive size (mesh)	Percent retained	Character of residue
20	0.0	
60	0.8	Limonite (A); clay (C); selenite (C); quartz (S); pyrite (T); glauconite (T).
100	0.8	Limonite (A); clay (C); selenite (C); quartz (C); glauconite (C); muscovite (S).
250	2.0	Clay balls (A); limonite (C); quartz (C); selenite (S); glauconite (S); lignite (S).
Pan	96.4	Clay (A); limonite (S); quartz (T); lignite (T); selenite (T).

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Sample AE-3 (6-28')

	As Received Basis	Dry Wt. Basis
Moisture (Air dried)	7.45%	0.00%
Ignition Loss	6.83%	7.38%
Silica (SiO_2)	60.17%	65.01%
Iron Oxide (Fe_2O_3)	2.38%	2.57%
Alumina (Al_2O_3)	17.65%	19.07%
Titania (TiO_2)	1.00%	1.08%
Magnesia (MgO)	1.92%	2.07%
Lime (CaO)	1.16%	1.25%
Potash (K_2O)	0.46%	0.50%
Soda (Na_2O)	0.32%	0.35%
Total	99.34%	99.28%

X-RAY DIFFRACTION DETERMINATION

Sample AE-3 (6-28')

Prof. Russell interprets his X-ray diffractogram as follows: "This sample is predominantly an 18A° expanding lattice clay mineral, probably montmorillonite. There is some illite and small amounts of chlorite, halloysite, quartz and kaolinite."

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample AE-3 (6-28')

(Natural)

Water of plasticity: dry basis 55.5%; wet basis 35.6%.
Linear drying shrinkage: 11.7%.
Modulus of rupture: not determined.
Plasticity and extrusion: good.
Drying and warpage: very poor.
Color: grayish tan.

(Blended with 50% potters flint)

Water of plasticity: dry basis 34.3%; wet basis 25.5%.
Linear drying shrinkage: 8.5%.
Modulus of rupture: 1570 lbs./sq. in.
Plasticity and extrusion: good.
Drying and warpage: fair.
Color: light grayish tan.

PYROPHYSICAL PROPERTIES

Sample AE-3 (6-28')

Because of the abnormal drying and burning shrinkage behavior of the clay, little data could be obtained on the fired test bars. At Cone 07, 1803°F the absorption was 11.0% and the total linear shrinkage was 14.3%. At higher temperatures the clay sample test bars were in such small pieces tests could not be made.

The fusion point of the clay was determined to be Cone 13, or 2420°F.

At Cone 07 the color of the clay is salmon, at higher temperatures, red.

Pyrophysical properties of the clay when blended with 50% potters flint are as follows: at 2250°F—linear drying shrinkage total 10%, absorption 13.3%, modulus of rupture 2775 lbs./sq. in.

COMMENTS

This type of clay, Sample AE-3 (6-28′), is typical of a bentonite and as such does not lend itself to normal clay testing procedure. About the most that can be determined is of a negative nature relative to the common variety of clays; however, the clay has many specialized uses. Typical of this kind of clay is the high water of plasticity with accompanying high drying and firing shrinkage which coincidentally accounts for the extremely high bonding strength when used with non-plastic materials. Some bentonite clays are especially suited for some uses and some another. Research and experimentation will be needed to bring out the potentials of the clay. Certain possible uses are mentioned below.

POSSIBILITIES FOR UTILIZATION

The possibilities for utilization of Sample AE-3 (6-28′) are:

1. Heavy clay products—Some brick plants have as their prime source of material relatively non-plastic clays, shales and schists. The addition of small amounts of this clay (5%) would improve their plastic properties and dry strength. This also applies to sewer pipe manufacture where the body is made up of several raw materials.

2. Abrasives—Cutting wheels and the like are composed of specially prepared sharp hard aggregate, bonded usually with clay. The less clay that can be used for bonding, the better the wheel. Sample AE-3 having a high bond strength and low maturing temperature should be tested for this use.

3. Lightweight aggregate—A test was made for lightweight aggregate. At 2200°F there was a noticeable expansion of the natural pieces of clay. The expansion was mostly along normal bedding planes. Expansion of the clay was noted on clay bars (test pieces) but was along shrinkage and cracking lines. Further tests are in order.

4. Foundry bond—This type of clay is similar to that used in foundry work for bonding sand to make moulds. Its specific use requires further investigation.

5. Drilling mud—This is a highly technical subject. In general a clay of this type is suitable. The particular characteristics

of the clay concerning conditions under commercial use have not been investigated.

6. Filler—In water based glues: inorganic as sodium silicate; and organic as animal origin, the clay because of its affinity for water, has use as filler to produce necessary body, peculiar to certain applications.

7. Bleach—Bentonitic clays have long been used in processing edible oils, petroleum, gums and turpentine. This type of clay has possibilities for these uses.

Special tests for the above mentioned uses of the clay are not in the scope of this report.

Core Hole AE-4

Location: On the west edge of access road at approximately the sand-clay contact near the west corner of Delta Brick & Tile Company's clay pit (SE.¼, NW.¼, Sec.11, T.14 N., R.5 E.).
Elevation: 360 feet (altimeter) Date: August 6, 1962

Thickness (feet)	Depth (feet)	Description of strata
		Kosciusko formation
3.0	3.0	Clay, light-gray mottled yellow and red, plastic
7.0	10.0	Clay, light-gray to light-brown, plastic
1.0	11.0	Clay, light-brown to chocolate, plastic
3.0	14.0	Clay, light-gray to light-brown, plastic
2.0	16.0	Clay, light-gray, slightly silty, plastic
2.0	18.0	Clay, light-gray, silty
4.0	22.0	Silt, light-gray, sandy; stained yellow with iron oxide.

Screen Analysis

Sample AE-4 (3-16′)

Seive size (mesh)	Percent retained	Character of residue
20	0.0	
60	0.0	
100	0.0	
250	Trace	Quartz (A); limonite (S); clay (S); lignite (T); muscovite (T).
Pan	99+	Clay (A); quartz (T).

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Sample AE-4 (3-16')

	As Received Basis	Dry Wt. Basis
Moisture (Air Dried)	1.45%	0.00%
Ignition Loss	8.52%	8.64%
Silica (SiO_2)	61.70%	62.61%
Iron Oxide (Fe_2O_3)	0.94%	0.95%
Alumina (Al_2O_3)	25.27%	25.64%
Titania (TiO_2)	1.11%	1.13%
Magnesia (MgO)	0.03%	0.03%
Lime (CaO)	0.23%	0.23%
Potash (K_2O)	0.23%	0.23%
Soda (Na_2O)	0.06%	0.06%
Total	99.54%	99.52%

X-RAY DIFFRACTION DETERMINATION

Sample AE-4 (3-16')

Prof. Russell interprets his X-ray diffractogram as follows: "The extremely strong 7.1A° and 3.57A° reflections indicate that kaolinite predominates (probably over 80%). Quartz, illite (mica), an expanding lattice clay mineral, chlorite and a trace of feldspar in order of abundance comprise the remainder of the sample."

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample AE-4 (3-16')

(Natural)

Water of plasticity: dry basis 27.7%; wet basis 21.7%.

Linear drying shrinkage: 7.1%.

Modulus of rupture: 411 lbs./sq. in.

Plasticity and extrusion behavior: good.

Drying and warpage behavior: fair.

Color: light grayish tan.

(Blended with 50% potters flint)

Water of plasticity: dry basis 20.2%; wet basis, 16.7%.

Linear drying shrinkage: 5.5%.

Modulus of rupture: 368 lbs./sq. in.

Plasticity and extrusion behavior: good.

Drying and warpage behavior: good.

PYROPHYSICAL PROPERTIES

Sample AE-4 (3-16′)

(Natural)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
07	1803	8.5	17.6	2250	Light pink
04	1940	10.2	13.5	1700	White
02	2048	10.4	12.7	1860	White, steel hard
2	2088	12.0	10.5	3600	Light ivory, steel hard
3	2134	11.0	9.0	4650	Light ivory, steel hard
5	2185	13.0	6.4	3450	Light ivory, steel hard
10	2381	13.1	3.3	4300	Light ivory, steel hard blue stoned

Fusion point, P.C.E. Cone 29+ 3020°F.

PYROPHYSICAL PROPERTIES

Sample AE-4 (3-16′)

(Blended with 50% potters flint)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
5	2185	6.7	13.85	3050	White, not steel hard
10	2381	6.6	13.10	2675	White, not steel hard

COMMENTS

The clay, Sample AE-4 (3-16′), may be described in a commercial manner as a stoneware clay, a refractory bond clay, a ball clay or a brick clay. Its plastic, drying and firing behavior is such that it can be used in many clay products. The clay is ceramically equivalent to types found in several other counties; although, they may be from different formations.

The most distinguishing feature is the white to near-white color after burning. This, combined with normal plastic and drying properties with above normal strength and bonding power in a clay having a long firing range, point to possibilities for utilization limited only by production and research.

POSSIBILITIES FOR UTILIZATION

Clays of this type, Sample AE-4 (3-16′), are usually used in combination with other less potent clays and with non-plastic materials to produce ceramic bodies having particular properties. The clay can be used as is for thrown pottery. Listed below are some of the most obvious possibilities for use:

1. Brick manufacture and structural tile
2. Earthern ware
3. Art pottery and glazed tile
4. Sanitary ware and dinnerware by selective mining
5. A bond clay for refractory products
6. Conduit and fire proofing
7. Drain tile and chimney tile.

CORE HOLE AE-5

Location: On west side of dim log road approximately 0.05 mile northwest of an east-west gravel road (SW.¼, NW.¼, Sec.14, T.16 N., R.9 E.) about 0.95 mile west of State Highway 12.

Elevation: 511 feet (altimeter) Date: October 25, 1962

Thickness (feet)	Depth (feet)	Description of strata
2.6	2.6	Soil, clay loam, tan to brown, silty, sandy.
		Hatchetigbee formation
0.8	3.4	Clay, red, silty, sandy
6.8	10.2	Clay, light-gray mottled red, slightly silty to silty, plastic; contains some scattered selenite crystals
7.2	17.4	Silt, light blue-gray mottled yellow to red, variably clayey; contains some scattered selenite crystals
2.3	19.7	Clay, brown-gray to dark-gray, slightly silty, plastic; contains some yellow splotches of iron oxide stain
0.4	20.1	Clay, dark-gray to black, slightly silty, plastic, lignitic
2.2	22.3	Clay, gray to dark brown-gray, slightly silty, plastic; contains some yellow splotches of iron oxide stain
1.3	23.6	Silt, gray, clayey; contains yellow splotches of iron oxide stain
1.5	25.1	Clay, gray, slightly silty, plastic; contains yellow splotches of iron oxide stain
0.5	25.6	Silt, gray mottled yellow, clayey
0.6	26.2	Clay, gray, slightly to moderately silty, plastic

0.4	26.6	Clay, dark brown-gray to black; slightly silty, plastic, lignitic; contains thin streak of lignite
2.1	28.7	Clay, gray to dark-gray, slightly silty, plastic; contains some yellow splotches of iron oxide stain
0.5	29.2	Lignite, brown-black, soft, clayey; contains scattered nodules of pyrite
2.2	31.4	Clay, gray, slightly silty, plastic
1.0	32.4	Silt, gray, clayey
2.8	35.2	Clay, green-gray to dark-gray, slightly silty, plastic
2.8	38.0	Clay, gray to dark-gray, slightly silty, plastic
4.0	42.0	Clay, green, moderately silty to silty

SCREEN ANALYSIS

Sample AE-5 (4-10′)

Seive size (mesh)	Percent retained	Character of residue
20	0.0	
60	Trace	Quartz (A); selenite (C); hematite (C); lignite (S).
100	0.8	Quartz (A); selenite (C); hematite (C); lignite (S); muscovite (T).
250	11.0	Quartz (A); selenite (C); hematite (S); muscovite (S).
Pan	88.2	Quartz (A); clay (C); hematite (S); lignite (T).

X-RAY DIFFRACTION DETERMINATION

Sample AE-5 (4-10′)

Prof. Russell interprets his X-ray diffractogram as follows: "Montmorillonite and kaolinite form bulk of clay and there is a considerable amount of illite, quartz, chlorite, and probably gibbsite."

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample AE-5 (4-10′)

Water of plasticity: dry basis 21.3%; wet basis 17.6%.

Linear drying shrinkage: 5.3%.

Modulus of rupture: 1270 lbs./sq. in.

Plasticity and extrusion behavior: good.

Drying and warpage behavior: good.

Color: raw, mottled gray and pink; ground, grayish pink.

PYROPHYSICAL PROPERTIES

Sample AE-5 (4-10′)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
07	1803	5.9	10.8	1570	Salmon, steel hard
04	1940	9.2	5.8	4000	Light red, steel hard
02	2048	9.0	6.2	4380	Light red, steel hard
2	2088	9.5	3.0	6900	Red, steel hard
3	2134	not determined	2.76	not determined	Red, steel hard
5	2185	9.6	5.10	not determined	Red, steel hard
10	2381	9.2	9.65	2520	Brown, steel hard, bloated

COMMENTS

The clay, Sample AE-5 (4-10′), should be considered in connection with other samples and strata relative to the test hole. This particular sample while representing a 6-foot section, could well be extended an additional 8 feet. It could be blended further with clays and silts as combined in Sample AE-5 (18-38′).

The clay, Sample AE-5 (4-10′), has excellent plastic drying and working properties. The dry strength, 1270 lbs./sq. inch, is unusual with a clay having nominal shrinkage in both the dry and fired conditions.

On burning, the clay is mature at 1940°F and is not overburned at 2185°F. It develops unusually high strength at 2088°F with little alteration in shrinkage or color.

The clay is contaminated with fine crystals of gypsum which do not seem to have any adverse effect except for small white specks on the fired test pieces. It also contains soluble salts, probably iron sulfate, which has the effect of darkening the surface color. In commercial practice the contaminating minerals could be controlled by the addition of small amounts of barium salts.

The clay products should be dried at a high temperature 300-400°F before firing as in testing some of the test pieces exploded on fast burning.

POSSIBILITIES FOR UTILIZATION

The clay, Sample AE-5 (4-10′), is especially suited for making heavy clay products such as brick and tile without the addition of non-plastic materials. Because of its high dry and fired strengths, non-plastic materials could be added to reduce shrinkage and open up the body to assist in faster drying and burning schedules.

The clay is very desirable as a bond clay in the manufacture of sewer pipe. This possibility should be tested commercially.

It could be useful as a bond clay for heavy clay products that depend on slightly plastic clays and silts (loam and loess).

Screen Analysis

Sample AE-5 (18-38′)

Seive size (mesh)	Percent retained	Character of residue
20	0.0	
60	Trace	Clay (A); lignite (C); pyrite (C); limonite (C); quartz (S).
100	1.0	Quartz (A); limonite (C); lignite (C); muscovite (S); pyrite (S).
250	4.4	Quartz (A); lignite (C); limonite (C); clay (S); muscovite (S).
Pan	94.6	Quartz (A); lignite (S); muscovite (S); limonite (T).

X-ray Diffraction Determination

Sample AE-5 (18-38′)

Prof. Russell interprets his X-ray diffractogram as follows: "Kaolinite and montmorillonite (18A°) are the dominant clay minerals in this sample. A small amount of illite, chlorite, quartz, and feldspar are the remaining clay minerals."

Physical Properties in the Unburned State

Sample AE-5 (18-38′)

Water of plasticity: dry basis 26.0%; wet basis 20.6%.
Linear drying shrinkage: 6.6%.
Modulus of rupture: 948 lbs./sq. in.
Plasticity and extrusion behavior: good.
Drying and warpage behavior: fair.
Color: dark gray.

PYROPHYSICAL PROPERTIES

Sample AE-5 (18-38′)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
07	1803	6.7	15.2	1110	Steel hard, salmon
04	1940	10.5	7.8	1350	Steel hard, tan
02	2048	11.5	7.45	1850	Steel hard, tan
2	2088	12.1	3.92	2430	Steel hard, tan
3	2134	11.2	4.4	1990	Steel hard, tan
5	2185	11.7	2.22	1500	Steel hard, gray
10	2381	11.3	7.17	2024	Steel hard, gray, bloated

COMMENTS

The clay, Sample AE-5 (18-38′), which represents the lower part of Core Hole AE-5 is carbonaceous and has a fairly high drying shrinkage and very good strength. It has good working properties. The over-all shrinkage, drying and burning, is about 2 percent too high for use of the clay alone in making heavy clay products. Silt and sand noted on the log above and below the sample could be used as an addition to the sample to make a better product. The color is good for many clay products and the firing properties are consistent from 1940°F through 2185°F. The clay, Sample AE-5 (18-38′), could be combined with the upper strata, Sample AE-5 (4-10′), to give more burned strength and a deeper color toward pink or light red.

Clay from this test hole represents approximately 40 feet of usuable raw material for heavy clay products manufacture.

POSSIBILITIES FOR UTILIZATION

Clay products, such as face brick, conduit, flue lining, structural tile, fire-proofing and drain tile could easily be made from the strata represented by Sample AE-5 (18-38′). In combination with clays, sand and silt below and above the particular sample tested, a manufacturer would have, by selective mining, about everything desired to produce the various products above mentioned.

Core Hole AE-6

Location: In ditch below outcropping quartzitic rock on east side of State Highway 43 (NE.¼, NE.¼, Sec.9, T.14 N., R.7 E.), about 1.8 miles north of the intersection of State Highway 12 at Kosciusko.

Elevation: 498 feet (altimeter) Date: October 26, 1962

Thickness (feet)	Depth (feet)	Description of strata
		Zilpha formation (Upper clay shale and silt member)
7.0	7.0	Silt, light-gray mottled yellow, laminated, finely and sparingly micaceous; contains laminae of chocolate-brown clay
2.0	9.0	Clay shale, dark-gray to black, silty; contains laminae of gray silt
4.0	13.0	Silt, gray, clayey, laminated; contains laminae of dark-gray clay
5.0	18.0	Silty clay or clayey silt, dark-gray to black; contains laminae and a few thin layers of gray silt
4.0	22.0	Clay, dark-gray to black, silty; contains some laminae of gray silt.

Screen Analysis

Sample AE-6 (13-22′)

Seive size (mesh)	Percent retained	Character of residue
20	0.0	
60	Trace	Pyrite (A); lignite (C); clay (C); quartz (S); selenite (S).
100	Trace	Pyrite (A); lignite (C); quartz (C); hematite (S); muscovite (S); selenite (S).
250	3.5	Quartz (A); lignite (C); muscovite (C); clay (S); pyrite (S); glauconite (S).
Pan	96.5	Quartz (A); clay (S); lignite (T); muscovite (T).

Physical Properties in the Unburned State

Sample AE-6 (13-22′)

Water of plasticity: dry basis 27.7%; wet basis 22.3%.
Linear drying shrinkage: 7.2%.
Modulus of rupture: 1070 lbs./sq. in.
Plasticity and extrusion behavior: good
Drying and warpage behavior: poor.
Color: Dark gray when dry; black when wet.

PYROPHYSICAL PROPERTIES

Sample AE-6 (13-22′)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
07	1803	8.2	16.1	700	Light tan
04	1940	12.3	7.3	957	Light red, steel hard
02	2048	12.8	6.9	926	Red, steel hard
2	2088	13.0	6.7	1460	Red, steel hard
3	2134	12.3	5.2	1255	Red, steel hard
5	2185	10.9	Not determined	Not determined	Red, steel hard, cracked
10	2381	Not determined	Not determined	Not determined	Brown, steel hard, bloated

COMMENTS

The clay sample, AE-6 (13-22′), tested is highly carbonaceous. It also seems to be high in silica. The carbonaceous matter and most of the accessory silica is in a very fine state of division, some of which is colloidal and this may account for excessive drying shrinkage and the unusually high dry strength. It could also account for relatively low strength after burning because of the inherent ceramic bond deficiency and also account for the tendency of the sample to crack on burning and cooling.

POSSIBILITIES FOR UTILIZATION

Clay AE-6 (13-22′) could be used for making common brick but is less desirable than other clays in the County. It was tested for lightweight aggregate by burning lumps of the raw clay quickly to a temperature of 2200°F. Most of the lumps of clay expanded to make a very tough aggregate which could be especially suited for high strength concrete and asphalt paving. Some pieces of the clay sample seem to be composed of silt which was not affected by the heat treatment.

Core Hole AE-7

Location: Approximately 30 feet south of gravel private access road and about 190 feet west of the center of the main north-south farm-to-market road (SW.¼, SE.¼, Sec.9, T.13 N., R.6 E.) about 0.25 mile north of the junction of a road west.

Elevation: 367 feet (altimeter) Date: October 31, 1962

Thickness (feet)	Depth (feet)	Description of strata
3.2	3.2	Soil, clay loam, buff to tan, silty.
		Kosciusko formation
1.5	4.7	Sand, yellow to tan mottled orange-red, fine-grained, silty
4.0	8.7	Clay, light brown-gray mottled yellow, slightly to moderately silty, plastic; contains some iron oxide stains along joints
5.0	13.7	Clay, brown-gray, very slightly silty, plastic
4.5	18.2	Clay, light brown-gray mottled yellow, slightly to moderately silty, plastic; contains some iron oxide stains and selenite coatings along joints
4.5	22.7	Clay, gray to brown-gray, slightly to moderately silty, plastic; contains some iron oxide stains and selenite coatings along joints
2.2	24.9	Clayey silt or silty clay, brown-gray mottled yellow; contains selenite as coatings and fillings in joints
2.2	27.1	Clay, brown-gray to dark bluish-gray, silty
2.0	29.1	Silt, light-gray to brown-gray mottled yellow; contains laminae of clay
0.5	29.6	Clay, brown-gray to dark blue-gray, silty
0.4	30.0	Sand, light-gray mottled yellow, very fine-grained.

Screen Analysis

Sample AE-7 (9-13′)

Sieve size (mesh)	Percent retained	Character of residue
20	0.0	
60	Trace	Clay (A); selenite (C); pyrite (S); lignite (S); limonite (S); glauconite (S).
100	Trace	Quartz (A); selenite (C); clay (C); lignite (S); limonite (S); glauconite (S); pyrite (T).
250	1.0	Quartz (A); selenite (C); clay (S); limonite (S); muscovite (S); glauconite (T).
Pan	99.0	Clay (A); quartz (C); lignite (S).

Mississippi State Chemical Laboratory

Analysis No. 328,579

Sample AE-7 (9-13')

	As Rceived Basis	Dry Wt. Basis
Moisture (Air Dried)	2.51%	0.00%
Ignition Loss	7.52%	7.71%
Silica (SiO_2)	63.08%	64.70%
Iron Oxide (Fe_2O_3)	1.31%	1.34%
Alumina (Al_2O_3)	21.91%	22.47%
Titania (TiO_2)	0.63%	0.65%
Magnesia (MgO)	0.98%	1.00%
Lime (CaO)	0.42%	0.43%
Potash (K_2O)	0.37%	0.38%
Soda (Na_2O)	0.33%	0.34%
Total	99.06%	99.02%

X-RAY DIFFRACTION DETERMINATION

Sample AE-7 (9-13')

Prof. Russell interprets his X-ray diffractogram as follows: "Kaolinite and montmorillonite dominate the sample. There are also small amounts of illite, quartz, chlorite, and feldspar. Difficulty in deflocculating this sample suggests that it probably contains something like calcium."

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample AE-7 (9-13')

(Natural)

Water of plasticity: dry basis 22.7%; wet basis 18.5%.

Linear drying shrinkage: 6.2%.

Modulus of rupture: 710 lbs./sq. in.

Plasticity and extrusion behavior: good.

Drying and warpage behavior: fair.

Color: light gray in structure when dry—darker gray color on surface of test bars when dry.

(Blended with 50% potters flint)

Water of plasticity: dry basis, 19.1%; wet basis 16.0%.

Linear shrinkage: 5.5%.

Modulus of rupture: 987 lbs./sq. in.

Plasticity, extrusion, warpage and drying behavior: good.

Color: light gray.

PYROPHYSICAL PROPERTIES

Sample AE-7 (9-13′)

(Natural)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
07	1803	7.5	10.7	2081	Cream, steel hard
04	1940	9.8	6.04	Not determined	Buff, steel hard, cracked
02	2048	10.5	4.6	Not determined	Buff, steel hard, cracked
2	2088	10.2	3.92	Not determined	Buff, steel hard, cracked
3	2134	10.7	2.24	2700	Buff, steel hard, cracked
5	2185	10.0	1.83	Not determined	Buff, steel hard, cracked
10	2381	9.5	Not determined	Not determined	Grayish buff, steel hard, cracked

PYROPHYSICAL PROPERTIES

Sample AE-7 (9-13′)

(Blended with 50% potters flint)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
5	2185	6.0	11.6	3120	Cream, not steel hard
10	2381	6.5	11.3	3860	Cream, steel hard

COMMENTS

The clay, Sample AE-7 (9-13′), representing a 4-foot interval in Core Hole AE-7 could be described as a ball clay, a bond clay or a bentonite as it has some of the typical characteristics of all. The clay is very fine-grained and slightly carbonaceous.

The physical properties of the unburned clay are normally typical of a ball clay where the mineral kaolinite predominates. Under liquid conditions as in a casting slip, the clay has characteristics of a bentonite as it tends to jell and requires large volumes of water to develop a body mixture that will flow. As a bond clay it makes a stronger body when diluted with 50% non-plastic than in its natural state. And further as a bond clay, it has a fusion point at Cone 23 or 2860°F which places it in a No. 2 category for refractory use in a range of temperature where a typical bentonite could not be used.

The clay is relatively free from contaminating minerals except a small amount of gypsum and contains staining salts, the nature of which have not been determined.

On burning, the clay develops steel hardness at Cone 07 (1803°F) and has a tendency to crack and blue stone at higher temperatures; although, shrinkage and absorption values are nominal for a ball clay.

On diluting the clay sample with 50% non-plastic potters flint, the linear shrinkage and the water of plasticity was reduced slightly; however, the normal high bonding strength (natural clay) of 710 lbs./sq. in., was increased to 987 lbs./sq. in. Further, on burning the clay-flint mixture to Cone 5 and to Cone 10, unusually high bond strength was developed with nominal shrinkage and absorption values, accompanied by no cracking or blue stoning. A slight surface discoloration from soluble salts was noted on the burned test pieces.

POSSIBILITIES FOR UTILIZATION

The clay, Sample AE-7 (9-13′), should be considered as a single sample and also in relation to strata above and below the sample as tested and reported here as Sample AE-7 (5-9′ - 13-23′).

Sample AE-7 (9-13′), represents a 4-foot interval and as such may not be available in commercial quantities sufficient to justify commercial development suggested below.

The clay should be investigated for use in glazes and enamels where small quantities of clay are used as a suspending agent. It may have some use in various white ware bodies where small amounts of clay are needed for suspending and bonding. Possibilities are in order for use in bonding graphite for use in crucibles and various non-plastic refractory materials for refractory use. The bonding uses should be investigated for grinding wheels and other abrasives. The clay seems to have possibilities as a refractory foundry bond and as a drilling mud. Its use in sewer pipe should be considered.

SCREEN ANALYSIS

Sample AE-7 (5-9′; 13-23′)

Seive size (mesh)	Percent retained	Character of residue
20	0.0	
60	0.0	
100	0.0	
250	1.2	Quartz (A); muscovite (C); limonite (S); clay (S); lignite (T); pyrite (T); magnetite (T); selenite (T).
Pan	98.8	Clay (A); quartz (C); lignite (T); limonite (T).

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample AE-7 (5-9′; 13-23′)

Water of plasticity: dry basis 26.2%; wet basis 20.2%.
Linear drying shrinkage: 5.6%.
Modulus of rupture: 1610 lbs./sq. in.
Plasticity and extrusion behavior: good.
Drying and warpage behavior: good.
Color: gray.

PYROPHYSICAL PROPERTIES

Sample AE-7 (5-9′; 13-23′)

At cone	Temp. °F	Linear shrinkage Total %	Absorption in %	Modulus of rupture Lbs./sq. in.	Color & remarks
07	1803	6.7	9.9	3380	Light pink, steel hard
04	1940	8.1	6.8	2100	Pink, steel hard
02	2048	8.5	6.55	3380	Pink, steel hard
2	2088	8.4	5.38	3820	Pink, steel hard
3	2134	8.0	5.25	3820	Pink, steel hard
5	2185	8.1	5.73	4750	Dark pink, steel hard
10	2381	8.6	8.75	3180	Brown, steel hard, bloated

COMMENTS

The composite Sample AE-7 (5-9′; 13-23′), representing a 4-foot interval above Sample AE-7 (9-13′), and a 10-foot interval below, has about the most ideal natural properties in both its unburned and burned state for use in heavy clay products without adding or taking away anything as any clay tested by the writer.

Water of plasticity and drying shrinkage and other working properties are nominal for use in the manufacture of heavy clay products. What is unusual is the high dry strength, 1610 lbs./sq. in., which is equal to the burned strength of many common clays. What further is unusual is the high burned strength accompanied by normal burning shrinkage, low absorption values in a temperature range of 382°F without an appreciable change in color or other fired characteristics. The clay develops steel hardness at Cone 07, and at Cone 04 nominal low shrinkage, absorption values and high strength are consistent through Cone 5. At Cone 10, the clay is overburned but not to such an extent to make it unusable at high temperatures.

POSSIBILITIES FOR UTILIZATION

The clay, Sample AE-7 (5-9′; 13-23′), burns to a beautiful pink color which makes it architecturally desirable for use in face brick, solar tile, paving tile and quarry tile. It is well suited for use in various structural tile, jumbo brick, conduit and flue lining. It could be the principal constituent of sewer pipe.

CONCLUSIONS

The clays of Attala County as represented by the 9 samples submitted to the writer and tested by him suggest a wide variety of industrial uses. These tests must, however, be regarded as reconnaissance in nature and insufficient for the immediate establishment of any new industry. However, they were made on materials which are characteristic of the County and appear to be present in large quantities. A variety of possible industrial products is indicated. Among these products are a wide range of heavy clay products including sewer pipe, brick, tile and other similar items; a bonding clay for possible use in foundry molding sand; ball clay suitable as a major ingredient in high-grade commercial pottery; large quantities of impure, silty, lignitic clays in several formations in the County which, on preliminary tests, indicate the possibility for good lightweight and medium-weight artificial aggregate for concrete or bituminous material.

Before the establishment of any industry utilizing the materials tested herein, the prospective industry would itself, in all probability, wish to make more detailed investigations and tests of its own to determine the exact size of the individual deposits and the variation of the quality of the materials. This further investigation is a normal procedure before the establishment of such industrial plants.

SUBSURFACE GEOLOGY OF ATTALA COUNTY

WILLIAM H. MOORE

ABSTRACT

Four wells drilled in Attala County penetrated rocks of Paleozoic age. The Paleozoic section in two of these wells shows evidence of weak metamorphism and is considered by some geologists to be of the "Ouachita facies."

The cuttings and cores from the Paleozoic section in these wells contained specimens of an unusual mineral which has been identified as a fibrous variety of quartz. Study is now being made as to a name that can be applied to this quartz mineral.

The remainder of the stratigraphic column discussed in this subsurface report is in ascending order, Upper Jurassic, Lower Cretaceous, Tuscaloosa, Eutaw, Selma and Midway.

A structure map of the County, using the top of the Cretaceous as a datum, shows gentle dip to the southwest over most of the County, with a steepening of dip in the southwestern part of the County. An isopachous map of the interval from the top of the Cretaceous to the top of the Paleozoic in Attala County and adjoining counties shows considerable thickening of this interval in the southwestern portion of the County. This thickening is in the Lower Cretaceous and Jurassic intervals.

There have been only two shows of oil or gas reported in wells in the County, but this does not condemn Attala County as a producing county. Only 15 wells have been drilled and this is not sufficient to explore the production possibilities of all formations. The Upper Cretaceous rocks seem to be most favorable objectives in Attala County.

INTRODUCTION

All available cuttings and cores from the 15 wells drilled in Attala County were examined and the information gained from this examination was compared with electrical logs and drillers' logs from these wells. Data from wells in the surrounding counties were studied, and the regional geologic aspects were taken into consideration as to structural conditions, regional gravity data, favorable trends for oil and gas exploration, etc.

STRATIGRAPHY

This subsurface study concerns beds from the Midway group of Tertiary age to those of Paleozoic age as the younger beds are discussed in other sections of this bulletin. The stratigraphic column applicable to this subsurface study is shown by Figure 1.

		THICKNESS
TERTIARY	MIDWAY	650'-700'
CRETACEOUS	SELMA	750-820'
	EUTAW	500'
	TUSCALOOSA	650'
	LOWER CRETACEOUS (UNDIFFERENTIATED)	1200'-1600'
JURASSIC	UPPER JURASSIC (UNDIFFERENTIATED)	700'-800'
PALEOZOIC	PENNSYLVANIAN ?	350'-750'

Figure 1.—Generalized pre-Wilcox stratigraphic succession and thickness in Attala County.

PALEOZOIC

Three wells in Attala County, the Shell No. 1 Wheeles, Stanolind No. 1 Steed and Continental No. 1 Sudduth bottomed in rocks of Paleozoic age. A fourth well, the Hunt No. 1 Murphy was reported to have gone into the Paleozoic rocks. The electrical log of this well substantiates this report, but no samples were available from the lower part of this well so that the Paleozoic section could be examined.

The Wheeles well, in the eastern part of the County, encountered approximately 675 feet of Paleozoic rocks. This section is dark-gray to black shale, containing some black, silty shale. The lower 300 feet contain small quartz veins.

The samples from the Paleozoic section in this well do not exhibit the weak metamorphism found in the cuttings from wells in the southwestern portion of the County. Samples from this well were described by King[1] as "Paleozoic rocks. Top at 5,504 feet. Pottsville formation (Pennsylvanian) to total depth (Dott and Murray, ed., 1954; Beikman and Drakoulis, 1958a). Classed by some geologists as of 'Ouachita' facies. Published log shows that the Pennsylvanian is shale and sandy shale. Thin sections were studied of cuttings and cores from depths of 5,635, 5,847, 5,950, 6,010, 6,080 and 6,160 feet (August Goldstein, Jr., 1960; P. T. Flawn, 1959). Most of the rocks are dark carbonaceous shale, largely silty, partly calcareous. In one specimen (6,080 feet) laminae of quartzose feldspathic siltstone alternate with laminae of silty carbonaceous shale. Part of the clay in the shales is unaltered, but as much as half or more has been recrystallized to chlorite and minor sericite. One specimen (5,635 feet) is dark, laminated, sublithographic limestone, veined by quartz. All the specimens show incipient to very low grade metamorphism. 'Finely divided and disseminated organic matter reduces the apparent metamorphic grade of the rock. Without this, these rocks might have been equal in metamorphic grade to those in Stanolind No. 1 Steed farther west in the County' (Goldstein). The rocks are comparable in metamorphic grade to many of those in the Ouachita belt, but they are interpreted here as part of the belt of deformed Pennsylvanian rocks close to the structural front."

In the southwestern part of the County two wells encountered Paleozoic sections which showed weak metamorphism. The Steed well penetrated 360 feet to its total depth and the Sudduth well 770 feet.

Samples from this section in the Steed well were described by King[2] as "Paleozoic (?) rocks. Top at 6,724 feet. Thin sections were studied from depths of 6,700, 6,705, 6,805, 6,815, 6,886, 6,905, 6,995, 7,075 and 7,085 feet (August Goldstein, Jr., 1960). Most of the specimens are chert, cherty clay-slate, and clay-slate, but there is one specimen (6,805 feet) of siliceous limestone and another of metaquartzite (6,905 feet). The cherts are variably argillaceous, dolomitic, and calcareous, and grade into cherty or siliceous slate. The whole suite was probably a high-silica shale before metamorphism, but half or more of the clay has been recrystallized to chlorite and sericite; metamorphism is weak to low grade (muscovite-chlorite subfacies of green schist facies). In some of the cherts are monaxon sponge spicules that have been recrystallized and partly resorbed, but no other fossils are visible. 'These cuttings are comparable in metamorphic grade to rocks of Ouachita facies along the Balcones fault zone in central Texas. It is not possible to assign them to a definite formation, but their general aspect is Ordovician(?)' (Goldstein)."

King[3] also described rocks from the Paleozoic section in the Sudduth well as "Paleozoic(?) rocks. Top at 7,249 feet. Rocks are weakly metamorphozed but strongly sheared black slate. Cores were examined from depths of 7,080, 7,601, 7,798 and 7,970 feet (Josiah Bridge, 1953; P. T. Flawn, 1959). They are carbonaceous or graphitic clay-slate, containing abundant mica and chlorite, well foliated and in places with incipient fracture cleavage or microfaults. Foliation crosses bedding at angles of 20° to 40°. In one core (7,970 feet) thin layers of black graphitic slate alternate with thin layers of fine-grained dolomite, in which the carbonate grains are stretched and twinned. Quartz veinlets, dolomite veinlets, and pyrite are common; one core (7,798 feet) is a breccia of angular vein quartz fragments, cemented by limestone and shale. Metamorphism is weak but with a strong shearing element. The cores were searched for fossils without result, but the general aspect of the rocks would seem to be like that of the older Paleozoic formations of Ouachita facies."

It is reported that the Hunt No. 1 Murphy in the northwestern corner of the County encountered a weakly metamorphosed Paleozoic section but as stated, the samples from the lower portion of this well were not available for study.

The age of the Paleozoic section in these wells has not been determined. A comparison with the Paleozoic rocks found in other wells in nearby counties and a study of the regional geology leads the writer to believe that the age of these beds is Pennsylvanian.

In addition to the material described by King, an unusual mineral was noted in the cuttings from below 7,000 feet in the Steed well and below 7,200 feet in the Sudduth well. The mineral is colorless, light-gray and pale green, depending on the thickness of the sample. It is fibrous in appearance yet harder than steel. Several small pieces of this mineral were found at various depths and a large specimen is present in a core from the Sudduth well. This specimen and its relationship to the surrounding material in the core is shown by Figure 2.

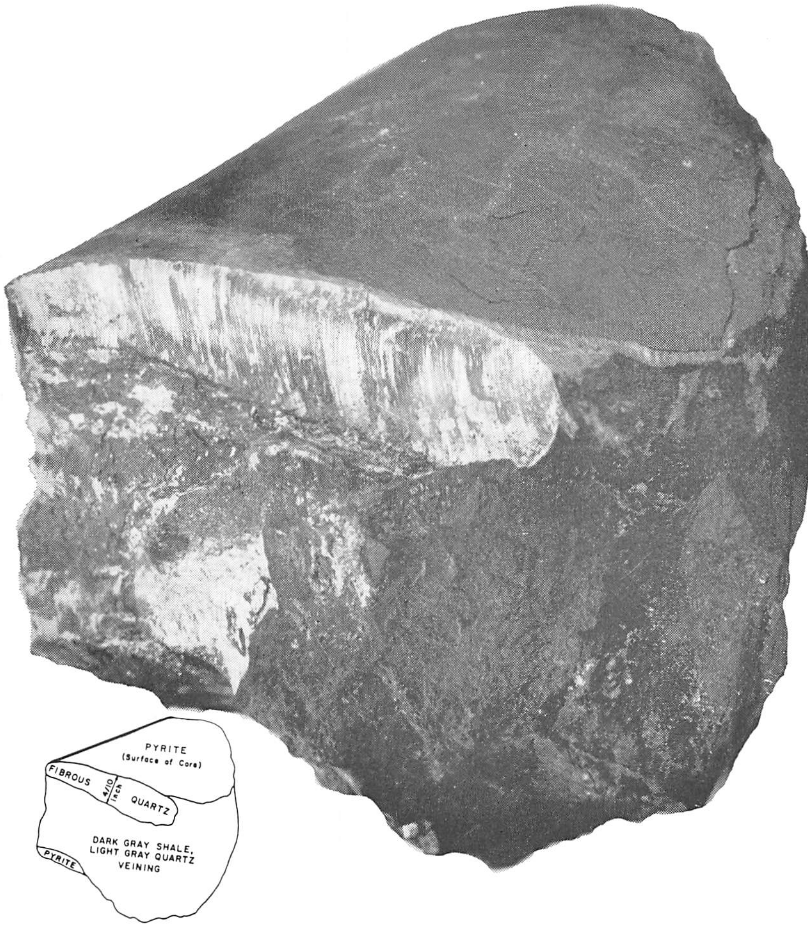

Figure 2.—Core from Continental Oil Co. No. 1 Sudduth below 7200 feet.

A sample of the mineral was sent to Dr. Charles Milton of the Petrological Services and Research Branch of Experimental Geochemistry and Mineralogy of the United States Geological Survey, Washington, D. C., Dr. Milton's[4] identification is as follows: "The prismatic or fibrous mineral from Continental, Sudduth No. 1, Attala County, Mississippi, 7200-7300 feet, is quartz, both by optical study and x-ray diffraction analysis (powder pattern).

"In the new Dana's system, Volume III Silica Minerals, there does not seem to be any specific mention of this kind of fibrous quartz unless it is included in the discussion of chalcedony, in which case it might be related to iris agate (page 203). Very precise optical measurements differentiate between ordinary quartz and the chalcedonic fibrous varieties."

Wendell B. Johnson of the Millsaps College Geology Department read Dr. Milton's identification and observed a photograph of the mineral contained in the core. Johnson[5] suggested that the mineral might be pseudo-morphous after the variety of gypsum selenite. Gypsum is commonly associated with dolomite, calcite, pyrite and quartz, and all these minerals are present in the cuttings and cores from the section in which the fibrous quartz mineral was found. Further study is being made as to the name to be applied to this variety of quartz.

In the Stanolind No. 1 Steed and the Continental No. 1 Sudduth an unusual section of rocks is present between the above described section and the overlying Jurassic rocks. The interval between 6680 feet and 6730 feet in the Steed well and between 7030 feet and 7240 feet in the Sudduth well contains rocks which are weakly metamorphosed.

These rocks are red, purple and gray and in color more closely resemble the overlying rocks than the subjacent black Paleozoic shales. King[6] has described cores from this section as "altered porphyry, in which feldspar laths are changed to clay, flowage structure in the ground mass suggests that the rock was extrusive." The writer found no material in the cuttings and cores which appeared to be igneous, although cores from the entire interval are not available. Two core samples from the Continental No. 1 Sudduth were examined by Clarence L. Moody[7] and his description is as follows:

"(a) 7116—In macroscopic appearance this rock is minuately laminated, essentially aphanitic and of light reddish gray color, specific gravity of three selected pieces average 2.18. From its general appearance and relatively low specific gravity it might easily be concluded that this rock was some form of very finely divided volcanic tuff or ash. Microscopic investigation, however, does not support this view. No relict shard structure is found and the largest particles, considerably less than 0.1 mm. in diameter, are either quartz or clay particles. The particle sizes grade downward rapidly, the majority of the area of the slide which was studied being made up of an unresovlable mineral mass. The laminated texture of the hand specimen is maintained down to the finest sub-microscopic material. Some evidence of recrystallization is to be seen, but there is no development of mica. The refractive index of the slide margins is slightly greater than that of the embedding balsam. Based on these observations, the best that I can do with this rock is name it an indurated CLAYSTONE.

"(b) 7120—In hand specimen this rock is well banded to laminated; color dark grayish red to light grayish red; specific gravity 2.8. In thin section this rock only remotely resembles that found only four feet above because it seems to have undergone a considerable cataclastic alteration. Sericite has developed in parallel arrangement with respect to the fracture lamina and is the only prominent transparent mineral in the slide. Perhaps 30% of the area of the thin section is made up of opaque rounded substance which I assume is amorphous hematite. The origin and significance of this occurrence present baffling problems which would be interesting to pursue further. I can find no textures at all suggesting a tuffaceous origin. The rock is distinctly incipiently metamorphosed to the extent that I would be inclined to characterize it as a phyllite except for the fact that it is reported that Paleozoic black shale was encountered below its depth in your well. So in order to ride the fence on this issue, I would be satisfied to call the rock a phyllitic CLAYSTONE."

The writer observed the same material described by Moody in the cuttings and core samples from this well, and in addition much red and amber quartz was present in the cuttings. One core sample was made up entirely of shattered white to pink vein quartz encrusted with siderite and with red shale inclusions. These rocks possibly represent the weathered and oxidized surface of the Paleozoic clastic sediments.

JURASSIC

Beds of Jurassic age were penetrated in four wells in Attala County. Three of these drilled through the Jurassic into Paleozoic rocks. The writer is of the opinion that the Jurassic beds are of the Cotton Valley group. The upper portion of the Jurassic section contains gray, green, ochre and purple mudstones containing siderite nodules and white, fine-grained sandstones bearing incipient siderite nodules. These lithologies characterize the Cotton Valley in other areas.

The Gulf No. 1 Peeler reached total depth after coring a 20-foot Jurassic section of gray mudstone and white, fine-grained sandstone containing siderite nodules. The Shell No. 1 Wheeles encountered a 400-foot section of Jurassic rocks above the Paleozoic. This section consisted of red, green, ochre, purple and gray mudstones containing some siderite nodules and white, fine-grained sandstones bearing siderite nodules along with white, fine- to coarse-grained sandstones. The section contained more coarse-grained material in the lower part. These two wells are near the eastern edge of the County.

In the southwestern part of the County, the Continental No. 1 Sudduth and the Stanolind No. 1 Steed penetrated Jurassic sections approximately 750 feet thick. The lower part of the Jurassic section in these two wells is composed of red shales and white, fine- to coarse-grained sandstones containing quartz pebbles and chert fragments. A good basal conglomerate is developed in both wells. A core taken in this basal conglomerate in the Stanolind No. 1 Steed contained quartz and chert pebbles up to one inch in diameter. The upper part of the Jurassic interval in these two wells is made up of vari-colored mudstones carrying siderite nodules and white fine-grained sandstones containing some siderite nodules and some white fine- to coarse-grained sandstone.

The section described in these four wells, and called Jurassic by the writer, has been placed in the Lower Cretaceous by reports in the trade papers and by Beikman and Drakoulis.[8] The reasons for assigning Jurassic age to this interval are: 1) a good basal conglomerate and an ascending progression to finer-grained material, 2) the presence of characteristic vari-colored mudstones containing siderite nodules and white fine-grained sandstones carrying siderite nodules, and 3) a return to coarse sandstones in the overlying beds.

LOWER CRETACEOUS

Eight of the wells drilled in Attala County penetrated beds of Lower Cretaceous age, and five of these wells drilled through the Lower Cretaceous into older beds. This section is nearly all a sequence of coarse-grained sandstones and red shales and no formation names are applied in this report. The Lower Cretaceous interval is 1,220 feet thick in the Gulf No. 1 Peeler in the eastern portion of the County. It thickens slightly to 1,300 feet in central Attala County in the Stanolind No. 1 Steed and thickens considerably to almost 1,600 feet in the Continental No. 1 Sudduth.

The lithology of the Lower Cretaceous is consistent in all wells, being red shales containing nodular limestone and white fine- to coarse-grained sandstones carrying quartz pebbles and chert fragments. Some of the sandstones are calcareous and some wells penetrated beds of red sandstone. There are also beds of red, gray and ochre mudstone present in some wells. The top of the Lower Cretaceous is picked on the first appearance of nodular limestone. In most of the wells there are no sideritic sandstones in the Lower Cretaceous, but a few contain beds of sandstone with inclusions of crystalline sideritic material.

UPPER CRETACEOUS

TUSCALOOSA GROUP

The thickness of the Tuscaloosa group in the Attala County subsurface is approximately 650 feet. This interval can be divided in this area into the Upper Tuscaloosa and the Lower Tuscaloosa. McGlothlin[9] considered the top of the Lower Tuscaloosa to be an unconformable surface overlain by a basal Upper Tuscaloosa gravel. Samples from wells in the County support McGlothlin's ideas.

The Lower Tuscaloosa is approximately 350 feet thick. The basal portion usually consists of a white, fine- to coarse-grained sandstone containing quartz pebbles and rare chert fragments. In about half of the wells in the County, this basal sandstone is overlain by a section of white, glauconitic, fine-grained sandstone and some gray shale. Above this section, or in wells where it is not present, above the basal sandstone, is a sequence of white, porous fine-grained sandstones and vari-colored shales. The sandstone contains inclusions of crystalline siderite or "ankerite." The mudstones are red, gray, purple and ochre. The gray mudstone contains spherical siderite or "ankerite" nodules.

The basal portion of the Upper Tuscaloosa consists of very coarse-grained sandstone containing quartz pebbles and abundant yellow and white chert fragments. Some wells contain several bodies of this coarse material separated by beds of vari-colored mudstone. The basal gravels are overlain by beds of white, porous, fine- to coarse-grained sandstone which contain inclusions and nodules of crystalline siderite or "ankerite" and red, purple, green, ochre and gray mudstone carrying siderite or "ankerite" nodules. The uppermost portion of the Upper Tuscaloosa is made up of gray mudstones with siderite or "ankerite" nodules. Some samples are made up entirely of these nodules.

EUTAW FORMATION

The Eutaw is approximately 500 feet thick in the Attala County subsurface. The placing of a lower boundary of the formation is difficult. There is no reliable characteristic on the electrical logs and the lithologies of the lower Eutaw and the upper part of the Tuscaloosa vary from well to well. The top of the formation is easily picked in samples and on electrical logs, as there is an abrupt change from the chalks of the Selma to the sandstones of the Eutaw.

The lower Eutaw is made up of white to orange, glauconitic, sideritic sandstones, which are, for the most part, fine-grained. The siderite is in the form of cement and as larger, irregular masses in the sandstones. There are beds of gray shale in the lower Eutaw and the lowermost shales in the formation are carbonaceous. The lower Eutaw contains small siderite nodules in some wells, but these are not as large or as abundant as those found in the underlying Tuscaloosa.

In 3 wells in the southwestern part of the County, a 100-foot interval containing gray, fine micaceous shales and white, glauconitic, fine-grained sandstones is present between the typical lower Eutaw described above and the vari-colored mudstones and non-glauconitic sandstones of the Upper Tuscaloosa.

The upper Eutaw is made up of white, slightly porous, glauconitic, micaceous, calcareous, fine-grained sandstones. Some wells contain fossiliferous sandstones and there are rare slightly sideritic sandstone beds. The shales of the upper Eutaw are gray, silty and finely micaceous in part. In the easternmost well in the County, the Gulf No. 1 Peeler, the upper 100 feet of Eutaw sandstones contain abundant sub-angular fragments of basalt.

SELMA GROUP

In this discussion, the Selma Group includes all beds between the top of the Eutaw formation and the base of the Clayton formation. This interval is thickest in wells in the eastern part of the County, being 802 feet thick in the Gulf No. 1 Peeler and 806 feet thick in the Shell No. 1 Wheeles. The Selma thins in wells in the central and northwestern part of the County. It is 754 feet thick in the Roscoe No. 1 Sims and 762 feet thick in the Hunt No. 1 Murphy. The Selma thickens slightly in wells in southwestern Attala County where the Crosby No. 1 Allen has a Selma thickness of 782 feet and the Continental No. 1 Sudduth a thickness of 785 feet for this interval.

Though the Selma is not divided into formations in this report, there are lithologic and paleontologic characteristics in the interval that seem to correlate with some of the formations found at the surface.

The lower 150 feet of the Selma consists of gray, argillaceous, glauconitic chalk, sandy in part. In some wells, this interval contains gray marl and beds of gray, calcareous shale. In the Crosby No. 1 Allen, large flakes of biotite mica are present in this section of the chalk. This interval correlates with the Mooreville of the outcrop.

In ascending order, the next 300 feet of the Selma is made up of gray, slightly argillaceous chalk, many samples containing pyrite. The rocks in this interval are fossiliferous. There are several species of foraminifera, fragments of oyster shells and *Inoceramus* prisms present. This section correlates with the Annona and Marlbrook of the outcrop.

The next 100 feet is made up of white chalk. This chalk is less argillaceous than the rest of the Selma interval and would seem to correlate with the Saratoga chalk. Some wells had vein calcite present in the samples although no porosity or fractures were seen in the chalk due to the small size of the cuttings.

The overlying 150 feet is made up of gray, argillaceous, glauconitic chalk, sandy and silty in part. The samples in this interval contain many specimens of *Lituola* sp., and some samples are made up entirely of *Lituola* fragments. This section also contains other foraminifera and fragments of larger fossils. The lithologic and paleontologic character of this interval enables it to be correlated with the Ripley of the surface.

The upper 100 feet of the Selma group is made up of gray, slightly argillaceous, fossiliferous chalk and is correlated with the Prairie Bluff formation of the outcrop area.

PALEOCENE

MIDWAY GROUP

The Midway is represented in the Attala County subsurface by the Clayton formation and the Porters Creek formation.

The Clayton formation is 20 to 30 feet thick in wells in Attala County. The Clayton consists of light-gray, argillaceous, fossiliferous chalk. In a few wells the Clayton is slightly sandy. It contains abundant foraminifera and is distinguished from the subjacent Selma group by the presence of typical foraminifera, such as *Vaginulina robusta,* which are not found in the Selma.

The Porters Creek formation is about 650 feet thick in eastern Attala and it thickens slightly to over 700 feet in the southwestern part of the County. The lithology of the Porters Creek is uniform in all wells, being gray, micaceous shale. The cuttings from many zones contain fragments of siderite concretions. In some wells, the upper part of the formation contains large flakes of mica and the shale is silty. With the exception of a few ostracods, no fossils were noted in the Porters Creek.

STRUCTURE

A structure map of the County, using the top of the Cretaceous as a datum, is shown by Figure 3. This map shows gentle dip to the southwest over most of the County with steepening of dip in the southwestern part. This part of the County is near the Pickens Field, a faulted area at the edge of the Mississippi

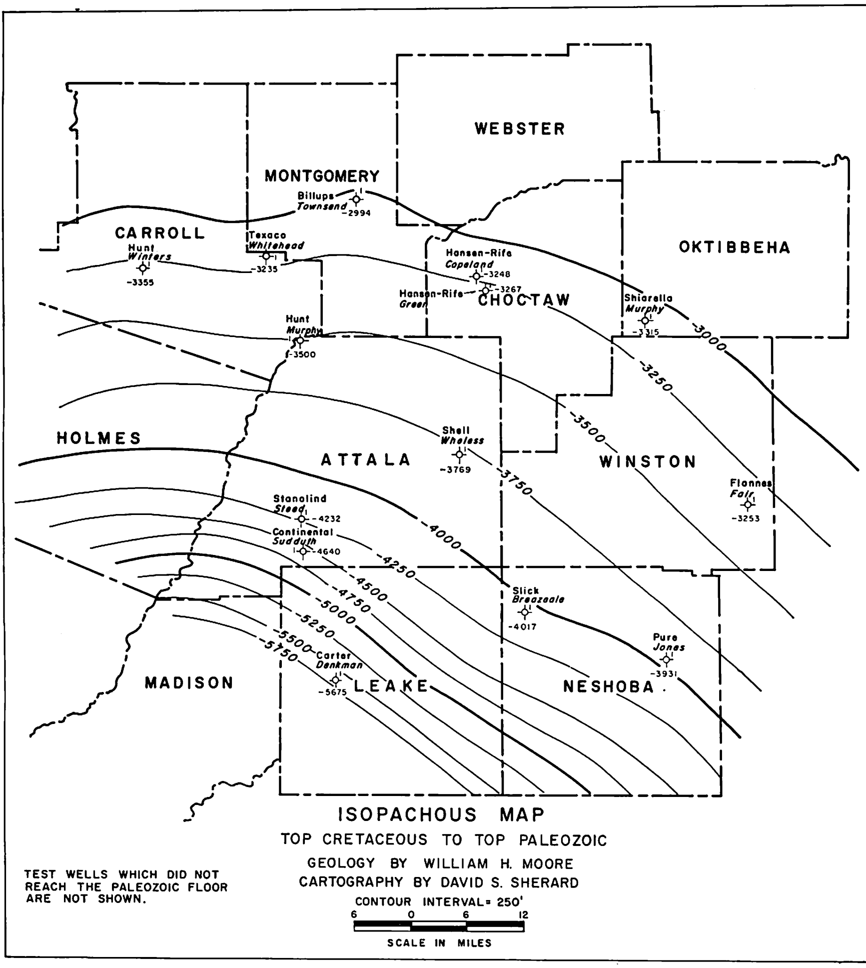

Figure 3.—Isopachous map, top Cretaceous to top Paleozoic.

Interior Salt Basin. This map has a contour interval of 100 feet and with the sparse control in the County does not show small local structures seen in Plate 3 of the section on surface geology.

An isopachous map of the interval from the top of the Cretaceous to the top of the Paleozoic in Attala County and adjoining counties is shown by Figure 3. This map shows considerable thickening of this interval in the southwestern portion of the County. Studies of the samples and electrical logs showed this thickening to be in the Lower Cretaceous and Jurassic sections.

The Upper Cretaceous and Paleocene formations maintain relatively constant thicknesses.

The thickening of these intervals shows the effect of the Central Mississippi Ridge, which trends southeast-northwest across central Attala County. Regional gravity maps show a positive feature trending southeast through central Attala County. The structral effect of the Central Mississippi Ridge and that of the Ouachita front in western Attala County had been minimized by Upper Cretaceous time as erosion in Permian, Triassic and early Jurassic time and subsequent deposition had smoothed the structural and physiographic irregularities of the Paleozoic surface.

Local structural anomalies have been located by detailed core hole programs and seismic work. Several wells in the County have been drilled on these local anomalies.

OIL AND GAS POSSIBILITIES

There is no oil and gas production in Attala County, and there have been only two shows reported in the 15 wells drilled. The Home Oil No. 1 Dill, drilled in 1911, was reported to have had a slight gas show while drilling the Selma section. The Crosby No. 1 Allen, drilled in 1940, reported a slight gas show in the Eutaw. There is some doubt as to the authenticity of these shows, but the formations in which the shows were reported are productive at Pickens Field just south of the southwestern corner of Attala County. Pickens Field lies at the northern edge of the Mississippi Interior Salt Basin, and Attala County is underlain by Cretaceous rocks laid down on the continental shelf area. The possibility of production from these Cretaceous shelf sediments has been discussed by Mellen.[10]

Attala County is north and east of the areas of most favorable facies development in the Lower Cretaceous and Jurassic rocks. Both of these intervals contain many feet of porous sands containing some discrete shale bodies so that the possibility of migratory oil being trapped in these rocks cannot be discounted.

The Paleozoic rocks underlying the western portion of the County are in the weakly metamorphosed zone of the Ouachita facies, and this probably precludes the retention of any oil originally formed in these rocks. Any production in these beds would come from oil migrating into fractured zones.

The eastern portion of the County is underlain by unmetamorphosed Paleozoic rocks, but not enough control is available to determine if porous beds are present in the Paleozoic section.

Attala County is at this time relatively unexplored for oil and gas possibilities but along with many other counties in north Mississippi, it certainly has not been condemned as a possible producing area.

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Water Resources of Attala County, Mississippi

by

B. E. WASSON

Prepared by the United States Geological Survey
in cooperation with

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and
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1963

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Water Resources of Attala County, Mississippi

B. E. WASSON

ABSTRACT

Attala County is underlain by ground-water reservoirs in the Wilcox Group, and in the Tallahatta, Winona, Kosciusko, and Cockfield Formations. These reservoirs, presently yielding about 5 mgd (million gallons per day) of water of good chemical quality are virtually undeveloped and are capable of supplying large quantities of water for industrial and municipal use in the future.

Most of the water (about 2½ mgd) for municipal and industrial water supplies in Attala County is obtained from highly productive sands in the upper part of the Wilcox Group. The lower sands, presently untapped, are probably capable of large yields and are a large ground-water reserve for future use.

The Tallahatta Formation includes water-bearing sands in the Meridian Sand Member, the Basic City Shale Member, and the Neshoba Sand Member. The Meridian Sand Member is used as a source of water for two industrial wells and a few domestic wells. The total pumpage is about 0.2 mgd. Water from the Meridian Sand Member is inconsistent in chemical quality but is generally satisfactory for most uses with little or no treatment.

The lenticular sands of the Basic City Shale Member of the Tallahatta Formation, a source of water for domestic wells, form a separate aquifer in the central and southern parts of the county. The Neshoba Sand Member is the most widely used aquifer for small-capacity domestic wells.

The Kosciusko (Sparta) Formation is capable of yielding 1,000 gpm or more to properly constructed wells in the western part of the county. The aquifers are now used only for domestic water supplies.

The Cockfield Formation crops out in a limited area in the extreme southwestern part of the county. It is capable of yielding moderate to large quantities of water to wells.

The hydrologic system in Attala County is conducive to the development of multiple-aquifer well fields which will permit the withdrawal of relatively large quantities of water with a minimum decline in water levels.

Big Black River, the western boundary of the county, and Yockanookany River, which drains the central part of the county, are potential sources of important surface-water supplies. The average low flow of Big Black River at the southwest corner of the county is about 39,000,000 gpd. The Yockanookany River at Kosciusko has an average flow of about 5,200,000 gpd.

Ground water in Attala County is generally of good chemical quality and is suitable for most uses with little or no treatment. Some iron trouble is caused in water from shallow wells because of the corrosiveness resulting from low pH values. In a few places, the water contains excessive iron in solution.

INTRODUCTION

Purpose and Scope of Investigation

The future economic growth of Attala County is to a great extent dependent upon the development and proper utilization of the water resources. This investigation was made to determine the occurrence, quantity and quality of water in Attala County.

Larger future water needs, especially for industrial use, show the propriety of examining the possible sources of water and the hydrologic system of which they are a part. Those concerned with water development and management may then make more intelligent decisions concerning the water resources.

Ground water is the source of all public, industrial, and domestic water supplies in Attala County, except for a few rainwater collection systems. Several irrigation systems in the county pump water from streams and lakes. Most of the larger farms in the county have both ponds and perennial streams.

Attala County is included in a general ground-water survey of the south half of northwestern Mississippi being conducted by the U. S. Geological Survey in cooperation with the Mississippi Board of Water Commissioners. More comprehensive work was done for inclusion in this report to be published as a part of the geology and mineral resources of Attala County by the Mississippi Geologic, Economic, and Topographic Survey.

Information has been collected on several hundred water wells and test holes in the county (fig. 1 and table 7). Detailed hydrologic or geologic data, or both, have been collected on several holes. One aquifer test was made to determine hydraulic characteristics of the principal aquifer at Kosciusko. Field analyses were made on over 100 water samples, and several complete analyses were made at laboratories of the U. S. Geological Survey.

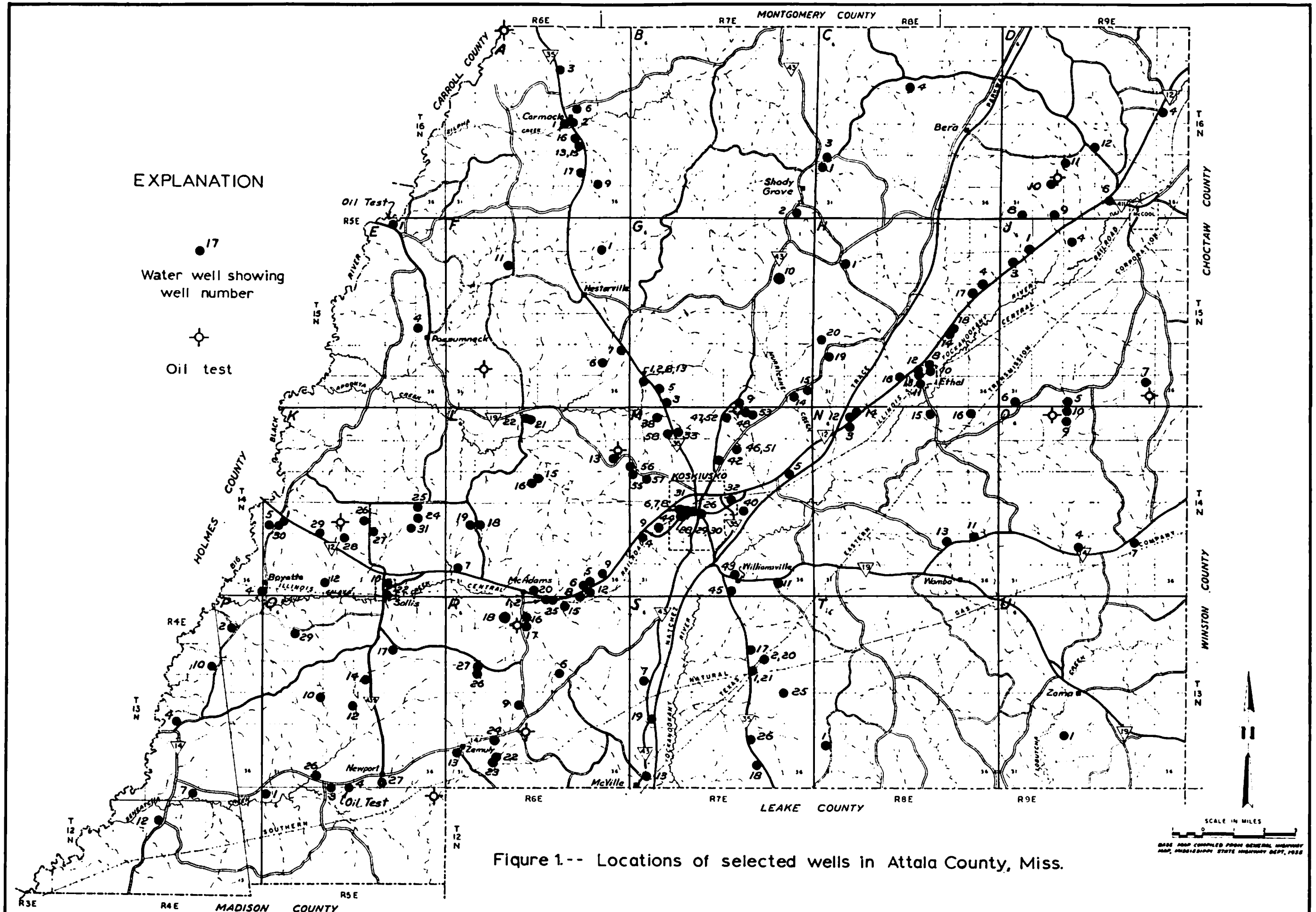

Figure 1.-- Locations of selected wells in Attala County, Miss.

Well-Numbering System

The well-numbering system used by the U. S. Geological Survey in Mississippi is based on the rectangular grid system for the subdivision of public land (fig. 1). For each county, grids (townships) are designated alphabetically beginning with A in the upper left township. Areas smaller than half a township are included with an adjoining township. The letter I is not used. Wells in each grid are numbered consecutively, for example B2 (fig. 1 and table 7).

ACKNOWLEDGMENTS

The City of Kosciusko, the Pet Milk Company, and the Kosciusko Ice and Coal Company made the aquifer test possible by controlling pumping rates and through other efforts. Well owners and drillers supplied most of the well data.

GENERAL HYDROLOGY

The average annual precipitation in Attala County is about 52 inches. About 17 inches runs off as streamflow and most of the remainder is returned to the atmosphere through evaporation and transpiration by vegetation. The small percentage of rainfall that percolates into the soil and reaches the water table of an aquifer (a bed of saturated sand or other material that will give up water to a well) is important because it is the primary source of water for wells, springs, and perennial streams (a stream which flows continually, usually sustained by ground-water discharge).

The amount of water added to a ground-water reservoir depends on such factors as depth of the water table (upper surface of a saturated zone) below land surface, permeability (ability to transmit water) of the soil, amount and rate of precipitation, vegetation, humidity, wind speed, and temperature. When the water table is at or very near the land surface little or no additional water can be stored. The shallow outcrop areas of the aquifers in Attala County are full to overflowing, as is evidenced by the many springs and perennial streams in the county. The outcrops of the geologic units (table 1 and Plate 1*) in Attala County are such that about half the surface of the county is permeable to very permeable and about half is relatively im-

Plate 1.*—A geologic map of Attala County included in the cooperator's part of report.

Table 1.--Generalized section of subsurface geologic units in Attala County, Miss. and their water-bearing properties

Era	System	Series	Group	Stratigraphic unit	Symbol	Subsurface thickness (feet)	Lithologic character	Water-bearing properties
Cenozoic	Quaternary	Recent		Alluvium and Colluvium	Qa	0-30	Clay, silt, and sand.	May yield small to moderate supplies to domestic wells.
Cenozoic	Tertiary	Eocene	Claiborne	Cockfield Formation	Ec	150+	Fine to medium sand, silt, clay, shale, and lignite.	Yields water to small domestic wells in southwestern part of county, but would probably yield 500 gpm to large wells.
				Wautubee Formation (Cook Mountain Formation)	Ecm	100	Lignitic clay, shale, silt, and lenticular fine sand.	Not known to be an aquifer.
				Kosciusko Formation (Sparta Sand)	Ek	240-280	Beds of medium to coarse sand up to 100 feet thick interbedded with shale, clay, silt, and lignite.	Yields 1,100 gpm to well near southwestern corner of county. Many domestic wells in western part of county.
				Zilpha Formation (Zilpha Clay)	Ez	40-200	Clay, shale, and lenses of sand and silt at top. Highly glauconitic sand, silt, and rock lenses at base.	The Zilpha is not considered to be an aquifer, but some domestic wells may be in the sand and silt lenses near the top of the formation.
				Winona Formation (Winona Sand)	Ewi	20-50	Highly glauconitic, fossilifersous sand and marl.	Not extensively used as an aquifer except in the outcrop where it is a source of water for many small domestic wells.
				Tallahatta Formation: Neshoba Sand Member	Etn	60 - 145 (160±)	Beds of fine to medium micaceous sand, and some shale.	The source of water for many domestic water supplies in most of the county.
				Tallahatta Formation: Basic City Member (Basic City Shale Member)	Etb	30 - 80 (160±)	Shale, packed sand, and "buhrstone."	The source of water for many domestic supplies primarily in the outcrop area.
				Tallahatta Formation: Meridian Member (Meridian Sand Member)	Etm	35-80	Fine to coarse micaceous sand and interbedded shale, clay, and lignite.	Yields 60 gpm each to two wells. Few wells are sourced in the downdip part of the Meridian because sufficient water for domestic supplies is available at shallower depths.
			Wilcox	(Wilcox)	Ew	900-1,900	Sand, shale, silt, and clay; usually lignitic; very lenticular and irregular.	Wells yield up to 1,200 gpm. Quality of water is good. Many domestic wells in eastern part of county and nearly all large capacity wells in county have their source in the Wilcox, mostly in upper sand.
		Paleocene	Midway		--	650-800	Mostly hard blue to black massive clay.	Not an aquifer.
Mesozoic	Cretaceous				--	Several thousand	Thick beds of chalk, clay, sand, and gravel.	Contain brackish water. Deeper beds contain saline water.

The names in parentheses are presently used by the U. S. Geological Survey.

permeable. Rainfall in the county is above average in the spring and below average in the fall. Even in the most permeable recharge areas (sandy hills) in most years some runoff results from several hard rains.

More than 75 percent of Attala County is covered with forest (mixed pine and hardwood), and all of the county is covered with vegetation unless bared and kept bare by man. Vegetation usually decreases surface runoff but does not necessarily increase ground-water recharge because increased vegetation transpires increased quantities of water. The quantity of water transpired by vegetation is demonstrated by many marshes in the county, many of which dry up during the summer and fall when vegetation is using large quantities of water. The first killing frost in the fall has the effect of turning off many small well pumps, and the ground water entering the mash causes the water table to rise rapidly, even without rain. Marsh conditions return until another season of vegetative pumping overtakes the available combined precipitation and ground-water supply.

Low humidity, high wind speed, and high temperature increase the amount of water lost to evaporation and transpiration. Humidity is normally high, wind speed usually less than 10 miles per hour, and the mean annual temperature is about 65°F.

GROUND WATER

General Geology of Water-bearing Units

Attala County is in the east-central part of the Mississippi Embayment of the Gulf Coastal Plain. The sediments underlying the area to a depth of several thousand feet consist mostly of sand, silt, clay, shale, lignite, and limestone, most of which is unconsolidated to semiconsolidated (table 1).

Sediments of Cretaceous age that contain highly mineralized water lie approximately 1,500 feet deep in the northeastern corner of Attala County and dip to the southwest across the county. The nearest well developed in sediments of Cretaceous age is approximately 20 miles east. Water from Cretaceous aquifers would likely be too highly mineralized in Attala County for most uses.

Water from all wells inventoried in Attala County comes from saturated sands in formations of Tertiary age which overlie the Cretaceous beds. The Tertiary formations dip to the southwest at rates ranging between 20 and 50 feet per mile and most thicken downdip (Plate 1, Water Resources).

In ascending order, the Tertiary units which include aquifers are the Wilcox Group,[1] Tallahatta Formation, Winona Formation,[1] Kosciusko Formation,[1] and Cockfield Formation. The aquifer systems in each formation are relatively independent and may be considered separate ground-water reservoirs.

Shallow surficial deposits of alluvium and colluvium of Quaternary age are present in the county and may be water-bearing, particularly the alluvium along larger streams. However, these sources of water are of little significance except for domestic water supplies.

GROUND-WATER HYDROLOGY

Most of the sand and sandstone beds occurring in the subsurface of Attala County are aquifers, and most of the silt, clay, shale, rock, and lignite beds are "aquicludes" which impede or block the vertical movement of water. In places no constant recognizable aquiclude is present between two predominately sandy units. A schematic diagram (fig. 2) shows artestian and water-table conditions essentially as they exist in Attala County.

Water flows because of difference in pressure, or difference in water level. When water is withdrawn from an aquifer the water level or water pressure at that point is reduced and water flows toward that point along the paths of least resistance. Of the sediments underlying Attala County, uniformly coarse sand offers the least resistance to ground-water movement. With the lowering of the water level a slope or gradient is established which results in lower levels throughout the affected area. Hence, pumping one well lowers the water level in nearby wells. The amount of lowering is dependent on rate and amount of pumping, distance to the pumping well, and the hydrologic characteristics of the aquifer. Large wells pumping continually may cause measurable water-level declines at a distance of several miles. Except in a few areas of large withdrawals of water by pumped

[1]Geologic nomenclature currently used by the Mississippi Geological, Economic, and Topographical Survey is used in this report. Refer to table 1 for current U. S. Geological Survey nomenclature.

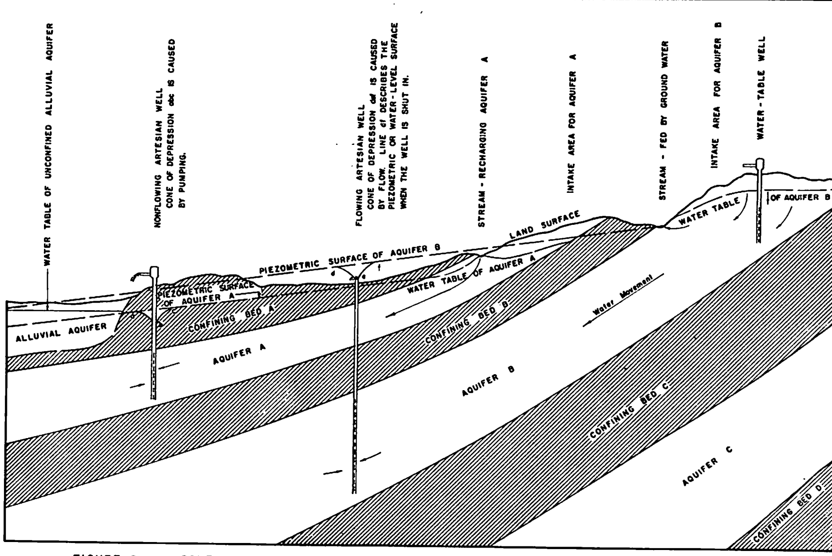

FIGURE 2. -- SCHEMATIC DIAGRAM SHOWING ARTESIAN AND WATER - TABLE CONDITIONS.

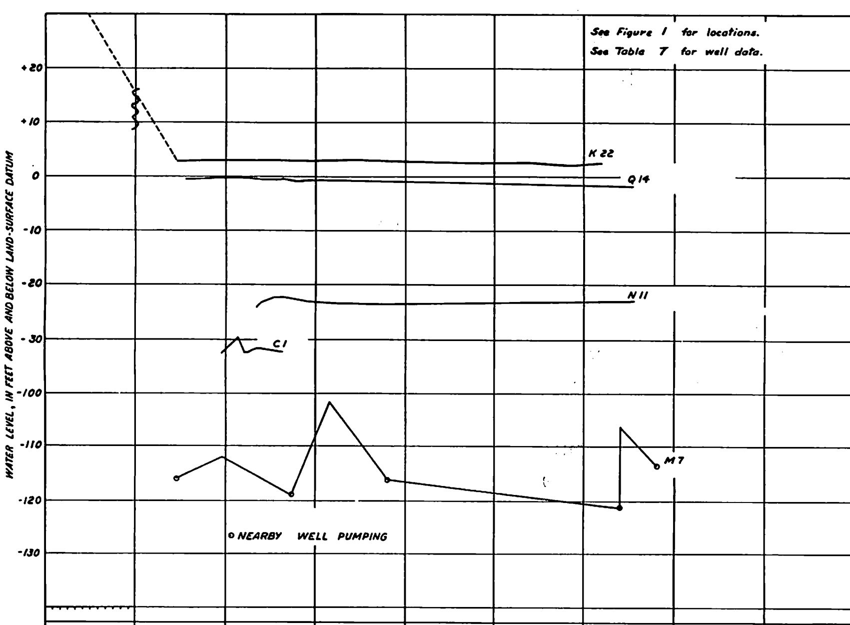

FIGURE 3. -- HYDROGRAPHS OF SELECTED WELLS IN ATTALA COUNTY, MISS.

or flowing wells, water levels in Attala County have declined very little (fig. 3).

All aquifers used in Attala County also crop out in the county (Plate 1* Plate 1). Even though the outcrops of the aquifers remain approximately full, increasing quantities of water move downdip in response to lower water levels caused by the withdrawal of water by wells.

Westward dipping formations and westward sloping topography combine to give areas of artesian flow (places where water level is above land surface) in the western part of the county (figs. 7, 10, and 12). Ground water is under water-table conditions (unconfined) in the outcrop area of the aquifer and is under artesian pressure in the confined downdip areas.

CHEMICAL QUALITY OF GROUND WATER

The chemical quality of ground water in Attala County is generally good, but it changes with depth in each aquifer. However, waters from shallow wells and springs in different aquifers generally have many similar characteristics. Such water is likely to have very small amounts of dissolved solids, usually much less than 100 ppm (parts per million); it is usually soft (less than 50 ppm), clear, and has a low pH value (usually 6.0 or less). The average temperature of water from shallow wells and springs is about the same as the mean annual temperature (about 65°F).

Iron in excessive amounts (more than 0.3 ppm) is a general problem in the county. Indications of iron in water are: black tea, scum on water surface, red precipitate, red stains on clothes and water fixtures, and an "iron" taste. Shallow water usually contains free carbon dioxide gas (CO_2) in solution which causes the water to have a low pH value and to be corrosive to iron. Most of the iron in water samples from Attala County is dissolved from pipes.

Downdip in each aquifer the water contains larger amounts of dissolved solids, the pH increases and hardness decreases. Also, the water becomes warmer with increasing depth. Representative chemical analyses on the geologic section (Plate 1) show the relative quality of water and the changes in chemical constituents in the several aquifers as the water moves down the dip.

*Geologic map in the cooperator's part of report.

Generally, where pH is low, adjustment of pH by aeration or chemical means will prevent the solution of iron from water systems. Use of noncorrodable materials for the construction of wells and distribution systems eliminates the sources of iron.

Table 2.--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	Hardness	Alkalinity	pH	Total solids	Remarks
Air conditioning1/	...	...	0.5	0.5	0.5	...	...	...	...	A, B
Baking	10	10	.2	.2	.2	2/	...	...	...	C
Boiler feed:										
0-150 psi	20	80	...	...	...	75	...	8.0+	3000-1000	
150-250 psi	10	40	...	...	...	40	...	8.5+	2500-500	
250 psi and up	5	5	...	...	...	8	...	9.0+	1500-100	
Canning:										
Legumes	10	...	.2	.2	.2	25-75	...	...	...	C
General	10	...	.2	.2	.2	...	...	...	...	C
Carbonated beverages3/	2	10	.2	.2	.3	250	50	...	850	C
Confectionery	...	...	.2	.2	.2	...	...	4/	100	...
Cooling5/	50	....	.5	.5	.5	50	...	...	...	A, B
Ice (raw water6/	1-5	5	.2	.2	.2	...	30-50	...	300	C
Laundering	...	...	.2	.2	.2	50	...	...	...	
Plastics, clear, uncolored	2	2	.02	.02	.02	...	...	...	200	
Paper and pulp7/										
Groundwood	50	20	1.0	.5	1.0	180	...	...	...	A
Kraft pulp	25	15	.2	.1	.2	100	...	...	300	
Soda and sulfite	15	10	.1	.05	.1	100	...	...	200	
Light paper, HL-grade	5	5	.1	.05	.1	50	...	...	200	B
Rayon (viscose) pulp:										
Production	5	5	.05	.03	.05	8	50	...	100	D
Manufacture	0.3	...	.0	.0	.0	55	...	7.8-8.3	...	
Tanning8/	20	10-100	.2	.2	.2	50-135	135	8.0	...	
Textiles:										
General9/	5	20	.25	.25	...	20	...	...	...	
Dyeing	5	5-20	.25	.25	.25	20	...	...	...	
Wood scouring10/	...	70	1.0	1.0	1.0	20	...	...	...	
Cotton bandage	5	5	.2	.2	.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 sulfer 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 organ[illegible] [illegible]y be objectionable.

Iron occurring naturally and iron dissolved from pipes can be removed by aeration. Softeners are used to remove hardness (calcium, magnesium).

Chemical analyses of water may be evaluated by referring to table 2, "Water Quality Tolerance for Industrial Application," in this report, and to a general discussion of chemical and physical characteristics of water by Lang and Boswell (1960).

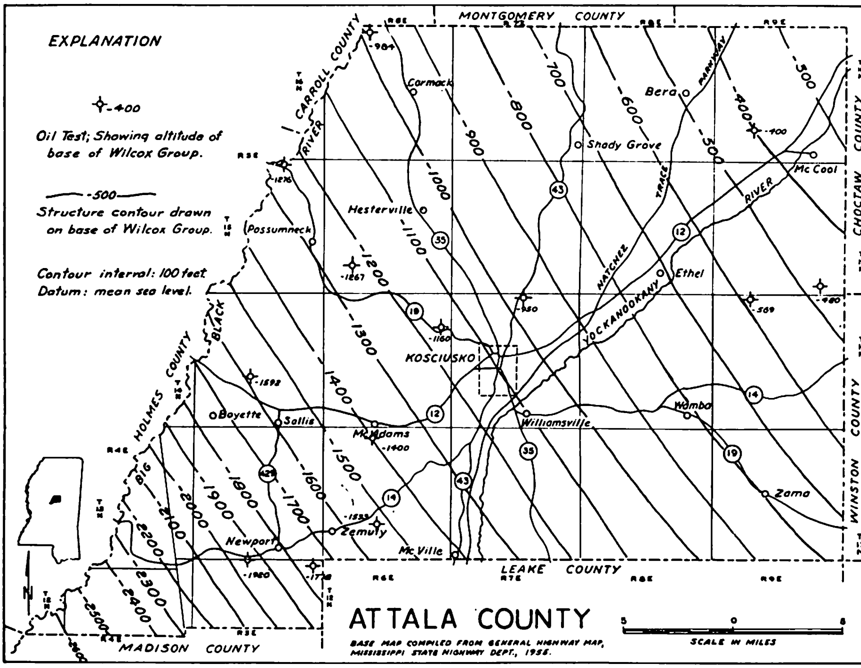

Figure 4.—Configuration of the base of the Wilcox Group.

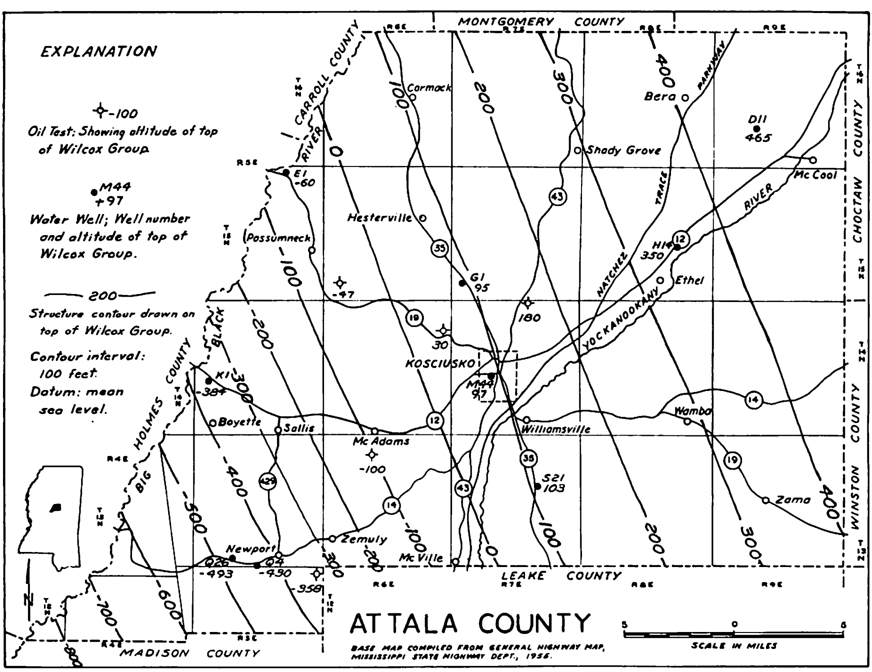

Figure 5.—Configuration of the top of the Wilcox Group.

WATER-BEARING UNITS

Wilcox Group, Undifferentiated

GENERAL GEOLOGY

The Wilcox Group underlies the entire county and includes the oldest aquifers penetrated by water wells. The Wilcox contains beds of sand, shale, clay, silt, and lignite. All electrical logs of oil tests in the county showed at least one good sand and most showed several, some more than 100 feet thick. However, the formation is lenticular and the sands are difficult to correlate. The upper sand is the most persistent. Studies of well samples and electrical log correlations indicate that the upper sand is the lower part of the Meridian Sand Member of the Tallahatta Formation as used in the subsurface to the west (Brown, 1947).

The Wilcox increases in thickness from about 600 feet in the area of outcrop in the northeastern corner of the county to about 1,800 feet in the subsurface in the southwestern corner of the county. The depth to the base of the Wilcox below land surface increases from about 600 feet to about 2,900 feet (fig. 4). The base of the water-bearing sand is 200-300 feet above the Midway-Wilcox contact and this should be considered when estimating the depth for wells tapping the basal sands. The top of the Wilcox is at or near land surface in the eastern part of the county and, due to the westward dip, deepens to about 1,000 feet in the southwest corner (fig. 5).

HYDROLOGY

The Wilcox aquifers are recharged by precipitation in the 15 to 20 mile wide belt of outcrop, the western edge of which is in northeastern Attala County (Plate 1*). The water table is sufficiently high in the outcrop area to discharge water from springs and seeps to streams. Spring discharges of 5-10 gpm are common, and a spring about 2 miles east of the county line in Choctaw County flows about 75 gpm.

All domestic wells in the outcrop area and most municipal, industrial, and school wells in the remainder of the county obtain water from sands in the Wilcox Group. Four towns in Holmes County along the west bank of the Big Black River have devel-

*Geologic map in cooperator's part of the report.

oped wells in the upper sand of the Wilcox Group. However, most domestic water supplies west of the Wilcox outcrop are sourced in the overlying and consequently shallower formations. Approximately 2.5 mgd (million gallons per day) of water is withdrawn from the Wilcox, mostly by wells tapping the upper sand.

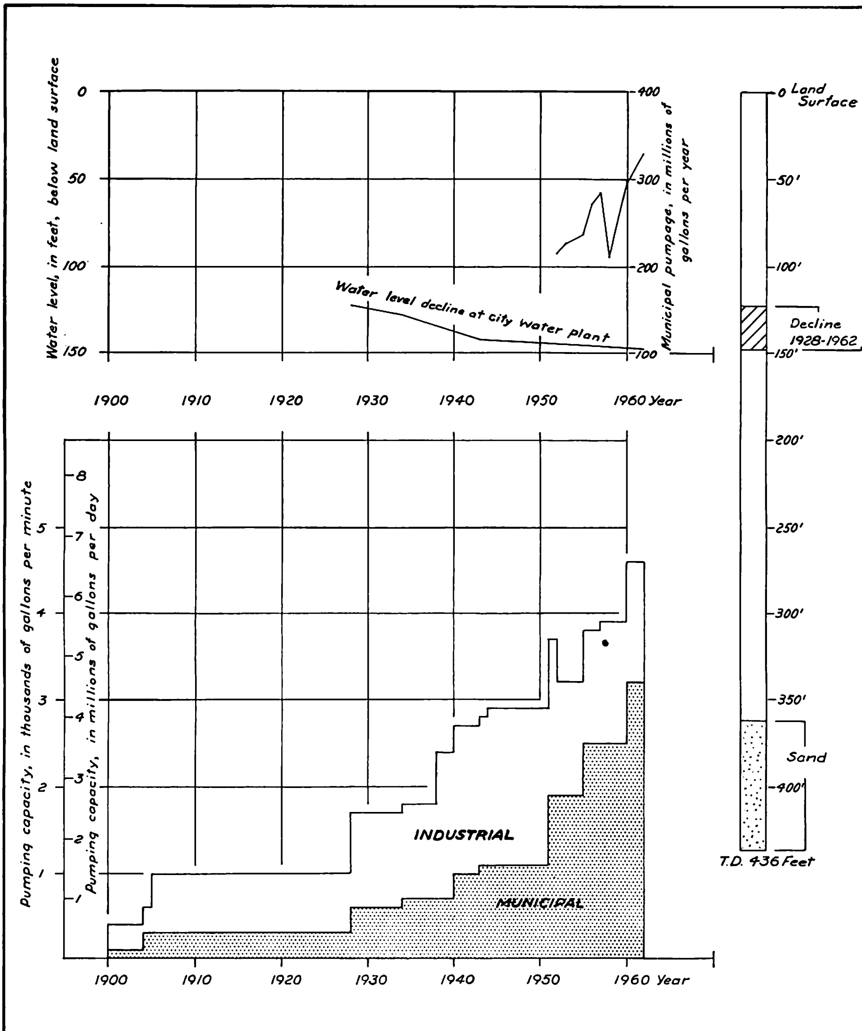

FIGURE 6. -- MUNICIPAL AND INDUSTRIAL PUMPING CAPACITY AND WATER-LEVEL DECLINE IN RELATION TO AVERAGE MUNCIPAL PUMPAGE, KOSCIUSKO, MISS.

Pumping capacity of wells in Kosciusko has increased from about 1 mgd in 1905 to about 6.5 mgd in 1962. The six municipal wells (M28, 29, 30, 31, 32, and 44) had a pumping capacity of about 4.5 mgd in 1962. Average pumpage from municipal wells is about 1 mgd and the average for all wells in Kosciusko is almost 2 mgd.

Old records are fragmentary but indicate that the Wilcox water level at the city water plant was about 60 feet below land surface about 1900. The water level has further declined from 122 feet below land surface in 1928 to 148 feet in 1962, a total decline of 26 feet in 34 years or an average of .76 foot per year (fig. 6). Reported and measured water levels in the Pet Milk Company wells (M6, 7, and 8) indicate an average decline of nearly 1 foot per year since 1938.

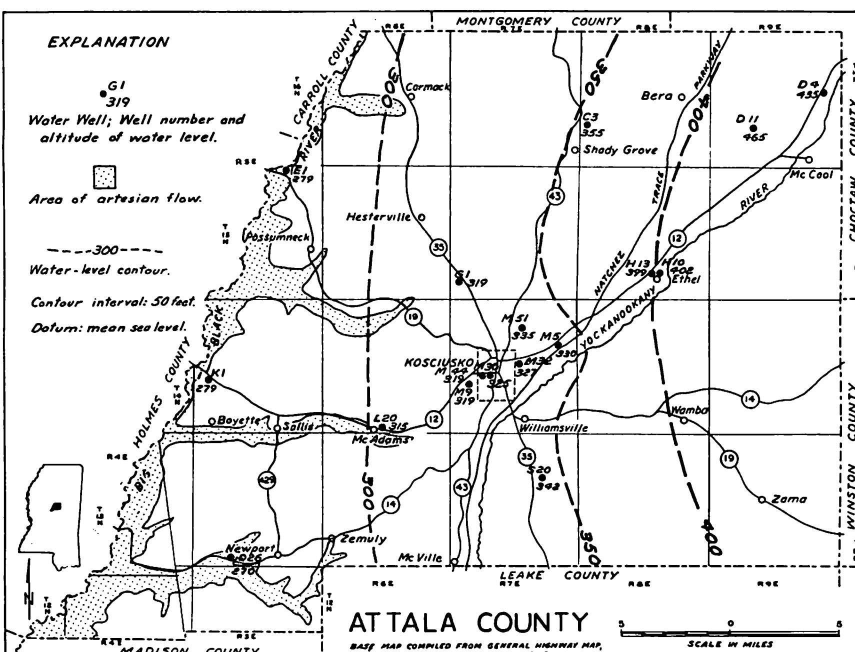

Figure 7.—Water levels in the Wilcox Group and in the lower part of the Tallahatta Formation.

A small part of the water-level decline at Kosciusko may be attributed to regional water-level declines resulting from widespread pumpage from this extensive aquifer in northwestern Mississippi. However, most of the decline is the result of increases in pumpage within the city during the past several years. The decline at Kosciusko is a normal cone of depression resulting from withdrawals by large wells and it is not indicative of a diminishing supply. The decline is accompanied by steepening hydraulic gradients in the aquifer; water moves faster toward the center of pumping and adjustments will continue until an approximate equilibrium is attained. Increases or decreases in pumpage will result in continued adjustment.

Water in the Wilcox moves westward across the county from the outcrop area. The piezometric surface (static level of water confined in an artesian aquifer) slopes westward at the rate of about 8 feet per mile (fig. 7). In a north-south trending central belt across the county, the water level averages about 100 feet below land surface. The water level in the upper sand of the Wilcox at the southwestern corner of the county is about 50 feet above land surface and it is at about land surface in the northwestern corner.

Wells developed in the Wilcox Group and located in the lower parts of the Big Black River and its tributaries will flow. Several flowing wells sourced in the upper sand of the Wilcox Group are located outside the western edge of Attala County, and a few are in the county. In the eastern half of the county the altitudes of the basins of Pearl River and Lobutcha Creek are higher than the piezometric surface of the Wilcox aquifers (fig. 7).

AQUIFER CHARACTERISTICS

The yield of a well depends on the construction of the well and on the hydrologic characteristics of the aquifer penetrated. Some drilled domestic wells in the outcrop area are completely cased and screened, but others are of open-hole construction. Open-hole construction is often used when a thickness of sand necessary to set a screen is not found.

Most domestic wells yield 10 gpm or less. Public and industrial water supply wells are screened and most of the larger capacity wells are gravel-packed (gravel is packed around the outside of the screen). The original yields of two municipal wells at Kosciusko (M31, M44) were 1,000 gpm each. A specific capacity of 32 gpm/ft (yield in gallons per minute per foot of water-level decline while pumping) was measured in well M44.

In May, 1962, an aquifer test was made using wells owned by the City of Koscuisko and the Pet Milk Co. City well M44 was pumped at the rate of 1,000 gpm and three other wells, M31, M8, and M7, were used as observation wells. Discharge of other wells in the vicinity was kept at a constant rate during the test. A plot

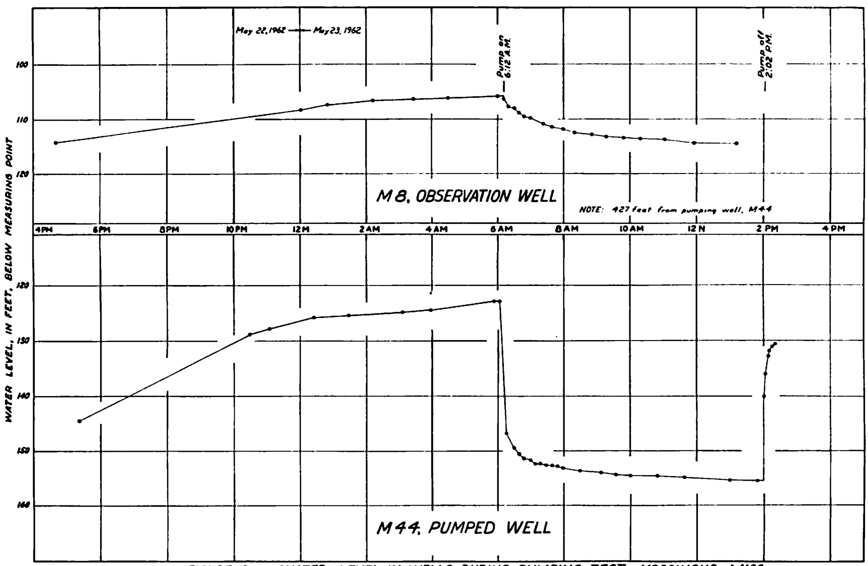

FIGURE 8 -- WATER LEVEL IN WELLS DURING PUMPING TEST, KOSCIUSKO, MISS.

of the water levels in two of the wells measured during the test is shown in figure 8. The coefficients of transmissibility,[1] permeability,[2] and storage[3] determined from the test are given in Table 3.

---

[1]Transmissibility (T) is expressed as the rate of flow of water, at the prevailing water temperature, in gallons per day, through a vertical strip of the aquifer 1 foot wide extending the full saturated thickness of the aquifer under a hydraulic gradient of 100 percent.

[2]Permeability (P) is the rate of flow of water, in gallons per day, through a cross-sectional area of 1 square foot under a hydraulic gradient of 1 foot per foot at a temperature of 60°F.

[3]The coefficient of storage (S) of an aquifer is defined as the volume of water it releases from or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface.

Table 3.—Aquifer characteristics, upper part of Wilcox Group

No. Well	Transmissibility (gal per day per ft)	Aquifer thickness (feet)	Permeability (gal per day per sq ft)	Coefficient of Storage	Specific Capacity (gpm per ft of drawdown)
M8	46,000	88	520	.0005	----
M31	57,000	71	800	.00015	----
M44	55,000	74	740	----------	32
M7	55,000	87	630	.0008	----

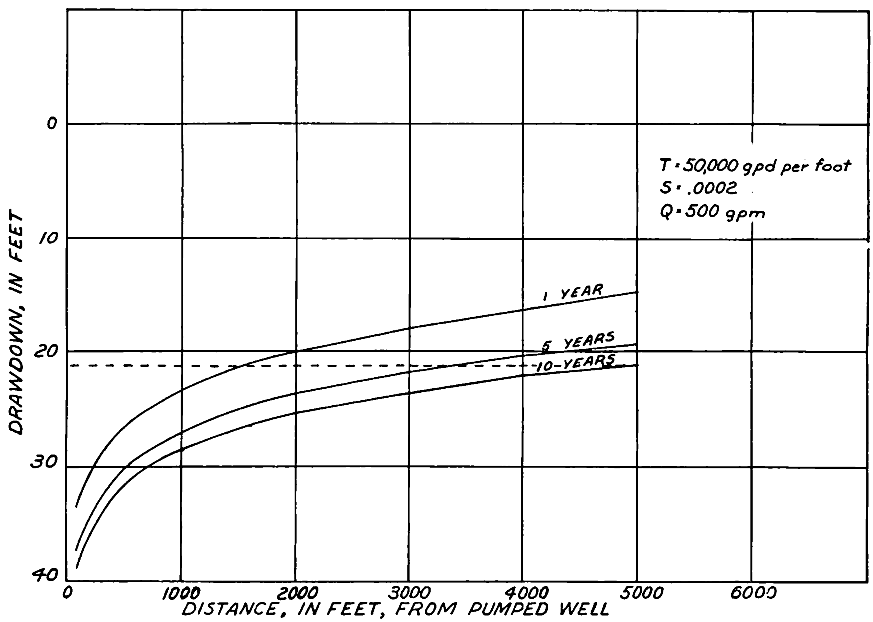

Figure 9.—Interference curves for aquifer in upper part of the Wilcox Group, Kosciusko, Miss.

Interference curves (fig. 9) were plotted from computations based on a transmissibility of 50,000 gal per day per foot and a storage coefficient of .0002. To determine the interference at a point 5,000 feet from a well pumping 500 gpm for a period of 10 years enter the bottom of the graph at 5,000 feet, follow the vertical line to the 10-year curve. Then follow a horizontal line to the left and read the interference, 21 feet. Similarly, interference can be determined for other times and distances. For example, values for 1,000 gpm are double those for 500 gpm.

The test showed that the characteristics of the aquifer at Kosciusko are similar to those of the same aquifer at Winona, Montgomery County, Mississippi, 30 miles to the north of Kosciusko where a similar test has been made (Harvey, 1962). These and other aquifer tests outside the county indicate that similar aquifer coefficients would apply for other locations in the county having similar thicknesses of Wilcox sand.

Results of the aquifer test and records of pumpage and water-level change show that the aquifer is capable of yielding much larger quantities of water.

CHEMICAL QUALITY OF WATER

Chemical analyses and electrical logs indicate that all the water in the Wilcox Group in Attala County is of reasonably good chemical quality. None of the water collected for analysis had appreciable odor, taste, or color. Iron precipitate was common in water from shallower wells, but in most instances the iron content was found to be the result of corrosion of the pipes of the distribution and well systems.

Most chemical analyses available from the Wilcox are for water from the upper sand. Dissolved solids in water from the upper sand increase from less than 50 ppm to about 250 ppm down the dip across the county (Plate 1). Chloride ranges from about 2 to 10 ppm and flouride ranges from .0 to .4 ppm (table 5).

A large number of water samples were tested in the field for specific conductance, chloride, hardness, and pH. Specific conductance of water depends upon the ions present, and ionization varies with amount and kind of dissolved solids. Specific conductance is an indication of the approximate dissolved solids content of water.

TALLAHATTA FORMATION

GENERAL GEOLOGY

The Tallahatta Formation crops out or is present in the subsurface of Attala County except where the underlying Wilcox Group crops out in the northeast (Plate 1*). The formation has three members; the Meridian Sand Member, the Basic City Shale

*Geologic map

Member, and the Neshoba Sand Member. Thickness of the Tallahatta increases from 190 feet near the outcrop to about 240 feet in the subsurface in the southwestern corner of the county (plate 1).

The Meridian Sand Member of the Tallahatta Formation is the basal part of the formation and overlies the Wilcox beds. It is composed mostly of interbedded sand, shale, and clay. Thickness of the Meridian in the subsurface ranges from about 40 to 80 feet. In places, sand of the Meridian lies directly on Wilcox clay and in places shale lies on Wilcox sand.

The Basic City Shale Member overlies the Meridian Sand Member. The Basic includes very thin to thick beds of sand, silicious siltstone (buhrstone), and shale. A few feet of relatively impermeable siltstone and shale normally compose the base of the member. The combined thickness of the Basic City Shale Member and the overyling Neshoba Member in the subsurface averages about 160 feet. The rock and shale in the Basic City may be as thin as 30 feet or thicker than 80 feet. From south to north the Basic City Shale intertongues with the Neshoba Sand and becomes thinner as the Neshoba thickens.

The Neshoba Sand Member underlies the Winona Formation and ranges in thickness from about 70 to 145 feet. The Neshoba is considered to include the predominantly sandy beds lying below the glauconitic sand of the Winona.

HYDROLOGY

The Tallahatta Formation is recharged by precipitation in the approximately 12 mile wide belt of outcrop across the northeastern part of the county (Plate 1*). The water table is sufficiently high in the area of outcrop to discharge water to streams.

The Meridian Sand Member is tapped by two industrial wells south of Kosciusko, one at Texas Eastern Transmission Company (S20) and the other at United Gas Pipeline Company (S21). Few drilled domestic wells obtain water from the Meridian Sand. About .2 mgd of water is withdrawn from the Meridian Sand Member.

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*Geologic map in cooperator's part of the report.

Most domestic wells in or west of the outcrop of the Tallahatta tap sands in the upper two members of the Tallahatta Formation. No large capacity wells are known to tap the Neshoba Sand Member in Attala County but it is presently the most widely used source of water for domestic wells. However, two municipal wells at Vaiden, Carroll County, about 4 miles northwest of the northwestern corner of the county, are screened in the basal part of the Neshoba Sand Member. About 1.5 mgd of water is discharged from the upper part of the Tallahatta by more than 100 small diameter flowing wells in the valleys of the Big Black River and its tributaries. Pumpage from the other wells is about .1 mgd.

Water levels in the Meridian Sand Member of the Tallahatta Formation are about the same as water levels in the Wilcox Group (fig. 7) and, because in places there is no continuous aquiclude between the two aquifers, they are hydrologically one unit.

Water levels in the lenticular sands of the Basic City Shale Member of the Tallahatta Formation are generally higher than water levels in either the Meridian Sand or the Neshoba Sand Members. In a north-south belt through the central part of the county the water levels in the Basic City are about 40 feet higher than in the Meridian and about 10 feet higher than in the Neshoba.

The difference in water levels in the four separate aquifers is shown by water levels in four wells (G1, G2, G8, G13) at the Fred Turnipseed residence 4 miles north of Kosciusko. The wells are within 20 feet of each other and at about the same altitude (360 feet). A Zilpha-Winona contact is in the road cut in front of the house at an altitude of 368 feet. A new dug well (G13) and an old drilled or driven well (G8) are 22 and 21 feet deep. Using a common adjusted lsd (land surface datum) of 360 feet, these wells tapping the Winona Formation have the same water level which fluctuates seasonally from 10 to 15 feet below lsd. This aquifer discharges water to a perennial stream about 100 feet north at an altitude of 340 feet, 20 feet below the wells and 5 to 10 feet below the water level in wells G8 and G13.

The next deeper well (G2) is sourced in the basal part of the Neshoba Sand Member of the Tallahatta Formation at a depth of 140 feet. The piezometric surface, or artesian water level, in this well fluctuates from 8 to 11 feet below lsd.

Well G1 is 337 feet deep and is sourced in the upper sand of the Wilcox Group. The water level is 41 feet below lsd. After well G1 was completed, it flowed outside the casing for several days until sealed. This flow came from sands in the Basic City Shale Member of the Tallahatta Formation.

A summary of water levels at the Turnipseed residence on January 11, 1963 follows:

Well No.	Well Depth	Water level altitude	Geologic unit
G1	337	319	Upper Sand of Wilcox Group
G2	140	351	Neshoba Sand Member
G8	21	345	Winona Formation
G13	22	345	Do
G13, flow	166-218	360+	Basic City Shale Member
Stream	----	340	

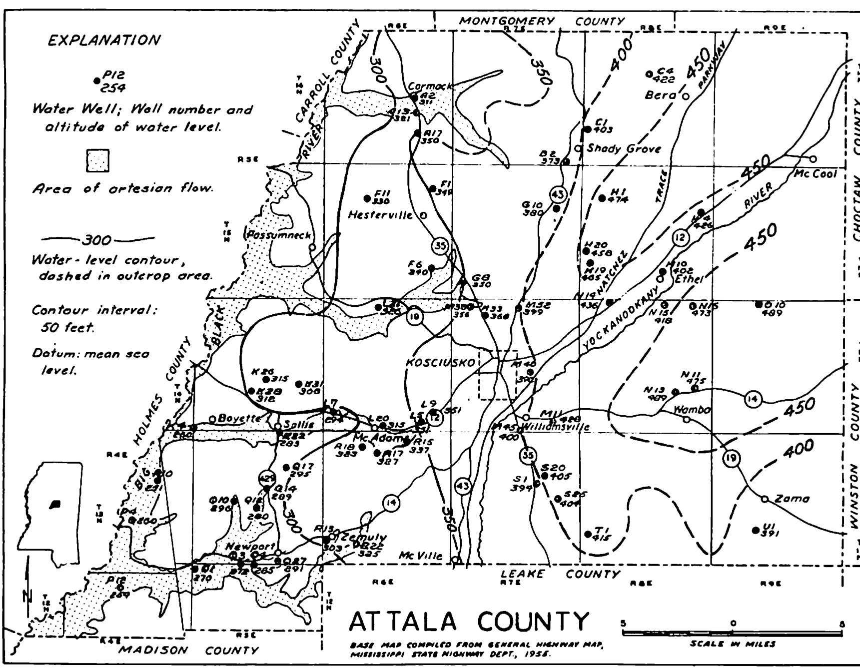

Figure 10.—Water levels in the Winona Formation and in the upper part of the Tallahatta Formation.

Because the sands of the Winona Formation and the Neshoba Sand Member of the Tallahatta Formation are in contact in most places, their water levels are about the same.

Direction of water movement in the Winona Formation and in the upper part of the Tallahatta Formation is westward and slopes at the rate of about 10 feet per mile (fig. 10) The water level map is based on piezometric water levels below the 400-foot contour line in the south half of the county and below the 350-foot contour line in the north half (fig. 10). Water-table conditions prevail east of these contours in the outcrop. The irregularity of contours in the outcrop area reflects the effect of discharge into streams. The piezometric surface in the western part of the county reflects the effect of discharge by flowing wells in the valleys of Zilpha, Apookta, Bogue Phalia (Long), and Seneatcha Creeks (fig. 10).

Mostly as a result of the unrestricted flow from wells, artesian water levels in the upper part of the Tallahatta Formation have declined as much as 30 feet and the decline will continue. Histories of water levels and withdrawals indicate that additional wells pumping 3 or 4 mgd in the western part of the county would lower water levels sufficiently to stop the flow. However, much more water could be pumped before dewatering or over-developing the aquifer.

AQUIFER CHARACTERISTICS

Many of the wells in the upper part of the Tallahatta Formation are of open-hole construction. Perforated pipe or screens are set in other wells. Few of the small diameter wells yield more than 20 gpm.

A specific capacity of 9.5 gpm/ft while pumping 180 gpm was measured in a well drilled in 1962 for the town of Vaiden. The well was 196 feet deep and screened in the lower part of the approximately 140 feet of sand in the Neshoba Sand Member.

Well S20, developed in the Meridian Sand Member, had a drawdown of about 13 feet while pumping 60 gpm, or a specific capacity of about 4.5 gpm per foot of drawdown.

CHEMICAL QUALITY OF WATER

Water in the Tallahatta Formation is likely to be less corrosive but more highly mineralized and harder than water from other formations at similar depths.

The chemical quality of water in the Meridian Sand Member is highly variable, depending on the permeability of the sand and the hydraulic relationship to the underlying Wilcox. Where permeable Meridian sand overlies permeable Wilcox sand, water from the two sands is likely to be very similar. Water from Meridian sands not in contact with upper Wilcox sands is likely to be more highly mineralized and harder than that from the Wilcox.

Water in the Basic City Shale and Neshoba Sand Members of the Tallahatta Formation and in the Winona Formation ranges from very soft in the outcrop to very hard a few miles downdip; further downdip, it becomes gradually softer but is more mineralized and harder than water in either the underlying Wilcox Group or the overlying Kosciusko Formation (Plate 1). Table 4 compares the chemical and physical characteristics of water from representative wells in, above, and below the Tallahatta Formation.

Table 4.—Comparison of chemical and physical characteristics of water from representative wells in the Wilcox Group, Tallahatta Formation, and Kosciusko Formation

Well No. Depth (ft.) Formation	M44 422 Wilcox	L6 168 Tallahatta	K12 126 Kosciusko
Iron (Fe)	0.17	0.08	----
Calcium (Ca)	14	40	10
Magnesium (Mg)	4.1	18	3.5
Sodium (Na)	2.5	14	21
Potassium (K)	4.3	9.8	3.5
Bicarbonate (HCO^3)	60	198	88
Sulphate (SO^4)	13	23	7
Chloride (Cl)	3.1	12	6.5
Flouride (F)	.0	.1	.2
Nitrate (NO^3)	.1	2.7	.7
Dissolved solids	134	----	----
Hardness	52	174	40
Specific conductance (micromhos at 25°C)	138	393	170
pH	6.5	----	----

WINONA FORMATION

The Winona Formation, a glauconitic sand, overlies the Neshoba Sand Member of the Tallahatta Formation. The Winona thickens from about 20 feet in the outcrop to about 50 feet in the subsurface of the western part of the county (Plate 1). The contact between the glauconitic sand of the Winona Formation and the overlying shale of the Zilpha Formation is a good marker for geologists and well drillers.

The hydrology of the Winona Formation is very closely associated with that of the Neshoba Sand Member of the Tallahatta Formation (p. 23). Many dug wells obtain water from the Winona but most drilled wells go slightly deeper into the Neshoba Sand Member.

The chemical quality of water from the Winona Formation in the area of outcrop varies. The more highly weathered and leached areas yield soft water that is low in dissolved solids. Water from wells in less weathered outcrop areas and from the shallow downdip subsurface part of the formation is generally a hard calcium bicarbonate type. The chemical quality of water from deep wells in the western part of the county is similar to water from the Neshoba Sand Member of the Tallahatta Formation.

No aquifer test data or well performance data are available for determination of the hydrologic characteristics of the Winona Formation.

KOSCUISKO (SPARTA) FORMATION

GENERAL GEOLOGY

The Kosciusko Formation in places is nearly all sand and in other places is nearly all clay. The Kosciusko outcrops in the western part of the county (Plate 1*). It is as much as 280 feet thick and dips to the southwest at a rate of about 30 feet per mile (fig. 11).

HYDROLOGY

A large part of the wide belt of outcrop is permeable sand and perennial springs and streams are numerous. Movement of

*Geologic map

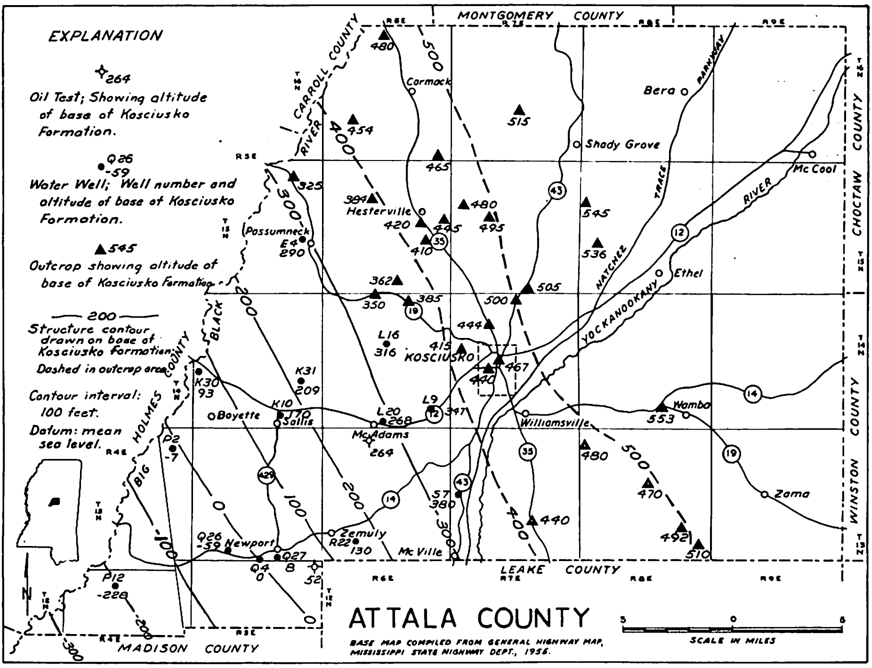

Figure 11.—Configuration of the base of the Kosciusko Formation.

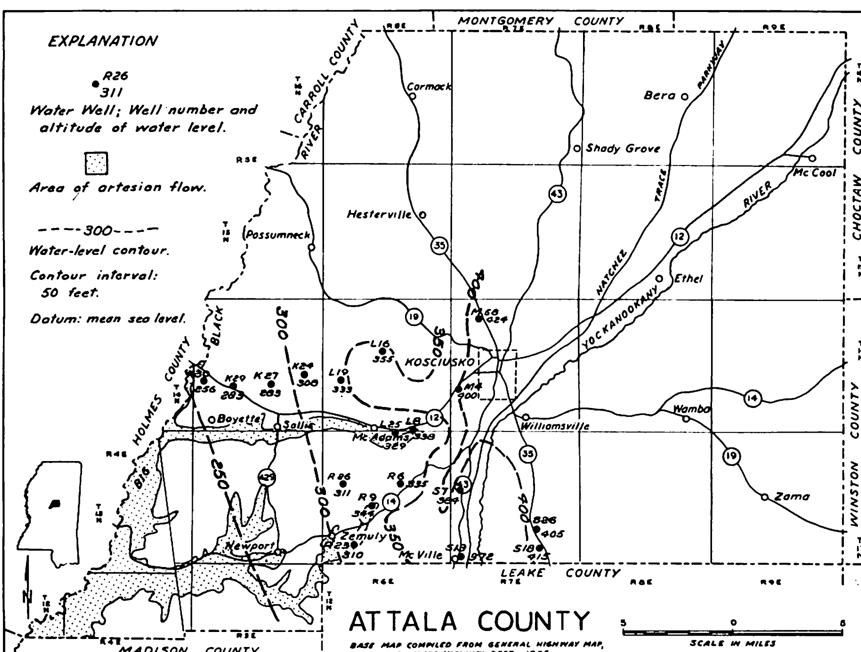

Figure 12.—Water levels in the Kosciusko Formation.

water in the outcrop areas of the Kosciusko Formation is mostly determined by lithology and topography. Many sandy hill areas are underlain by impervious clays in the Kosciusko or by the clay and shale in the Zilpha Formation. In such areas springs are common along the contact between the sand and the underlying clay or shale. Along the tributaries of Big Black River the water table in the adjoining sand hills is higher than the valleys and water is discharged to the streams. A few wells at low altitudes flow. Water movement in both the outcrop and the subsurface of the Kosciusko is generally westward (fig. 12).

Many shallow domestic wells and one irrigation well (S18) are sourced in the Kosciusko Formation in the southwestern part of the county. Total discharge by wells from the Kosciusko is small, probably less than .2 mgd.

AQUIFER CHARACTERISTICS

No aquifer test of the Kosciusko Formation has been made in Attala County but the characteristics of the sand and aquifer tests made on the formation in other parts of the State indicate that large quantities of water could be withdrawn from the aquifers. A 570-foot industrial well 1 mile west of the southwest corner of the county taps the formation. When drilled the well flowed 77 gpm and had a drawdown of 40 feet for a pumping rate of 1,100 gpm (specific capacity, 28 gpm per foot of drawdown). Any wells in the formation in Attala County will be in or near the areas of recharge.

CHEMICAL QUALITY OF WATER

Chemical quality of water in the Kosciusko Formation is generally good. Several shallow wells in sandy areas seemed to be slightly contaminated with salts leached from residence premises and barnyards and possibly from fields. Water from these wells (K24, 27, 29, and R23) contained above normal amounts of chloride and dissolved solids.

Water from the Kosciusko Formation is usually soft and low in dissolved solids and chloride. A low pH causes the water to dissolve objectionable quantities of iron from pipe. The tendency to dissolve iron is the most objectionable characteristic of water from the Kosciusko Formation.

COCKFIELD FORMATION

The Cockfield Formation consists mostly of sand, clay, shale, and lignite. Probably no more than 150 feet of Cockfield is present in the area of outcrop in the southwestern corner of Attala County (Plate 1*).

In the outcrop area the Cockfield receives water from precipitation and discharges water to streams. Only a relatively small number of shallow domestic wells are sourced in the Cockfield in Attala County. Water withdrawn by water wells from the Cockfield is insignificant when compared to water discharged to streams.

The Cockfield Formation in southwestern Attala County could yield large quantities of water to wells, though not as much as the underlying Kosciusko Formation. Water from the Cockfield is of good quality. Like other shallow ground water in the county it has a low dissolved solids and chloride content. It is soft, has a low pH (pH of about 6.0), and is likely to dissolve objectionable quantities of iron from pipe.

APPLICATION OF GROUND-WATER DATA

A person seeking ground-water information is usually interested in the possibilities of water development at some particular location or possibly the relative possibilities at two or more locations. The use of the maps, geologic sections, tables, and text included in this report contain sufficient data for an analysis of water-supply possibilities at selected locations.

The geologic section (plate 1) and the contour maps (figs. 4, 5, and 11) may be used to determine approximate well depths necessary to penetrate any of the Tertiary sands. If the proposed well site is near the section the altitudes and thicknesses of the different sands can be determined directly from the section. If the site is not near the section then one of the structure maps (figs. 4, 5, and 11) can be used to find the approximate altitude of a particular geologic horizon, for example, the Kosciusko-Zilpha contact. On the geologic section trace the Kosciusko-Zilpha contact to the same altitude as that determined by the structure map. This point on the section is along the strike from

*Geologic map

Table 5.--Descriptions and analyses of water from wells in Attala County, Miss.

Well No.: Well numbers correspond to those on well-location map, geologic section, and well table.

Water-bearing unit: Ew, Wilcox Group; Et, Tallahatta Formation; Ewi, Winona Formation; Ek, Kosciusko (Sparta) Formation; Ec, Cockfield Formation.

Analysis by: MSBH, Mississippi State Board of Health; USGS, laboratory analysis by Quality of Water Branch of U. S. Geological Survey; USGS, F, partial analysis made in field.

Well No.	Water bearing unit	Depth (feet)	Date of collection	Temperature (°F)	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)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Analysis by
											Wilcox Group												
C3	Ew	403	10- 1-61	66	35	0.03	16	4.9	6.4	3.8	81	0	12	0.0	0.1	0.3	148	59	0	166	6.5	10	USGS
D4	Ew	17	9-27-62	--	--	--	--	--	--	--	--	--	--	85	--	--	--	75	--	400	<6.0	--	USGS, F
D6	Ew	126	9-27-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	40	--	115	6.2	--	Do
E1	Ew	400?	1- 3-62	67	37	.82	19	5.2	6.9	3.9	92	0	11	2.0	.1	.0	156	68	0	177	7.4	5	USGS
H12	Ew	204	7-28-60	--	2.8	1.0	11.53	1.16	7.02		--	--	7.24	5	0	--	57.45	33.6	--	--	5.8	--	MSBH
H13	Ew	204	1-10-57	--	--	.00	6.8	2.4	3.3	2.9	35	0	6.8	2.5	.0	.5	100	27	0	77.4	6.6	5	USGS
H14	Ew	222	9-17-62	64	--	--	--	--	--	--	--	--	--	4.0	--	--	--	30	--	80	6.0	--	USGS, F
H17	Ew	100	9-17-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	34	--	55	6.2	--	Do
J3	Ew	140	9-27-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	50	--	135	6.4	--	Do
J4	Ew	425	9-27-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	100	--	255	7.8	--	Do
J7	Ew	35	9-28-62	--	--	--	--	--	--	--	--	--	--	8.8	--	--	--	20	--	75	<6.0	--	Do
K1	Ew	674	9-21-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	85	--	205	6.9	--	Do
M26	Ew	412	3-14-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	40	--	110	6.8	--	Do
M28	Ew	430	7-28-60	--	5.6	.8	11.06	3.49	8.99		--	--	6.42	3	.2	--	70.7	42.0	--	--	6.1	--	MSBH
M29	Ew	435	7-28-60	--	4.0	.75	12.50	3.59	7.19		--	--	6.42	3	0	--	68.79	46.0	--	--	6.1	--	Do
M30	Ew	436	7-28-60	--	4.4	.8	12.5	3.79	7.36		--	--	8.23	4	0	--	71.27	46.80	--	--	5.9	--	Do
M31	Ew	419	1- 5-57	67.5	27	.28	13	4.6	3.8	4.2	58	0	11	3.0	.1	.2	132	51	4	130	6.6	10	USGS
(a) M28-31	Ew	--	12- 5-59	--	32.4	.4	16.54	3.60	19.78		--	--	8.56	5	1.0	--	100.45	65.6	--	--	8.9	0	MSBH
M32	Ew	425	6-29-54	--	8.4	7.5	15.44	4.28	--	--	--	--	7.57	4	0	0	76	69.62	--	--	6.6	--	Do
M44	Ew	422	9- 5-62	--	41	.17	14	4.1	2.5	4.3	60	0	13	3.1	.0	.1	134	52	3	138	6.5	5	USGS
M51	Ew	447	9-17-62	--	--	--	--	--	--	--	--	--	--	18	--	--	--	256	--	470	6.2	--	USGS, F
O4	Ew	136	2-26-57	--	--	.73	5.7	2.6	3.5	1.4	30	0	4	3.5	.4	.0	--	24	0	70.2	7.5	--	USGS
O7	Ew	135	2-27-57	--	--	6.6	7.6	4.6	9.4	1.4	40	0	18	6.0	.2	.2	--	38	5	126	7.6	--	Do
											Tallahatta Formation												
C1	Et	40	2-17-62	--	--	--	--	--	--	--	--	--	--	8.0	--	--	--	30	--	87	7.2	--	USGS, F
C4	Et	23	7- -62	--	--	--	--	--	--	--	--	--	--	7.2	--	--	--	68	--	190	<6.0	--	Do
D8	Et	20	9-27-62	--	--	--	--	--	--	--	--	--	--	22	--	--	--	25	--	110	<6.0	--	Do
D9	Et	3	9-27-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	10	--	<50	<6.0	--	Do
D10	Et	20	9-27-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	55	--	135	6.3	--	Do
D11	Et	39	9-27-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	10	--	<50	<6.0	--	Do
D12	Et	50	9-27-62	--	--	--	--	--	--	--	--	--	--	19	--	--	--	15	--	115	6.0	--	Do
G14	Et	21	9-17-62	--	--	--	--	--	--	--	--	--	--	43	--	--	--	51	--	190	6.0	--	Do
G15	Et	40	9-17-62	--	--	--	--	--	--	--	--	--	--	39	--	--	--	34	--	150	6.0	--	Do
H4	Et	16	9-17-62	--	--	--	--	--	--	--	--	--	--	15	--	--	--	34	--	105	<6.0	--	Do
H16	Et	115	9-17-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	40	--	85	6.2	--	Do
H18	Et	20	9-17-62	67	--	--	--	--	--	--	--	--	--	19	--	--	--	65	--	180	6.2	--	Do
H19	Et	70	9-17-62	--	--	--	--	--	--	--	--	--	--	5.6	--	--	--	34	--	55	6.0	--	Do
H20	Et	156	9-17-62	--	--	--	--	--	--	--	--	--	--	1.6	--	--	--	<10	--	<50	6.0	--	Do
J1	Et	40	9-27-62	--	--	--	--	--	--	--	--	--	--	13	--	--	--	30	--	120	<6.0	--	Do
J5	Et	4	9-28-62	--	--	--	--	--	--	--	--	--	--	2.4	--	--	--	5-10	--	<50	<6.0	--	Do
J6	Et	127	9-28-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	10	--	<50	<6.0	--	Do
K22	Et	356	9-24-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	115	--	360	7.5	--	Do
K25	Et	300	9-19-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	103	--	325	8.0	--	Do
K26	Et	357	9-19-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	103	--	330	7.6	--	Do
K28	Et	329	9-19-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	51	--	350	8.0	--	Do
K31	Et	300	9-19-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	103	--	325	7.8	--	Do
L5	Et	168	9-19-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	205	--	325	7.4	--	Do
L6	Et	168	2- 1-57	--	--	.08	40	18	14	9.8	198	8	23	12	.1	2.7	--	174	0	393	8.5	--	USGS
L7	Et	240	4-10-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	160	--	315	7.1	--	USGS, F
L9	Et	302	1-24-62	--	--	--	--	--	--	--	--	--	--	6.0	--	--	--	135	--	275	7.0	--	Do
L12	Et	200	9-19-62	64.5	--	--	--	--	--	--	--	--	--	5.6	--	--	--	188	--	330	6.8	--	Do
L15	Et	228	9-18-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	137	--	220	7.0	--	Do
L18	Et	280	9-19-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	154	--	340	7.4	--	Do
L20	Et	182	10- 4-62	66	--	--	--	--	--	--	--	--	--	4.0	--	--	--	140	--	330	6.7	--	Do

Table 5.--Descriptions and analyses of water from wells in Attala County, Miss. (Continued)

Well No.	Water bearing unit	Depth (feet)	Date of collection	Temperature (°F)	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)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Analysis by
										Tallahatta Formation - Continued													
L21	Et	212	10- 4-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	105	--	225	7.0	--	USGS, F
M38	Et	130	9-18-62	65	--	--	--	--	--	--	--	--	--	11	--	--	--	239	--	395	6.0	--	Do
M46	Et	200	4-13-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	35	--	100	6.0	--	Do
M47	Et	220	4-13-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	25	--	55	6.0	--	Do
M52	Et	209	9-17-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	35	--	70	6.0	--	Do
M53	Et	140	9-17-62	--	--	--	--	--	--	--	--	--	--	6.4	--	--	--	137	--	200	6.6	--	Do
M55	Et	292	9-18-62	--	--	--	--	--	--	--	--	--	--	5.6	--	--	--	103	--	190	7.6	--	Do
N3	Et	145	9-17-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	34	--	75	6.2	--	Do
N12	Et	83	9-17-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	<10	--	< 50	<6.0	--	Do
N14	Et	20	9-17-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	15	--	< 50	6.0	--	Do
N15	Et	28	9-28-62	--	--	--	--	--	--	--	--	--	--	8.0	--	--	--	10	--	55	< 6.0	--	Do
N16	Et	83	9-28-62	--	--	--	--	--	--	--	--	--	--	7.2	--	--	--	20	--	65	< 6.0	--	Do
O9	Et	105	9-28-62	--	--	--	--	--	--	--	--	--	--	1.8	--	--	--	25	--	55	6.3	--	Do
O10	Et	17	9-28-62	65	--	--	--	--	--	--	--	--	--	4.0	--	--	--	20	--	< 50	6.0	--	Do
P12	Et	739	9-24-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	10	--	650	8.5	--	Do
Q1	Et	586	9-21-62	--	--	--	--	--	--	--	--	--	--	2.4	--	--	--	10	--	550	8.4	--	Do
Q3	Et	490	9-21-62	68.5	--	--	--	--	--	--	--	--	--	2.4	--	--	--	10	--	425	8.4	--	Do
Q4	Et	500	9-21-62	68.5	--	--	--	--	--	--	--	--	--	2.4	--	--	--	10	--	380	8.3	--	Do
Q27	Et	528	9-21-62	68.5	--	--	--	--	--	--	--	--	--	2.4	--	--	--	15	--	325	8.3	--	Do
R2	Et	150	9-19-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	188	--	340	7.0	--	Do
R15	Et	150	9-19-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	188	--	330	6.8	--	Do
R17	Et	250	9-20-62	65	--	--	--	--	--	--	--	--	--	4.8	--	--	--	205	--	410	7.1	--	Do
R18	Et	285	9-20-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	171	--	380	7.2	--	Do
R22	Et	390	1-24-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	15	--	355	7.6+	--	Do
S20	Et	315	3-13-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	65	--	150	7.3	--	Do
S21	Et	375	3-13-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	40	--	110	6.2	--	Do
										Winona Formation													
G3	Ewi	6	2-13-57	--	--	0.48	2.4	2.7	5.6	0.4	15	0	1	12	0.2	0.5	--	17	4	59.9	7.1	--	USGS
N33	Ewi	13	9-18-62	67	--	--	--	--	--	--	--	--	--	10	--	--	--	135	--	350	6.0	--	USGS, F
										Kosciusko (Sparta) Formation													
G9	Ek	3	4-13-62	--	--	--	--	--	--	--	--	--	--	5.4	--	--	--	10	--	<50	< 6.0	--	USGS, F
K5	Ek	250	9-21-62	--	--	--	--	--	--	--	--	--	--	4.8	--	--	--	45	--	140	6.5	--	Do
K12	Ek	126	2-28-57	--	--	7.8	10	3.5	21	3.6	88	0	7	6.5	.2	.7	--	40	0	170	8.1	--	USGS
K24	Ek	20	9-19-62	--	--	--	--	--	--	--	--	--	--	184	--	--	--	40	--	540	<6.0	--	USGS, F
K27	Ek	20	9-19-62	--	--	--	--	--	--	--	--	--	--	38	--	--	--	20	--	270	6.0	--	Do
K29	Ek	30	9-21-62	--	--	--	--	--	--	--	--	--	--	17	--	--	--	10	--	95	<6.0	--	Do
K30	Ek	145	9-21-62	--	--	--	--	--	--	--	--	--	--	8.0	--	--	--	55	--	110	6.2	--	Do
L8	Ek	4	9-19-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	10	--	<50	<6.0	--	Do
L13	Ek	100	9-18-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	10	--	<50	<6.0	--	Do
L16	Ek	47	9-18-62	65	--	--	--	--	--	--	--	--	--	2.4	--	--	--	35	--	85	6.2	--	Do
L19	Ek	120	9-19-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	10	--	<50	<6.0	--	Do
M48	Ek	15	4-13-62	--	--	--	--	--	--	--	--	--	--	5.4	--	--	--	10	--	<50	<6.0	--	Do
M56	Ek	120	9-18-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	10	--	<50	<6	--	Do
M58	Ek	4	9-18-62	--	--	--	--	--	--	--	--	--	--	10	--	--	--	15	--	60	6.0	--	Do
R1	Ek	65	9-19-62	--	--	--	--	--	--	--	--	--	--	2.4	--	--	--	10	--	< 50	<6.0	--	Do
R9	Ek	126	9-21-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	10	--	<50	<6	--	Do
R16	Ek	42	9-20-62	--	--	--	--	--	--	--	--	--	--	8.0	--	--	--	10	--	55	< 6	--	Do
R23	Ek	45	1-24-62	--	--	--	--	--	--	--	--	--	--	26	--	--	--	55	--	230	<6.0	--	Do
R24	Ek	126	1-24-62	--	--	--	--	--	--	--	--	--	--	1.6	--	--	--	<10	--	<50	6.0	--	Do
R25	Ek	20	9-19-62	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	10	--	< 50	<6	--	Do
R26	Ek	60	9-20-62	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	35	--	95	6.0	--	Do
										Cockfield Formation													
P7	Ec	15	9-21-62	--	--	--	--	--	--	--	--	--	--	10	--	--	--	20	--	100	<6.0	--	USGS, F

(a) Analysis of finished water as delivered to customers.

the proposed well and will give the best available estimate of formation altitudes, thicknesses, and lithology at the proposed site. Well depths necessary to reach certain sands can then be determined if the altitude of the land surface at the well site is known. Subtract algebraically the altitude of the formation from the altitude of the land surface at the proposed well to determine depth of well. Land surface altitudes may be determined from topographic maps, highway profiles, bench marks, or in other ways.

Table 6.—Chemical analyses of water samples from streams in Attala County, Miss.

(Analytical results in parts per million, except as indicated)

(Analyses by U. S. Geological Survey)

Date	Discharge[a]	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color
[b]Lake at Youth Center SW¼NE¼ sec. 16, T. 14 N., R. 6 E.																			
Sept. 18, 1962		85									1.6				15		<50	7.1	
Tributary of Apookta Creek SW¼NE¼ sec. 9, T. 14 N., R. 6 E.																			
Sept. 18, 1962		72									2.4				10		<50	6.6	
[b]Bogue Falaya Creek (Long Creek) NE¼SW¼ sec. 4, T. 13 N., R. 6 E.																			
Sept. 21, 1962		73									3.4				10		<50	6.7	
[b]Senoatcha Creek SW¼NW¼ sec. 4, T. 12 N., R. 4 E.																			
Sept. 21, 1962		73									2.4				15		<50	6.6	
[b]Big Black River SW¼SW¼ sec. 18, T. 14 N., R. 5 E.																			
Oct. 4, 1962		72									4.0				20		60	6.8	
Big Black River at Pickens SW¼SW¼ sec. 14, T. 12 N., R. 3 E.																			
Feb. 13, 1958	3,000	45	7.4	0.35	4.6	1.4	5.1	1.9	20	7.8	4.5	0.5	0.8	94	18	1	64	6.3	20
June 10, 1958	340	84	3.6	.04	6.9	1.6	5.6	2.7	21	8.2	6.0	.5	1.9	68	24	6	78	6.4	22
Oct. 22, 1958	179	65	4.6	.49	4.9	3.0	6.5	1.4	34	4.6	6.2	.0	1.0	59	24	0	87	6.8	5
[b]Yockanookany River at Ethel lower crossing SW¼SE¼ sec. 34, T. 15 N., R. 8 E.																			
Sept. 28, 1962		63									4.0				15		<50	6.6	
Yockanookany River near Kosciusko NE¼NE¼ sec. 33, T. 14 N., R. 7 E.																			
Dec. 9, 1959	110	44	1.9	0.07	1.1	0.2	2.4	0.5	5	0.0	3.5	0.0	0.5	38	4	0	23	5.5	10
May 24, 1960	32.8	77	6.1	.21	3.6	1.7	4.5	.9	17	4.6	5.2	.0	1.3	35	16	2	61	6.5	40
Feb. 2, 1960	2,770	—	3.9	.15	1.3	1.2	3.6	1.2	6	6.8	2.8	.1	1.2	54	8	3	36	5.4	70

[a]Discharges reported are either daily mean discharges or discharges for the time at which samples were collected, computed from a stage-discharge relation or from a measurement.

[b]Field analysis.

Water levels in most of the sands can be determined approximately by using the maps showing water-level contours for the Wilcox, Tallahatta, and Kosciusko (figs. 7, 10, and 12). Direction of water movement can also be determined from these maps.

Quality of water in the different formations at a proposed well site can be estimated by referring to geologic section AA' (plate 1). Move along the strike from the well site to section AA' as described above in connection with well depth determination.

Note and compare the several partial analyses within formations and among the several formations. Refer to the chemical analyses table (table 5) for other partial analyses and for complete analyses. Quality of water in Attala County within a formation changes very little along strike but does change down the dip as depth increases.

Specific conductance (tables 5 and 6), a value readily determined in the field, gives an indication of the dissolved solids content of water. A limited number of analyses indicates that in Attala County the specific conductance value may be converted to the approximate dissolved solids by multiplying the specific conductance value by the following factors:

Wilcox Group	1.0	(In the outcrop area and at shallow depths)
	.8	(wells of moderate depths)
	.7	(deeper wells in the western part of county)
Neshoba Sand Member of Tallahatta Formation	.8	
Sparta Sand	.9	

Yield of water to wells by the different formations can be estimated by referring to the lithology as shown on the section, to the yields of wells listed in the well table, and to the part of the text describing that formation.

SURFACE WATER

SOURCE AND DURATION OF STREAM FLOW

Attala County is drained by the Big Black River, the Yockanookany River, and Lobutcha Creek (fig. 1). Ground-water discharge from Attala County received by the Big Black River comes from the Tallahatta, Winona, Kosciusko, and Cockfield Formations, most of which is from the Kosciusko. The Yockanookany River receives ground water from the Wilcox Group, the Tallahatta Formation, the Winona Formation, and the Kosciusko Formation. Most of the ground water discharged to Lobutcha Creek in Attala County is from the Tallahatta Formation.

The U. S. Geological Survey maintains two gaging stations in or next to Attala County; one on the Yockanookany River at

Kosciusko and one on the Big Black River at Pickens at the southwest corner of the county. Some streamflow measurements have also been made on Lobutcha Creek at Zama and on Zilpha Creek (at Carmack) near Kosciusko.

The median annual low flow of a stream is an indication of the dependable amount of water available from the stream. Records of the U. S. Geological Survey show that the median annual low flow of the Yockanookany River at Kosciusko is about 8 cfs (cubic feet per second), Big Black River at Pickens is about 60 cfs, and Lobutcha Creek at Zama is about 1 cfs.

Precipitation and combinations of topography, geology, and vegetation largely determine frequency and duration of floods and low flows of streams. Most of the streams in Attala County are in valleys between high sand hills and are perennial. The water levels in the higher and more extensive ranges of hills are usually several feet higher than the stream beds and continue to discharge ground water during long periods of drought. The headwaters of the Big Black River tributaries are some of the highest yielding streams in the county. This fact is attributed to both geology and topography of the drainage basin. Most of the dividing ridge between the basins of the Big Black River and the Yockanookany River is composed of sand. Altitudes are about 100 feet lower in the Big Black Basin than in comparable locations in the Yockanookany basin. Because the headwaters of the Big Black tributaries are much lower they receive most of the water discharged from the hills.

Hurricane Creek (fig. 1) is probably the largest creek in the county that is classified as intermittent (has extended periods of no flow). During dry weather it receives some ground water from the east side but none from the west side. The west valley wall is part of the dividing ridge between the Big Black basin and the Yockanookany basin.

Stream basins draining clay and shale terrain generally dry up during extended periods of no precipitation for lack of ground-water discharge. Some small streams having drainage basins in the outcrop of the Zilpha Formation south of Kosciusko and east of the Yockanookany River are in this category.

Table 7.—Records of selected wells in Attala County, Miss.

Well No.: Numbers correspond to those on well-location map, geologic section, and table 5.

Type of well: Most wells are rotary drilled. Exceptions are noted under "Remarks."

Depth of well and water level: Reported depths below land surface are given in feet; measured depths are given in feet and tenths.

Altitude: Altitudes determined from topographic contour maps or aneroid barometers.

Method of lift: B, bucket; C, cylinder; F, natural flow; J, jet; N, none; P, pitcher; T, turbine or centrifugal; S, submersible.

Use of water: D, domestic; I, industrial; Ir, irrigation; N, none; P, public supply; S, stock; T, test well.

Water-bearing unit: Ew, Wilcox Group; Et, Tallahatta Formation (includes Etm, Meridian Sand Member; Etb, Basic City Shale Member; and Etn, Neshoba Sand Member); Ewi, Winona Formation; Ek, Kosciusko (Sparta) Formation; and Ec, Cockfield Formation.

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
A 1	J. L. Leonard		----	9	30	Etn	313	3.03	6-12-57	---	D	Dug well, piston pump
A 2	Carmack School	E. L. McMillan	----	115	2	Et	295	+ 6	6-13-57	F,J	P	
								65.68	6-27-57			
A 3	J. B. Belk		1947	70	30	Etn	415	65.40	9-13-57	B	D	Dug well. Temp. 64°F. Observation well until destroyed in 1958.
								65.06	3-31-58			

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
A 6	G. A. Williams		-------	14	30	Etn	312	8	1957	J	D,S	Dug well
A 9	J. A. Weaver		1957	45	30	Etn	389	36	1957	J	D	Dug well
A13	W. D. Trimble	E. L. McMillan	1955	135	2	Et	314	+ 6	1957	F,J	D,S	Measured flow 3 gpm 9-13-57. Temp. 65°F.
								1.06	6-21-57			
A15	do	do	1934	113	2	Et	318	3.15	10-19-62	N	N	Observation well
A16	Milton Palmertree	do	1945	105	2	Et	310	+10	1945	F	D,S	Estimated flow 8 gpm in 1957. Temp. 65°F.
A17	W. E. Carter	Braswell Well Co.	1960	210	2	Et	380	30	1960	----	D,S	
B 2	D. I. Forrester	Bailey Drilling Co.	1952	225	2	Et	498	125	1952	C	D,S	
C 1	Mrs. Z. A. Wasson		1850?	40	28	Etb	435	32.21	8-10-58	C	D	Dug well. Former observation well.
C 3	D. E. Wasson	Braswell Well Co.	1960	403	2	Ew	431	86.20	7- 4-61	N	N	Destroyed in 1961
C 4	Mrs. Clark Cook		-------	23	36	Etb	442	20.24	7-12-62	B	D	Dug well. Temp. 68°F.
D 4	F. L. Rainey		1906	17	30	Ew	450	15	1957	B	D	Dug well
D 6	J. D. Milner	E. L. McMillan	-------	126	2	Ew	470	----	-------	J	P	
D 8	W. S. McKnight		-------	20	48	Etm	480	15.00	9-27-62	J	D,S	Dug well

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
D 9	....		....	3	24	Etm	451	+	9-27-62	N	D	Spring
D10	Frank Halderman		1961	20	28	Etm	494	18.00	9-27-62	B	D	Dug well
D11	Loyd Lee		....	39	8	Etm	499	34.20	1962	B	D	Bored well
D12	Mrs. B. H. Veal		1950	50	28	Etm	533	45	1950	J	D	Dug well
E 1	Moore No. 1	Ark.-La. Pipeline Co.	1930	400?	6	Ew	271	+ 8	1960	F	S	Est. flow 100 gpm. Oil test. Temp. 67°F.
E 4	C. D. Maddox	Bailey Drilling Co.	1955	369	3x2	Et	......	....	....	J	D,S	
F 1	Earl Alexander		....	18	30	Ewi	358	9.07	6-21-57	B	D,S	Dug well. Temp. 65°F.
F 6	Tom Weatherly		1945	26	12	Ewi	365	20	1957	B	D	Bored well
F 7	Weaver Gilbert		1953	22	36	Ewi	360	11.38	6-12-57	Piston	D	Dug well
F11	R. W. Nevil	Braswell Drilling Co.	1961	168	2	Et	372	42	1-25-61	J	D	
								41.07	6-10-62			
G 1	Fred Turnipseed	Presley & Smith	1957	337	2	Ew	360	41.04	10-19-62	J	D	
								9.26	9-13-57			
G 2	do		1948	140	2	Et	361	10.97	6-10-62	N	N	Observation well
G 3	E. E. Gentry		....	6	24	Ewi	355	+	2-13-57	F	D,S	Spring. Temp. 65°F.
G 5	R. T. McCool		1954	30	30	Ewi	380	21.22	6- 6-57	J	D	Dug well

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
G 8	Fred Turnipseed		------	21	2	Ewi	360	13.12	9-13-57	P	N	Observation well
G 9	Ray Shelley		------	3	30	Ek	490	+	4-13-62	F	D,S	Four mile spring, flows 5 gpm
G10	Mrs. Brownie Carson	Herron Drilling Co.	1956	146	2	Et	465	85	1956	J	D	
G13	Fred Turnipseed		1962	22	30	Ewi	361	13.24	6-10-62	J	D	Dug well
G14	Frank Lord		1962	21	12	Etn	427	----	------	J	D,S	Bored well
G15	Sally Coffee		------	40	8	Etn	452	28	1962	B	D	Bored well
H 1	Brice Nabors	Presley & Smith	1957	165	2	Et	558	84	1957	C	D,S	
H 4	E. W. Kimbrough		1940	16	30	Et	434	8	1957	J	D	Dug well
H 8	Attala Lumber Co.	A. M. Hanna	------	65	4	Et	430	30	3-28-57	J	I	Steam jet. Pumps 10 gpm.
H10	do.	do.	------	170	4	Et	433	31.39	3-28-57	J	I	Cased to rock at 60 ft.
H11	Moler & Vandenboon Lbr. Co.		1942	90	6	Et	428	20	1957	J	I	Pumps 30 gpm. Cased to rock at 40 ft.
H12	Town of Ethel	Layne-Central Co.	1941	204	8	Etm	489	75	1941	T	P	Pumps 110 gpm. Temp. 65°F.

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
H13	do	Robert E. Ratliff Co.	1954	204	8	Etm	489	90	1954	T	P	Pumps 120 gpm. Temp. 64°F.
H14	Ethel Colored School	Herndon Drilling Co.	1961	222	4x2	Ew	426	----	--------	T	P	Pumps 80 gpm. Temp. 64°F.
H16	J. R. Greenlee	Presley & Smith	1961	115	2	Et	438	40	1961	J	D,S	
H17	E. W. Kimbrough, Jr.	do	1958	100	2	Ew	446	----	--------	J	D,S	
H18	M. G. Simpson		1960	20	36	Etb	416	8	1962	J	D	Dug well
H19	Don McCardy	Randel Thompson	1960	70	36	Etn	530	65	1960	J	D,S	Dug well
H20	Quitman Bain	Presley & Smith	1960	156	2	Et	508	50	1960	J	D,S	
J 1	Johnie Jones	Randel Thompson	1953	40	28	Et	459	31	1953	J	D,S	Dug well
J 3	Greenlee School	Presley & Smith	1954	140	2	Ew	440	60	1954	J	P	
J 4	D. B. Lewis	do	1960	425	2x1¼	Ew	440	37	1960	C	D,S	
J 5	C. E. Burchfield		--------	4	30	Etb	533	+	1962	F	D,S	Spring. Flow 1 gpm. Temp. 64°F.
J 6	J. A. Proctor	Braswell Drilling Co.	1959	127	2	Etn	635	----	--------	C	D,S	
J 7	D. M. Simmons		1900	35	36	Etw	520	----	--------	J	D	Dug well
K 1	S. I. Musselwhite	Bailey Drilling Co.	1952	674	2	Ew	314	35	1952	J	D	

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
								+35	1906			
K 4	C. C. Cain		1906	440	2	Et	260?	+	1957	F	D,S	Flowed 5 gpm, 1957.
K 5	Love Sugs	Truitt Sudduth	1957	250	2	Ek	352	115	1957	C	D,S	Temp. 66°F.
K10	Sallis School	Bailey Drilling Co.	1951	301	4x2½	Et	290	7	1951	J	P	
K12	Edd Gordon		-------	126	2	Ek	------	----	--------	C	D	
K22	Town of Sallis		1908	356	2	Et	280	+ 2.81	6-19-57	F	P	
K24	J. B. Burrell		1900	20	30	Ek	320	11.75	9-19-62	B	D,S	Dug well. Temp. 72°F.
K25	W. W. Allen	Presley & Smith	1960	300	2	Et	351	----	--------	J	D,S	
K26	Hubert Robertson	Braswell Drilling Co.	1959	357	4	Et	355	40	1959	J	D,S	
K27	do		-------	20	8	Ek	298	15	1962	P	D	Bored well. Temp. 67°F.
								20	1962			
K28	Miss Violet Bosse	John Holly	1928	329	2	Et	332	14	1928	J	D,S	
K29	Hardy Cochran		old	30	40	Ek	304	21.15	9-21-62	B,J	D,S	Dug well. Temp. 62°F.
K30	Norris Culpepper	Thomas & Son	1962	145	2	Ek	344	88	1962	J	D	
K31	J. M. Waddell	Jack Martin	1961	300	2	Et	346	38	1961	J	D,S	
L 5	Thomas Benson	Presley & Smith	1953	168	2	Et	350	+ 1	1957	J	D	

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
L 6	W. R. McCrory	E. L. McMillan	1954	168	2	Et	350	+ 5	2- 1-57	F	D,S	Temp. 64°F.
L 7	Joe Jackson	do	1951	240	2	Et	288	+ 6	1962	F		Flows 10 gpm
L 8	B. W. Pitman		-------	4	30	Ek	338	+	1962	F	D,S	Spring flows 1 gpm. Temp. 61°F.
L 9	V.F.W. Post	Presley & Smith	1961	302	3x2	Etn	451	100	1961	C	P	
L12	L. Braswell	Braswell Drilling Co.	1962	200	2	Et	344	+ 5	1962	F	S	
L13	V. D. Steen	E. L. McMillan	1940	100	2	Ek	472	----	-------	C	D	
L15	Jessie McMillan	Presley & Smith	1962	228	2	Et	362	----	-------	J	D	
L16	Youth Center House		-------	47	1¼	Ek	363	8.06	9-18-62	P	P	Temp. 66°F.
L18	H. L. Sanders	E. L. McMillan	1952	280	2	Et	373	40	1952	J	D,S	
L19	do	do	1940	120	2	Ek	373	40	1940	J	D,S	
L20	Wesley Guess	Braswell Drilling Co.	1960	182	2	Et	310	+ 5	1962	F	D,S	Hole to 325 feet
L21	H. E. Jenkins	Hearon Drilling Co.	1962	212	2	Et	346	18	8-30-62		D,S	Air compressor
L22	do		1940	412	2	Ew	344	----	-------	J	D,S	Replaced by well L21
M 4	Ramond Collins	E. L. McMillan	1952	80	2	Ek	462	62	1950	J	D	
M 5	Tracewood Subdivision	Bailey Drilling Co.	1950	286	4x2	Et	440	110	1950	T	P	Pumps 20 gpm

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
M 6	Pet Milk Co.	Layne Central Co.	1938	391	12	Ew	427	94	1938	T	I	Originally pumped 500 gpm
M 7	Pet Milk Co.	Layne-Central Co.	1928	426	12	Ew	424	108.95	5-23-62	T	I	Not in use in 1962. Observation well.
M 8	do	do	1957	456	16	Ew	423	104.10 123.80	3-13-62 3-13-62	T	I	
M 9	United Warehouse Co.	do	1944	428	10	Ew	443	127.34	10-19-62	T	I	Not in use in 1962
M11	J. R. Vines		1925	53	30	Ewi	465	37.30	2-14-57	B,J	D,S	Converted to cesspool in 1958
M26	Kosciusko Ice & Coal Co.	Layne-Central Co.	1938	412	12	Ew	560	----	--------	T	I	Pumps 400 gpm. Temp. 67°F.
M28	City of Kosciusko	do	1940	430	12	Ew	455	123.0	3-13-62	T	P	Originally pumped 510 gpm
M29	do	do	1943	435	12	Ew	472	146.7	3-13-62	T	P	Pumps 400 gpm
M30	do	do	1951	436	12	Ew	467	142.25	3-13-62	T	P	Pumps 470 gpm
M31	do	do	1955	419	16	Ew	443	119.50	3-13-62	T	P	Pumps 950 gpm. Temp. 67°F.

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
M32	do	do	1951	425	12	Ew	430	102.75	3-14-62	T	P	Pumps 425 gpm
								4	1957			
M33	J. E. Mangrum		1910	13	48	Ewi	380	12.00	9-18-62	N	N	Temp. 67°F.
M38	Homer Britt	E. L. McMillan	1946	130	2	Et	350	+ 6	6- 6-57	F	D,S	Est. flow 3 gpm in 1962. Temp. 65°F.
								27.22	6-14-57			
M40	Lamar Young		-------	126	2	Et	421	29.49	12-20-57	N	N	Destroyed in 1958
M42	S. J. Peeler	Bailey Drilling Co.	1953	385	4x2	Ew	490	138	1953	T	D,S	
M43	D. S. Hartness	do	1950	237	2½	Et	420	----	--------	J	D	
M44	City of Kosciusko	Layne-Central Co.	1960	422	18	Ew	439	119.80	3-13-62	T	P	Pumps 1000 gpm, 33 ft. drawdown
M45	Donald Jordan	Braswell Drilling Co.	1961	143	2	Etn	440	40	1961	J	D	
M46	Attala County Farm & Home	E. L. McMillan	1950	200	4	Et	460	----	--------	T	P	Replaced by well M51. Temp. 66°F.
M47	Woodard Harvey	Hearon Drilling Co.	1952	220	2	Et	477	72	1952	J	D,S	Replaced by well M52
M48	Howard Miles		old	15	24	Ek	511	6	4-13-62	B	D	

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
M51	Attala County Farm & Home	Forest Butane Co.	1962	447	4x2½	Ew	460	125	6-28-62	T	P	Temp. 68°F.
M52	Woodard Harvey	Hearon Drilling Co.	1962	209	2	Et	477	78	5- 9-62	C	D,S	
M53	American Legion Skating Rink	Braswell Drilling Co.	1962	140	2	Et	503	----	--------	C	P	
M55	Roby McCool	Hearon Drilling Co.	1960	292	2	Et	504	----	--------	—	D	Air compressor. Temp. 66°F.
M56	Annie Lee McMillan	E. L. McMillan	1943	120	2	Ek	516	----	--------	C	D	
M57	Miss. Forestry Comm.	Nichols	1961	443	4x2	Ew	543	----	--------	J	D	
M58	J. E. Mangrum		1962	4	36	Ek	424	+	1962	F	D	Flows ½ gpm. Temp. 65°F.
N 3	C. A. Barton	Presley & Smith	1955	145	2	Et	460	----	--------	J	D	
N11	J. P. Brown		1949	42	6	Etn	499	25.01	9-13-57	B	D,S	
N12	E. N. Barton	Bailey Drilling Co.	1948	83	2	Etn	478	25	1948	J	D	
								21.19	4-28-58			
N13	Houston Veasey		--------	30	30	Ewi	510	21.78	6-10-62	N	N	
N14	W. B. Simmons		1961	20	1¼	Etn	444	8	1962	P	D	

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
N15	A. A. Blaine	Henry Washburn	1945	28	30	Etn	436	18	1954	J	D,S	Dug well
N16	A. O. Bain		1940	83	8	Etn	528	55.50	9-27-62	B	D	Do
O 4	A. T. Mangrum	Hearon Drilling Co.	1951	136	2	Ew	......	....	....	J	D,S	
O 7	Glendale School	E. L. McMillan	1950	185	2	Ew	......	....	....	J	D	
O 9	Bryon Prevost	do	1947	105	2	Et	530	....	....	J	D,S	
O10	H. H. Wheeless	Randel Thompson	1950	17	30	Etb	502	13.37	9-28-62	B	D	Temp. 65°F.
P 2	J. W. Burrell	Presley & Smith	1957	672	2	Ew	......	....	....	J	D,S	
P 4	J. O. Jenkins	E. L. McMillan	1942	670	2	Et	240	+30	1957	F	D,S	Flows 10 gpm. Temp. 70°F.
P 7	L. C. Garvey		1956	15	1½	Ec	241	— 4	1956	J	D	
P10	Victor Donald	Truitt Sudduth	1956	715	2½	Et	245	+ 6	1956	F	D,S	Flows 4 gpm. Temp. 67°F.
P12	Alvin McCrory	Braswell Drilling Co.	1961	739	2	Etn	242	+12	1962	F	D,S	Temp. 71°F.
Q 1	H. L. May	E. L. McMillan	1940	586	2	Etn	266	+ 4	1-25-57	F	D,S	
Q 3	H. S. Smithson, Jr.	E. L. McMillan	1954	490	2	Etn	262	+10	1957	F	D,S	Temp. 67°F.
Q 4	J. F. Allen No. 1	Hawkins & Howell	1940	500	5	Et	279	+ 6	1962	F	D,S	Flows 6 gpm. Temp. 68°F. Oil test.

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
Q10	Quitman Horne	E. L. McMillan	1955	500	2	Et	295	+ 1	1955	J	D,S	Water level of Etn (-14 ft.)
Q12	Henry Aldy	do	1951	450	2	Et	268	+12	1952	F,J	D,S	
Q14	Ezra Aldy	John Holly	1946	409	2	Et	290	.87	6-20-57	J	D,S	
								30	1927			
Q17	Mrs. D. A. Robertson	do	1927	335	2	Et	345	50	1957	J	D,S	
Q26	Alvin McCrory	Bailey Drilling Co.	1952	810	2½x2	Ew	265	+ 5	1962	J	D,S	Temp. 68°F.
Q27	G. H. Hutchins	Braswell Drilling Co.	1960	528	2	Etn	287	+ 4	9-21-62	F	D,S	Flows 3 gpm. Temp. 68°F.
Q29	Clinton Hunt	Bailey Drilling Co.	1950	572	3x2	Et	----	56	5-19-50	J	D,S	
R 1	G. W. Hester	E. L. McMillan	1944	65	2	Ek	339	----	----	J	D	
R 2	do	do	1949	150	1½	Etn	333	+ 1	2- 1-57	P	S	Temp. 66°F.
								.0	9-19-62			
R 6	Walter Terry		----	3	36	Ek	335	+	3-29-57	F	D	Temp. 63°F.
R 9	E. L. Odom	E. L. McMillan	1945	126	2	Ek	340	+ 4	1962	F,J	D,S	Temp. 65°F.
R13	Bethel Church	do	1915	315	2	Et	300	+ 3	3-29-57	E	D	
R15	C. Y. Suduth	do	1928	150	2	Etn	333	+ 4	1962	F	D,S	Temp. 65°F.

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
R16	S. C. Payne	do	1953	42	2	Ek	333	----	--------	J	D	
R17	J. W. Jones	do	1946	250	2	Etn	324	+ 3	1962	F	D,S	Temp. 65°F.
								10	1940			
R18	W. L. Armstrong		1940	285	2	Et	333	10.10	12-20-57	J	D,S	
R22	J. C. Jenkins	Braswell Drilling Co.	1962	390	3	Etn	340	15	1-23-62	J	D,S	
R23	do		--------	45	8	Ek	340	30	1-23-62	B	S	
R24	H. D. Ballard	E. L. McMillan	1957	126	2	Ek	360	70	1957	J	D,S	
R25	Robert Hollingsworth		1940	20	48	Ek	345	16	9- 9-62	J	D,S	
R26	Mrs. Grace Guyton		--------	60	28	Ek	355	44.10	9-20-62	J	D	
R27	Paul Guyton	E. L. McMillan	1946	400	2	Et	378	----	--------	C	D	
S 1	United Gas Pipe Line Co.	do	1951	220	4	Et	492	97.70	3-14-62	S	D	
S 2	Texas Eastern Transmission Co.	Layne-Central Co.	1951	318	8	Etm	445	39.36	3-14-62	N	N	Abandoned. Temp. 65° F. Test hole to 764 ft.
S 7	David Burt		1936	22	8	Ek	400	16.1	2-15-57	J	D	

Table 7.—(Continued)

Well No.	Owner	Driller	Year drilled	Depth of well (ft.)	Diameter (in.)	Water-bearing unit	Altitude of land-surface datum (ft.)	Water Level: Above (+) or below land-surface datum (ft.)	Water Level: Date of measurement	Method of lift	Use of water	Remarks
S13	Mrs. W. G. McMillan		1956	36	30	Ek	388	14.13 16.40	5-21-58 10-16-58	B	D	
S17	W. M. Scott	E. L. McMillan	1947	204	2	Et	420	----	--------	J	D	
S18	H. A. Winkler	Layne-Central Co.	1953	85	6	Ek	440	25	1953	T	Ir	Originally pumped 250 gpm
S19	Holly Hill Picnic Area	Robert E. Ratliff Co.	1958	460	------	Ew	405	----	--------	T	P	
S20	Texas Eastern Transmission Co.	Layne-Central Co.	1959	315	10	Etm	445	102 102.68	1959 3-14-62	T	I	Pumps 60 gpm
S21	United Gas Pipe Line Co.	do	1961	375	8x4	Etm	488	----	--------	T	D	
S25	E. H. Cotton	Presley & Smith	1960	183	2	Et	490	86	1960	C	D	
S26	T. K. Jennings	Thomas & Son	1962	63	2	Ek	440	35	1962	J	D	
T 1	Ralph Cockroft	Hearon Drilling Co.	1957	200	2	Et	485	70	1957	----	D	Air compressor
U 1	Miss Lucille Gregory	do	1961	113	2	Et	450	59	1961	C	D	

CHEMICAL QUALITY OF SURFACE WATER

The chemical quality of all surface water in Attala County is good, unless it is contaminated by human activity. Several samples of surface water were taken and analyzed for chloride, hardness, acidity, and conductivity. Surface water in Attala County is generally neutral or slightly acid, soft, and has low chloride and dissolved solids contents (table 6). The samples were collected during periods of low to medium flow and are unaffected by surface runoff. Temperature varies with air temperature.

SUMMARY

Attala County is fortunate in having abundant supplies of ground water and surface water for future use. However, the development of large water supplies from either source should be preceeded by comprehensive investigation and testing of the potential source. Also, the effects of such developments on the hydrologic system should be evaluated.

Aquifers in the Wilcox Group underlie the entire county and the sands in the upper part of the group, presently the source of water for municipal and industrial supplies at Kosciusko, seem to be the most important aquifer for large supplies in the future. The sands in the lower part of the Wilcox Group, untapped by wells at the present time, also seem to be of potential importance.

The Meridian Sand Member, Basic City Shale Member and the Neshoba Sand Member of the Tallahatta Formation all include aquifers capable of supplying small to moderate amounts of water to wells. The Neshoba Sand Member is presently the most widely used aquifer for domestic and other small wells in the county.

The Kosciusko (Sparta) Formation is an important potential source for large water supplies in the western part of the county. It is a source of water for many small domestic wells.

The Cockfield Formation is limited to the extreme southwestern part of the county. It is of potential importance for moderate to large water supplies.

Multiple aquifer well fields are feasible throughout the county. For example, at Kosciusko wells may be developed in both upper and lower parts of the Wilcox Group. In the western part of the county the Wilcox aquifers may be supplemented by overlying aquifers in the Tallahatta Formation and, in the southwest, by those in the Kosciusko and Cockfield Formations. As the aquifers are essentially separate reservoirs, withdrawals of water from any particular stratum will have a negligible effect on the others. However, future developers of large water supplies in the central and western parts of the county might consider reserving the aquifers in the upper part of the Tallahatta Formation for continued use as a source for domestic wells.

Water-level declines are small, reflecting regional changes except in the Kosciusko area where municipal and industrial pumpage has induced a small cone of depression. Water levels are sufficiently high for flowing artesian wells in the lowlands along Big Black River and some tributary streams.

The average annual low flow of Yockanookany River at Kosciusko is about 8 cfs, or about 5.2 mgd. The average annual low flow of the Big Black River at the southwest corner of the county is 60 cfs, or about 39 mgd. The availability of water from these sources may be increased by reservoir construction, and storage facilities would be a necessity for an appreciable surface water supply from any other stream in the county.

Water from ground and surface-water sources in Attala County is generally of good chemical quality. However, ground water from shallow wells is characterized by a low pH which causes corrosiveness; as a result, troublesome amounts of iron are dissolved from well casings, distribution pipes, and other parts of water systems. In some instances, excessive amounts of iron are naturally present in the water.

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STATEMENT OF POLICY IN STRATIGRAPHIC NOMENCLATURE

The Mississippi Geological Survey has many requests for "official statements" on geologic nomenclature. At the present time we do not recognize that we have any "official nomenclature." Geologic knowledge is accrual: therefore, geologic conclusions and the nomenclature of geology are subject to review and to revision.

The rules of stratigraphic nomenclature are understood by us, by the geologists of the Surveys of our sister States, by those of the U. S. Geological Survey and by most other geologists. They are most recently expressed by American Commission on Stratigraphic Nomenclature in its "Code of Stratigraphic Nomenclature," A. A. P. G. Bull. Vol. 45, *No.* 5, *pp.* 645-665, *May,* 1961.

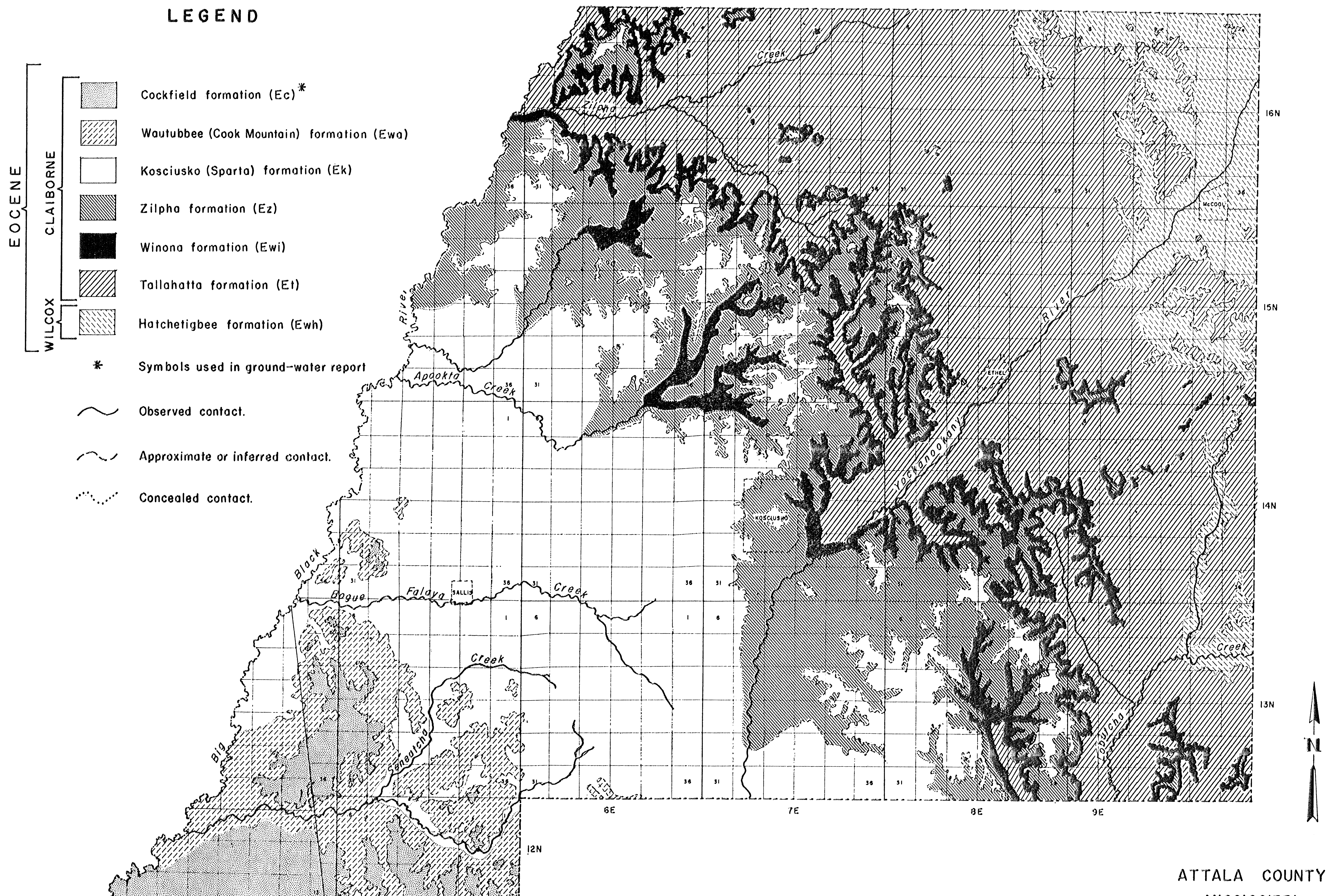
The problems being studied continually by us are those of stratigraphic nomenclature and taxonomy as they affect our economic investigations. Ranking of stratigraphic units appears to change as the detail of geologic knowledge unfolds. Is this advisable, desirable, or necessary? At what degree should "usage" take precedence over "priority?" These are some of the questions that concern us.

We are definitely working in the direction of standardization of nomenclatural usages. We are anxious to cooperate with other departments, geologists and organizations in the simplification and better definition of our nomenclature. We feel that it is a bit too early to announce "official nomenclature," for we, too, are trying to work out of a maze of duplication, poor descriptions and misunderstandings. The geologists writing our reports consult constantly with us and with others in their selection of names, and those names used in these reports are deemed most appropriate and valid by the individual on the basis of his consultations and information available to him at the time. It has been our policy to consult with and to inform the Geologic Names Committee, U. S. Geological Survey, of which George V. Cohee is Chairman. Such matters deal with opinions on stratigraphy, clearing and reservations of new names, and advice on revisions in nomenclature or rank.

The Staff

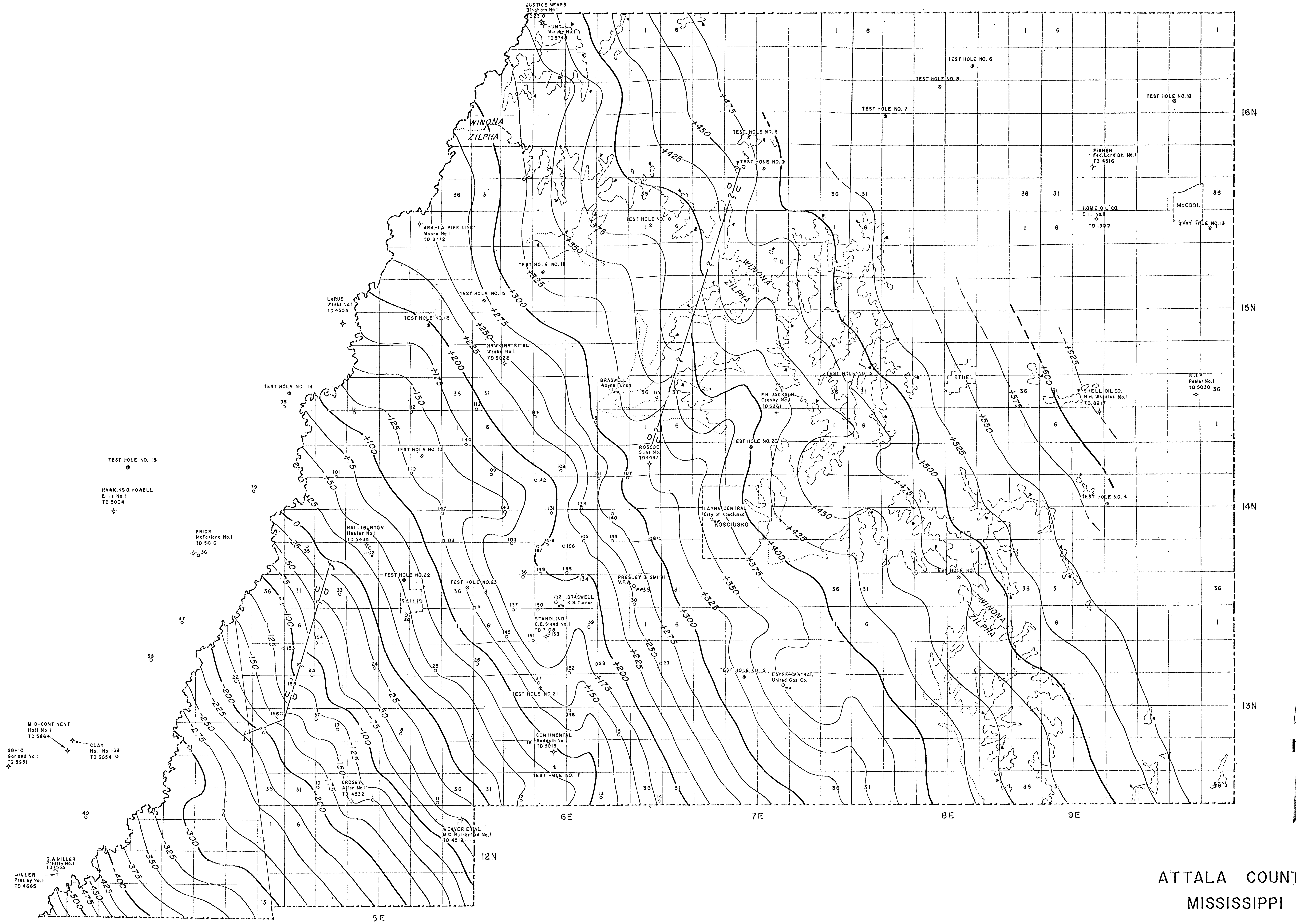
Mississippi Geological Survey

March 1, 1963



GEOLOGIC MAP

GEOLOGY BY WILLIAM S. PARKS
CARTOGRAPHY BY DAVID S. SHERARD
1963



ATTALA COUNTY
MISSISSIPPI

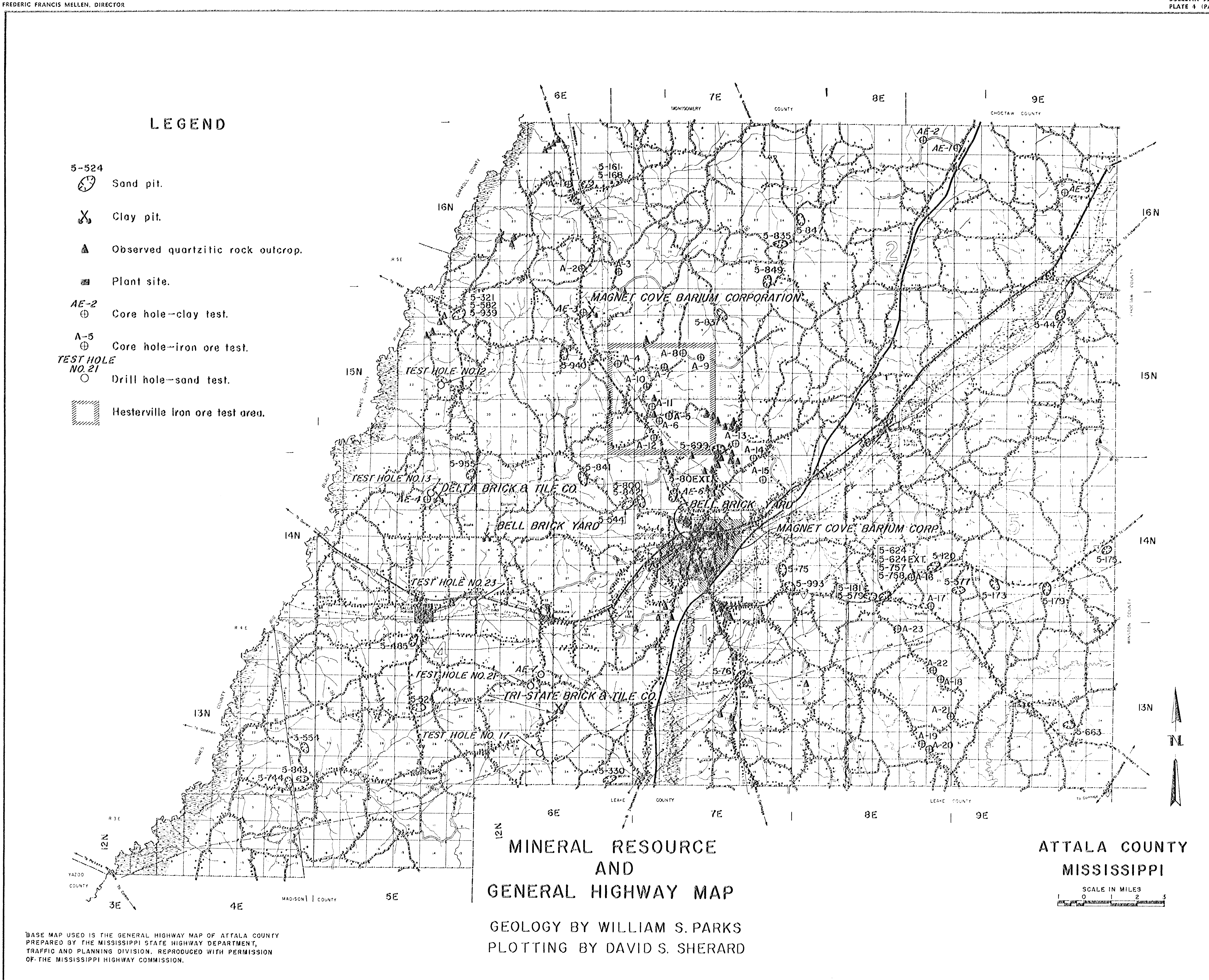
SCALE IN MILES

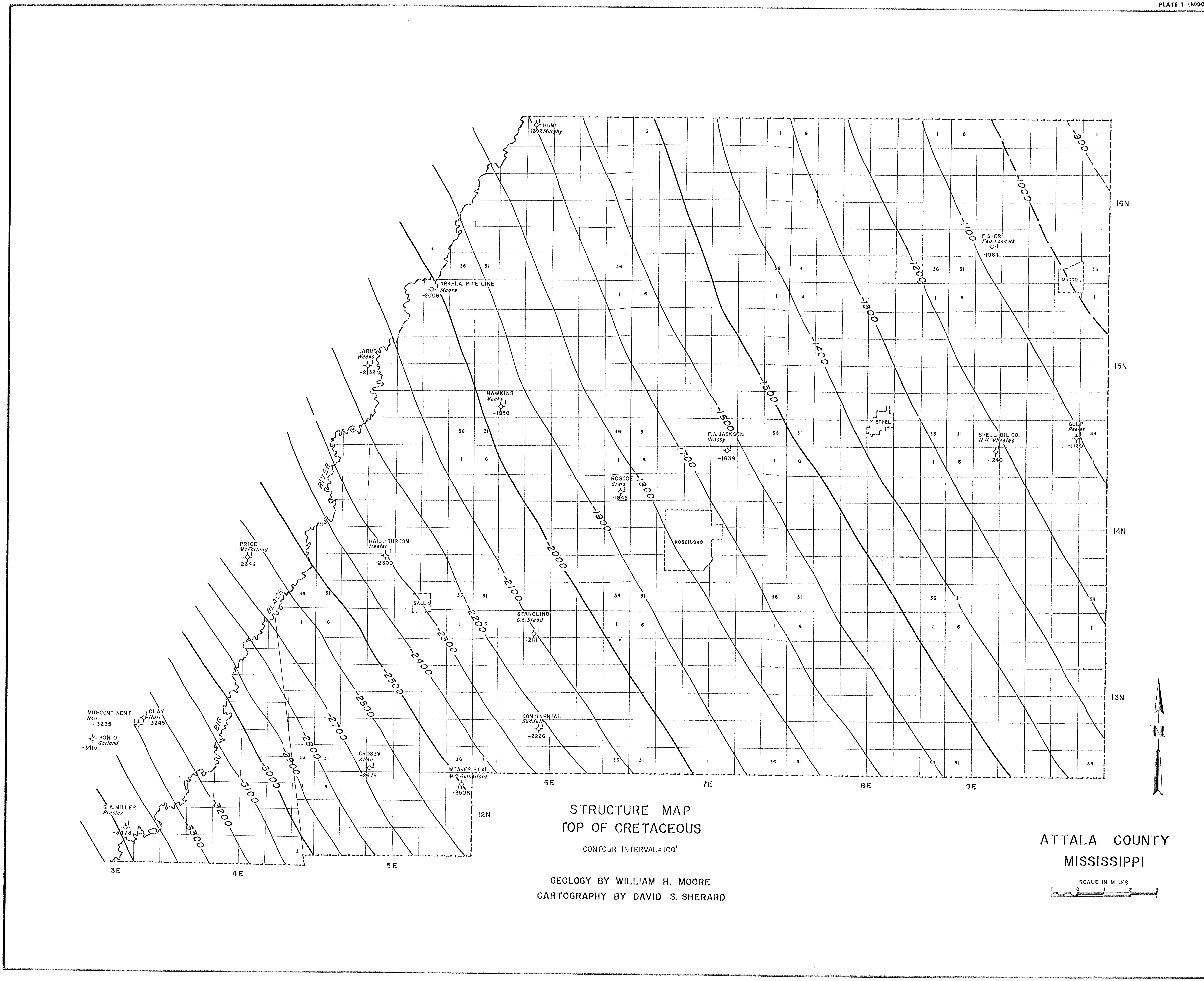
STRUCTURE MAP

DATUM TOP OF WINONA
GEOLOGY BY WILLIAM S. PARKS
CARTOGRAPHY BY DAVID S. SHERARD

CONTOUR INTERVAL = 25'

1963


LEGEND
5-524
Sand pit.
Clay pit.
Observed quartzitic rock outcrop.
Plant site.
AE-2
Core hole–clay test.
A-5
Core hole–iron ore test.
TEST HOLE NO. 21
Drill hole–sand test.
Hesterville iron ore test area.
MAGNET COVE BARIUM CORPORATION
DELTA BRICK & TILE CO.
BELL BRICK YARD
MAGNET COVE BARIUM CORP.
TRI-STATE BRICK & TILE CO.
TEST HOLE NO. 12
TEST HOLE NO. 13
TEST HOLE NO. 23
TEST HOLE NO. 21
TEST HOLE NO. 17
6E
7E
8E
9E
3E
4E
5E
16N
15N
14N
13N
12N
MONTGOMERY COUNTY
CHOCTAW COUNTY
LEAKE COUNTY
MADISON COUNTY
YAZOO COUNTY
N
SCALE IN MILES
1 0 1 2 3
MINERAL RESOURCE
AND
GENERAL HIGHWAY MAP
ATTALA COUNTY
MISSISSIPPI
GEOLOGY BY WILLIAM S. PARKS
PLOTTING BY DAVID S. SHERARD
BASE MAP USED IS THE GENERAL HIGHWAY MAP OF ATTALA COUNTY PREPARED BY THE MISSISSIPPI STATE HIGHWAY DEPARTMENT, TRAFFIC AND PLANNING DIVISION. REPRODUCED WITH PERMISSION OF THE MISSISSIPPI HIGHWAY COMMISSION.


STRUCTURE MAP
TOP OF CRETACEOUS
CONTOUR INTERVAL=100'
GEOLOGY BY WILLIAM H. MOORE
CARTOGRAPHY BY DAVID S. SHERARD
ATTALA COUNTY
MISSISSIPPI
SCALE IN MILES
N
BIG BLACK RIVER
KOSCIUSKO
SALLIS
ETHEL
McCOOL
3E
4E
5E
6E
7E
8E
9E
12N
13N
14N
15N
16N
HUNT
Murphy
-1692
ARK.-LA. PIPE LINE
Moore
-2006
LARUE
Weeks
-2132
HAWKINS
Weeks
-1950
FISHER
Fed. Land Bk
-1064
R.A. JACKSON
Crosby
-1639
SHELL OIL CO.
H.H. Wheeles
-1240
GULF
Peeler
-1120
ROSCOE
Sims
-1845
HALLIBURTON
Hester
-2300
PRICE
McFarland
-2646
STANOLIND
C.E. Steed
-2111
CONTINENTAL
Sudduth
-2226
CROSBY
Allen
-2678
WEAVER ET AL.
M.C. Rutherford
-2506
MID-CONTINENT
Hall
-3285
CLAY
Hall
-3245
SOHIO
Garland
-3415
G.A. MILLER
Presley
-3473
-900
-1000
-1100
-1200
-1300
-1400
-1500
-1600
-1700
-1800
-1900
-2000
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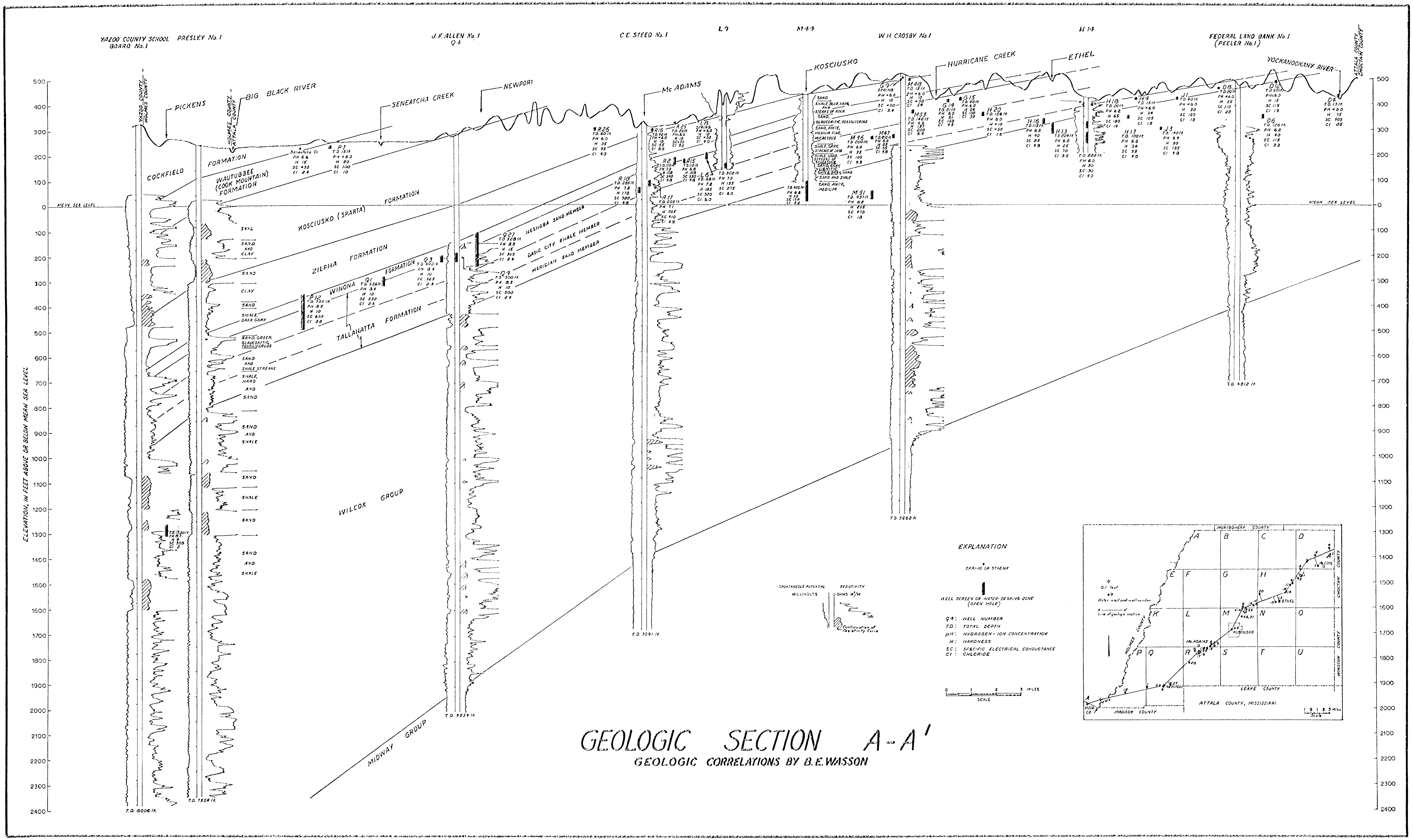
YAZOO COUNTY SCHOOL BOARD No. 1
PRESLEY No. 1
J. F. ALLEN No. 1
C. E. STEED No. 1
W. H. CROSBY No. 1
FEDERAL LAND BANK No. 1
(PEELER No. 1)
PICKENS
BIG BLACK RIVER
SENEATCHA CREEK
NEWPORT
Mc ADAMS
KOSCIUSKO
HURRICANE CREEK
ETHEL
YOCKANOOKANY RIVER
COCKFIELD FORMATION
WAUTUBBEE (COOK MOUNTAIN) FORMATION
KOSCIUSKO (SPARTA) FORMATION
ZILPHA FORMATION
WINONA FORMATION
TALLAHATTA FORMATION
NESHOBA SAND MEMBER
BASIC CITY SHALE MEMBER
MERIDIAN SAND MEMBER
WILCOX GROUP
MIDWAY GROUP
MEAN SEA LEVEL
ELEVATION, IN FEET ABOVE OR BELOW MEAN SEA LEVEL
EXPLANATION
SPRING OR STREAM
WELL SCREEN OR WATER-BEARING ZONE (OPEN HOLE)
Q4: WELL NUMBER
TD: TOTAL DEPTH
pH: HYDROGEN-ION CONCENTRATION
H: HARDNESS
SC: SPECIFIC ELECTRICAL CONDUCTANCE
Cl: CHLORIDE
SPONTANEOUS POTENTIAL MILLIVOLTS
RESISTIVITY OHMS M^2/M
SCALE
ATTALA COUNTY, MISSISSIPPI
MONTGOMERY COUNTY
CHOCTAW COUNTY
WINSTON COUNTY
LEAKE COUNTY
MADISON COUNTY
HOLMES COUNTY
GEOLOGIC SECTION A-A'
GEOLOGIC CORRELATIONS BY B.E. WASSON