MISSISSIPPI
STATE GEOLOGICAL SURVEY

WILLIAM CLIFFORD MORSE, Ph. D.
Director

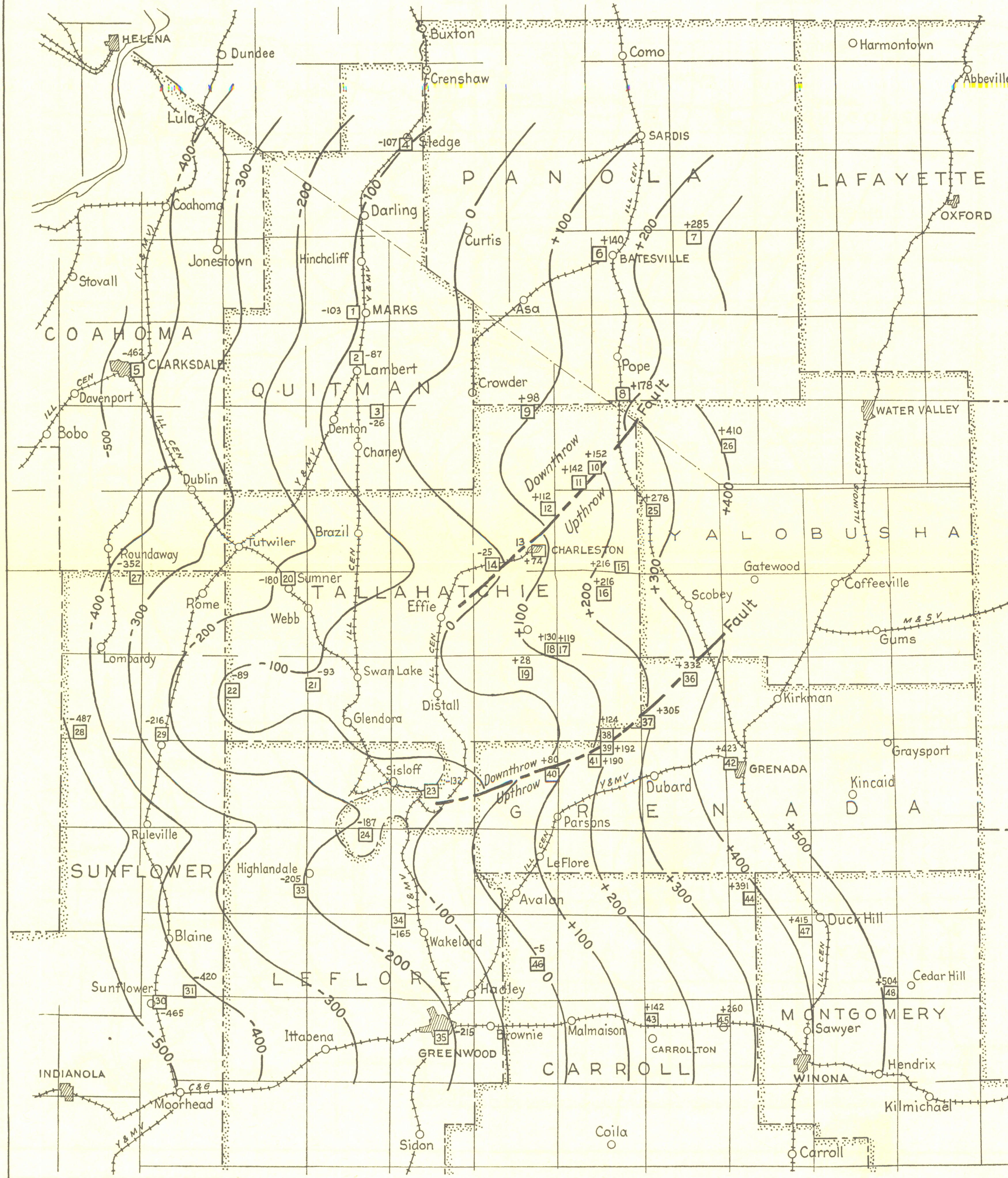
BULLETIN 50

TALLAHATCHIE COUNTY MINERAL RESOURCES

GEOLOGY
By
RICHARD RANDALL PRIDDY, Ph. D.

TESTS
By
THOMAS EDWIN McCUTCHEON, B. S., Cer. Engr.

UNIVERSITY, MISSISSIPPI
1942



REGIONAL STRUCTURE MAP
TALLAHATCHIE AND ADJACENT COUNTIES
MISSISSIPPI

0 5 10 15 20
SCALE OF MILES

Contours on Winona-Zilpha contact
Contour interval 100 feet
Location of datum points by section ☐
Number of datum point 12 15 41
Elevations below or above sea level −173, +96
Fault Zones

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Prepared in cooperation with the Tallahatchie County citizens and the WPA as a report on O. P. 65-1-62-137

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MISSISSIPPI GEOLOGICAL SURVEY

COMMISSION

STAFF

SUPERVISORS—WPA

LETTER OF TRANSMITTAL

Office of the Mississippi Geological Survey
University, Mississippi
September 5, 1942

To His Excellency,
Governor Paul Burney Johnson, Chairman, and
Members of the Geological Commission

Gentlemen:

Herewith is Bulletin 50, Tallahatchie County Mineral Resources—Geology by Richard Randall Priddy, Ph.D.; Tests by Thomas Edwin McCutcheon, B.S., Cer. Engr.—the publication of which constitutes a fulfillment in part of the sponsorship pledge of the Mississippi State Geological Survey, necessary to obtain Federal-WPA funds for the various county geological mineral surveys of the state.

The geologic part of the report is the work of Dr. Priddy even though Mr. Frederic Francis Mellen, who was assigned to the county as the first geologist, spent a number of months as the geologic director of the survey, before resigning to begin commercial oil work. As a matter of fact, Mr. Mellen's investigations led him in February, 1940 to submit for publication a brief article by William Clifford Morse and Frederic Francis Mellen in which were stated the results of his studies:

"Recent studies of the geology in northwestern Mississippi, particularly in Tallahatchie County under a grant by the Work Projects Administration, suggest that some two thousand square miles, shown on the latest geologic map of the state [1928—U. S. Geological Survey Water-Supply Paper 576] as the outcrop of the Grenada formation [Wilcox] should be mapped as 'Undifferentiated Claiborne.'

"The facts prompting this brief notice are:

"(1) The discovery of glauconite and a marine molluscan fauna in Tallahatta-like rock in the quarry of the Monolithic Paving Company eight miles southwest of Oxford, Lafayette County. Outside of Lauderdale County, no outcrop of marine Wilcox has been reported in Mississippi, and the Lafayette County discovery, 120 miles north of the latitude of Lauderdale County, suggests a Claiborne (Tallahatta) age for the beds.

"(2) The correlation of light-gray quartzitic sandstone and claystone north of Charleston and near Enid, Tallahatchie County, with the 'Kosciusko quartzite.' During January 1940 the junior writer studied the section at Kosciusko and traced the beds northward into northern Tallahatchie and southern Panola Counties; and determined the congeneric relationship of the light-gray quartzite and claystone with the 'Enid' bond clays.

"(3) The definite identification of cuttings from 178 to 220 feet from the Charleston Oil and Gas Company's Newton No. 1 as glauconitic slightly calcareous Winona sand. The Winona sand has been positively identified in northwestern Grenada and in northwestern Yalobusha Counties, and has been questionably identified in the region between Oxford and Batesville. The westward dip of the beds, around 20 feet per mile, would put the Winona within 100 to 300 feet of the surface at any place in eastern Tallahatchie County.

"An inspection of the 1928 geologic map will show: (a) Three mappable geologic units, the Tallahatta, the Winona, and the Lisbon terminating south of the Yalobusha River, the two former units lacking outcrops on the Bluff; (b) a divergence of the strike of the Claiborne beds at this latitude from the strike of the Cretaceous and lower Eocene formations; (c) a distance of only twenty miles on the strike, running southeast from Grenada, in which both the Grenada and Tallahatta formations are present.

"The mapping of the two thousand square miles north of the Yalobusha River as Grenada formation is a natural consequence of insufficient funds with which to conduct field work. The full appreciation of the northward gradation of lithology and the understanding and interpretation of outcrops in a region thickly blanketed with alluvial and colluvial deposits can only come through detailed work.

"Deep auger holes are being bored in Tallahatchie County by the WPA-Mississippi Geological Survey's Clay and Minerals Survey in an effort to throw additional light on the geology of this region."

It is gratifying that Dr. Priddy who was later assigned to the county as the geologist in charge independently arrived at essentially the same conclusions, for the stratigraphy of Tallahatchie County had been badly confused. As early as 1891 W. J. McGee on pages 413-415 of the Twelfth Annual Report of the U. S. Geological Survey, as first pointed out by the late V. M. Foster and then by Dr. Priddy in this report, had correctly stated that: "The terrane [the 'Calcareous Claiborne' and the 'Siliceous Claiborne'] is a crescentic zone, approaching the Mississippi in southwestern Tennessee and northwestern Mississippi, curving thence southeastward across Mississippi and east-southeastward across Alabama." Despite this fact, the beds of the age of these Claiborne terranes were shown in 1905 on the Preliminary Geologic Map of the State of Mississippi by E. C. Eckel and A. F. Crider (U. S. Geological Survey Water-Supply and Irrigation Paper No. 159) as extending from the Alabama line no farther north than the Yalobusha River in Grenada County. Similarly on the Geological Map of Mississippi by E. N. Lowe in 1915 and on the U. S. Geological Survey Reconnaissance Geologic Map of Mississippi by L. W. Stephenson in 1928 the Claiborne-Tallahatta and the Claiborne-Lisbon, as such, were shown no farther north than the Yalobusha River. They were, at least in part, however, shown as the Grenada-Wilcox extending along the base of the Mississippi River Bluffs entirely across Tallahatchie County and northern counties, and along some of the major tributary valleys.

The correctness of the abrupt termination of the Claiborne beds near the Yalobusha River on the State Geologic maps was questioned by the present State Geologist in 1918; and the work of Tom McGlothlin in Montgomery County in 1932, of Glen F. Brown on the ground water resources of the "Delta," of Emil Paul Thomas (Bulletin 48, The Claiborne), and of many other Oil Geologists brought up the same question. And the investigations of Mellen in January 1940 and his successor Priddy have proved, so far as Tallahatchie County stratigraphy is concerned, the correctness of McGee's work in originally extending the Claiborne terranes entirely across Mississippi, and that the beds mapped as Grenada-Wilcox are nonexistent as such. It should be added that Dr. Priddy's later work in Montgomery County materially aided in the solution of the stratigraphy of Tallahatchie County which he was thus able to revise. Another aid in the solution of the problem was the information obtained from the large number of test holes that were bored in the county—an accessory aid not available to the older geologists.

This excellent work of Mellen and Priddy and of others, especially in Tallahatchie County, in determining the correct stratigraphy of the Claiborne series will thus be of the utmost significance in the search for oil in the State. In fact it is impossible to overemphasize the importance of these conclusions in the future investigations, not only in the exploration for oil and gas, but for any other economic mineral.

Of importance, too, is the work of McCutcheon on the well known Tallahatchie County or Enid clays of the Zilpha member of the Claiborne which he classifies as:

1. Bond Clays or Ball Clays
2. Brick and Tile Clays: Group 1, Group 2, Group 3
3. Brick and Tile Clays—Group 4
4. Miscellaneous Clays

He states that:

"The bond clays of Tallahatchie County were extensively mined during World War I for use as a refractory bond in the manufacture of glass pots and metallurgical crucibles. In later years and at the present time the clay is being marketed as an enamel clay where it serves as a suspending medium for the wet enamel batch.

"The clays have many desirable properties some of which are unexcelled by other American bond clays. They also have some undesirable properties which limit their uses."

"The fired color at elevated temperatures is the prime feature which limits the use of these clays in whiteware bodies. Considerable experimentation was conducted to beneficiate the clays by washing, removal of iron, and by neutralizing the coloring effect of iron. The results were generally negative. Washing and screening tests were of value in removing lignite, silt, marcasite, and gypsum from the lower grade clays. With the higher grade clays no improvement was observed. Since there is an abundant supply of the better grade clays, beneficiation of lower grades by washing is economically impractical. The coloring effect of iron oxide is intensified by titanium oxide. These oxides appear to be present in chemical combinations with the clay molecule and are not readily removed by leaching with acids or corrosive gases without destroying the plastic properties of the clay."

In reviewing the study of The Engineering Experiment Station at Ohio State University on domestic ball clays in ivory and earthenware bodies, which included the ball clays mined to the north of Tallahatchie County but similar to the better grade Tallahatchie County clays, McCutcheon concludes:

"The report further makes it clear that no single ball clay possesses all the desired properties. It is believed that a substantial portion of the Enid clays blended with other American ball clays would produce a pottery body superior to that produced by any single ball clay. Of the clays tested for this report samples HA, HB, HC, HD, H5 7-11, H7 4-7, H93 4-9, H126 1-4, H128 1-2, H128 3-4, and H128 5-6 are sufficiently free from contaminating impurities to be used in a blend of ball clays for production of a superior pottery body."

As in the mineral surveys of other counties in Mississippi, the survey of Tallahatchie County would not have been possible without Federal-WPA funds, in securing which the Tallahatchie officials, citizens, and individuals acted as cosponsor to the sponsor, the Mississippi State Geological Survey. To all these, and especially to Mr. Ned R. Rice, President, Tallahatchie County Bank, and Mr. P. L. Mitchell, Merchant, the Mississippi State Geological Survey wishes to express its appreciation.

Very sincerely and respectfully,

William Clifford Morse,
State Geologist and Director

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TALLAHATCHIE COUNTY MINERAL RESOURCES

GEOLOGY

RICHARD RANDALL PRIDDY, Ph.D.

INTRODUCTION

Tallahatchie County lies in northwest central Mississippi (Fig 1). It is bounded on the north by Quitman and Panola Counties, on the east by Yalobusha and Grenada Counties, on the south by Grenada and Leflore Counties, and on the west by Sunflower and Coahoma Counties. The county has an area of some 643 square miles and had a population in 1940 of 34,130.

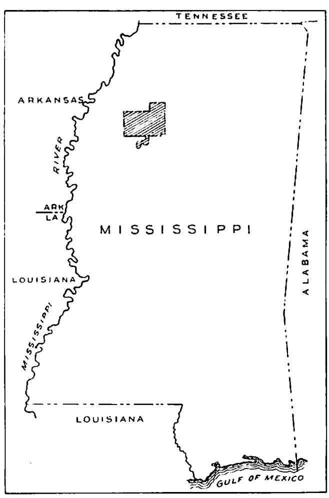

Figure 1.—Map showing the location of Tallahatchie County at the juncture of two major physiographic provinces, "the delta" and "the hills."

Charleston, one of the two county seats, is the principal town, having a population of 2,132. Next are Sumner, the other county seat, Tutwiler, Webb, Phillipp, Glendora, Vance, and Tippo, all in the delta. In the hilly eastern part of the county, the settlements referred to in this report are Enid, Cascilla, Teasdale, Crevi, Rose-bloom, Paynes, and Leverett.

PHYSIOGRAPHY

Tallahatchie County covers parts of two major physiographic provinces (Fig. 1). The western three-fourths lies within the Mississippi-Yazoo Alluvial Plain, "the delta," and the eastern one-fourth within the Thick Loess or Bluff Hill region, "the hills." Charleston is built on a terrace, near the base of a bluff which sharply separates the hills and the delta (Fig. 2). Since alluvial material covers the latter to a depth of 75 to 150 feet and bed rock crops out only in the hill region, most of the discussion which follows will deal with the hill section.

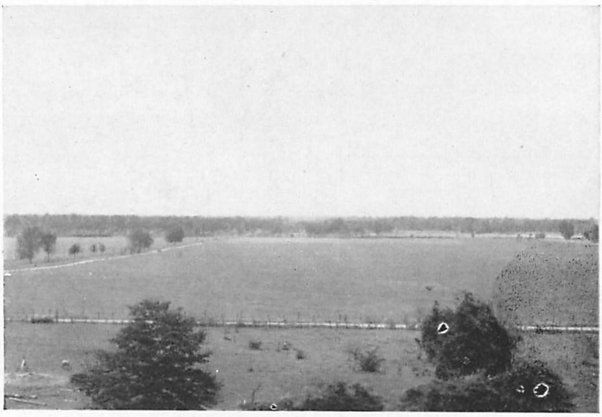

Figure 2.—View of "the delta" from "the hills" north of Charleston. September, 1940.

In contrast to the comparatively level delta, the hill section has a topographic relief of 200 feet, as shown by topographic maps of the Phillipp and Crowder quadrangles (obtainable from the Director, United States Geological Survey, Washington, D. C.). The ridges, having elevations of 300 to 400 feet above sea level (125 to 250 feet above the delta's edge), are remnants of a former land surface which was thickly mantled by bedded gravels, clays, and sands of the Citronelle formation. They are the result of greater resistance to erosion offered by the thicker gravels or semi-indurated sandstones. Conversely, the valleys of the present drainage system were formed where the capping was thinner. Most of the streams flow over debris contributed through the continuous reduction of the highlands, whereas only a few flow on strata of the Lisbon formation in which they were originally incised.

The small creeks, which drain the ridge-controlled hill section, are consequently short and meander through wide terraces. Most of them flow westerly into the delta and join the Tallahatchie River directly; a few are tributary to the Yocona River which flows westerly to the Tallahatchie, paralleling the county line to the north; and the remainder flow southerly or southeasterly to the Yalobusha River, which parallels the county line to the south and also joins the Tallahatchie River in the delta (Pl. 1). The more important west flowing creeks are, from north to south, Shelton, Buntyn, Sherman, the north and south forks of Tillatoba, Hubbard, Askalmore (called "Skullmore"), and Jackson. The larger of these have named tributaries: Mitchell, Bailey, Bellamy, and Little Creeks, which flow into the North Fork of Tillatoba; Hunter Creek which flows into the South Fork; and Askalmore which is fed by Young and Powers Creeks. Unfortunately Deese Creek is the only one of the north flowing streams named, but the southerly drainage area has two large streams, Rattlesnake and Long Creeks.

CULTURE AND INDUSTRY

Tallahatchie County is served by several highways. The partly paved Mississippi Highway 32 runs west from Oakland, western Yalobusha County, through the hills to Charleston, and into the delta to Webb. There it intersects U. S. Highway 49E which leaves Highway 49 at Tutwiler and extends south to Greenwood and Yazoo City. Numerous graveled and dirt roads traverse the delta or follow the ridge crest in the hilly eastern section.

The main line of the Illinois Central Railway System crosses the extreme northeast corner of Tallahatchie County and branches of the Yazoo and Mississippi Valley Railroad, a part of the same system, connect Charleston with towns in the delta to the south and west.

Charleston and several of the other towns have long been provided electric current by the Mississippi Power and Light Company and recently the Rural Electrification Administration has been extending service to still other towns and to some rural districts.

The chief industry of the county is the growing of cotton. However, farming is becoming more diversified with extensive rotation of grains and legumes in the delta and on the stream terraces of the hill region. Many of the hilltops and ridgetops are still timbered but the hillsides are partly cleared, affording fair grazing where gully erosion permits.

Tallahatchie County has had sporadic mining activity, which is in a measure responsible for this investigation. From 1910 to 1920, and especially during the war years, at least two thousand carloads

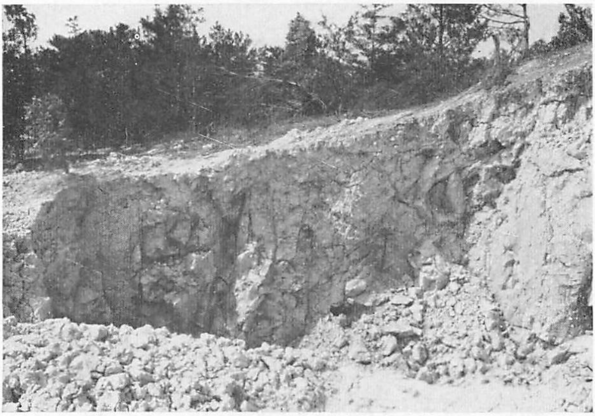

Figure 3.—A small pit in the "Enid" clay in the upper (continental) Zilpha. J. T. Bramlett estate property at Crevi, 10 miles north of Charleston. April, 1941.

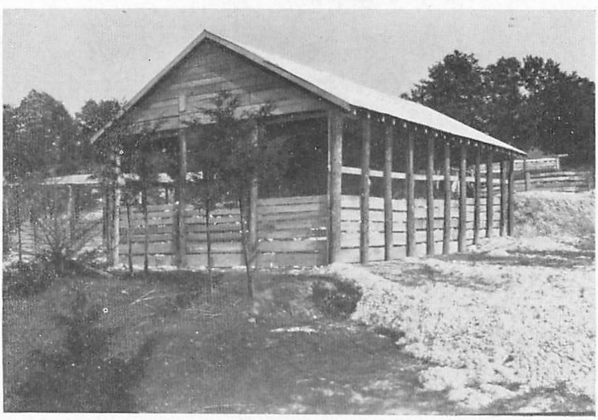

Figure 4.—Shed for drying "Enid" clay. J. T. Bramlett estate pits at Crevi, 10 miles north of Charleston. April, 1941.

of "Enid" clay were dug from the base of the bluff north of Charleston, hauled east by wagon to Enid, and shipped north on the Illinois Central Railroad. Some of these clay deposits have recently been re-opened although they are not worked on the former scale. Figures

3 and 4 show a small pit and a shed for drying the clay at the J. T. Bramlett estate workings (NE. 1/4, SW. 1/4, Sec. 3, T.26 N., R.2 E.) at Crevi, 10 miles north of Charleston. At present, the Tallahatchie Clay Company has a plant in Charleston and is collecting, testing, and marketing clays from various points in the county and from nearby counties.

Formerly, numerous gravel pits were worked in the hill section, but now only one is active, that of Fox and Guthrie, 7 miles north of Charleston, along Sherman Creek at the very base of the hills

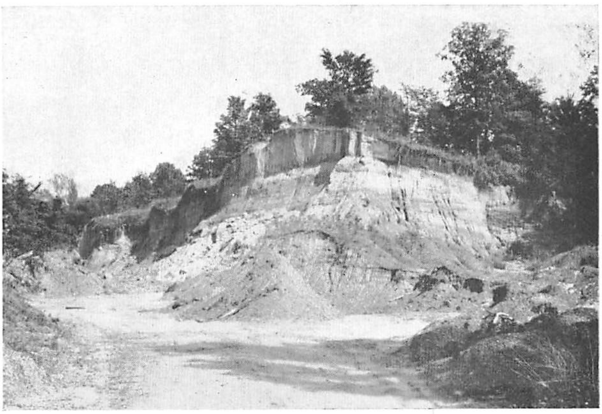

Figure 5.—Fox and Guthrie gravel pit, 7 miles north of Charleston. The face of the pit shows 38 feet of gravel overlain by 18 feet of loess. April, 1941.

(Fig. 5). Several small county or privately owned pits are located at or near the base of the bluffs where the gravel is thickest.

PREVIOUS INVESTIGATIONS

Due to the importance of the "Enid" clay, considerable sampling and testing were undertaken to determine its limits and the extent and value of other clay deposits in the hill section of Tallahatchie County. The results of some of these investigations are published in bulletins of the Mississippi and of the United States geological surveys.[1] In these reports, specific references are made to pits located at or near the base of the bluff: to the Bramlett and Mitchell pits at Crevi, 10 miles north of Charleston; to the workings of the French Clay Blending Company, 5 miles north of Charleston; to the test pits of the Southern Ball Clay Company on Shelton and Deese creeks; and to the McLendon Clay Company tests on Deese Creek, 6 miles west of Enid and 3 miles east of Crevi. In the course of the search several beds of lignite were sampled and their analyses compared with those of workable lignites from other areas.[2]

While the clay development was at its height, several investigations were conducted by local interests in an effort to find surface evidence of oil structures. As a result, from 1921 to 1934, five tests, which are referred to elsewhere in this report, were drilled in the hill section, four northeast of Charleston and the other to the south. All proved dry, although two were reported to have had encouraging shows. In 1940, three additional dry tests were drilled in the delta to the west on structures found by geophysical methods.

In dismissing the previous work in the area and before discussing present investigations, it is deemed advisable to point out that the clays and lignites do not belong to the "Grenada" formation, as cited, but belong to the Zilpha clay member, Lisbon formation, Claiborne series. In fact, it is now known that the Grenada, a supposed upper Wilcox unit, is non-existent so that the use of the term "upper Wilcox beds" is likewise in error.

STRATIGRAPHIC AND AREAL GEOLOGY

INTRODUCTORY SUMMARY

The bed rock which underlies the hill or bluff region of Tallahatchie County consists of sands, clays, shales, and quartzites of the Lisbon formation, Claiborne series, Eocene system. Lying non-conformably over this formation, at some places completely hiding it, is a thick blanket of interbedded gravels, silts, sands, and clays which probably represents the Citronelle formation of either the Pliocene or Pleistocene periods.[3] [4] Both the Lisbon and the Citronelle beds are overlain unconformably by thick silty Pleistocene loess which nearly everywhere borders the Yazoo Delta. At some places, especially near the bluff and along the larger creeks, there are several recent terrace deposits composed of reworked sands, silts, and gravels derived from the Lisbon and Citronelle beds and from the loess. The Lisbon formation alone can be subdivided, and it only on the basis of lithology. Two members of the four present in Mississippi are recognized, the Winona sand and the overlying Zilpha clay. The former, which is the lower member of the formation, consists of marine quartz sands, glauconitic sands, and claystones, and non-marine silts and clays, whereas the Zilpha is composed of basal marine beds of somewhat similar lithology overlain by lenses of freshwater clays and silts interbedded with sands, lignites, and carbonaceous clays. Thus the Tallahatchie County stratigraphic column, according to the latest classification of the Mississippi Geological Survey is as follows:

STRATIGRAPHIC COLUMN

Recent			terrace deposits
		erosional unconformity	
Pleistocene system			loess
		erosional unconformity	
Pliocene or Pleistocene system		Citronelle formation	gravel, silt, clay, silty clays
		erosional unconformity	
Eocene system	Claiborne series	Lisbon formation	Zilpha clay member Winona sand member

Previous to this report, only the gravels, the loess, and an underlying unit, the Grenada formation[5] of supposed upper Wilcox age, were recognized in Tallahatchie County. In fact, the most recent geologic map of Mississippi, 1928,[6] shows the Grenada as underlying a broad belt bordering the Yazoo Delta and extending from Grenada on the south to the Tennessee line on the north, despite the earlier observations of W. J. McGee[7] who described a "glauconitic element" curving from southwest Tennessee southeastward across Mississippi and into Alabama. This "element" is undoubtedly the Winona member of the Lisbon, for it is described as lying above the "Siliceous Claiborne and buhrstone" which is here interpreted as the Tallahatta formation.

But within the last few years, the very existence of such a unit as the Grenada has been questioned, since a study of the map shows that the Grenada belt of outcrop could logically be a continuation of the Lisbon outcrop which is shown as an even broader belt extending from the Alabama line, south of Meridian, northwest to Grenada. In fact, observations made during this field investigation, by other members of the Mississippi Geological Survey, by members of the United States Geological Survey,[8] and by petroleum geologists,[9] definitely prove that the Winona sand and the Zilpha clay crop out much farther north of Grenada, and together with the Tallahatta formation, underlie most if not all of the so-called Grenada outcrop belt. Because of the recent recognition of these Lisbon beds, care will be taken in the ensuing stratigraphic discussion to trace each unit from long known exposures south of Grenada northward into recently recognized outcrop areas in Tallahatchie County.

Usually a stratigraphic discussion is prefaced by a generalized stratigraphic column, but due to a thick mantle of loess and gravel, considerable faulting, and an unusual amount of lateral change within the Zilpha member, such a treatment is impracticable. In lieu thereof, a sample study of the upper part of the recently drilled Young-Ogilvie oil test, in the delta near Charleston, is substituted. The record satisfactorily shows the lithology of the Winona sand and the lower part of the overlying Zilpha clay:

SAMPLE STUDY OF UPPER PART OF M. R. YOUNG (ROESSER AND PENDLETON)-OGILVIE No. 1 OIL TEST (CENTER SE. 1/4, NW. 1/4, SEC. 32, T.25 N., R.2 E.), 3 MILES SOUTHWEST OF CHARLESTON

Elevation: 157 feet — Drilled: October 1940

	Feet	Feet
Alluvial material		105
Lisbon formation (Claiborne series)		180
Zilpha member	80	
105-110 Clay, slightly silty medium-gray		
110-140 Clay, slightly silty dark-chocolate-brown; micaceous laminae		
140-155 Clay, slightly silty grayish-brown; micaceous laminae		
155-175 Clay, fairly silty dark-gray lignitic		
175-180 Clay, fairly silty brownish-black		
180-185 Silt, clayey greenish-brown fairly glauconitic		
Winona member, upper division	30	
185-190 Claystone, grayish-tan fairly glauconitic; sand, glauconitic greenish-black		
190-205 Sand, silty glauconitic; silt, gray micaceous; claystone, grayish-tan fairly glauconitic		
205-215 Claystone, light-tan slightly glauconitic; silt, greenish-brown glauconitic; clay, slightly silty brownish-black		
Winona member, lower division	70	
215-225 Clay, slightly silty light-gray		
225-235 Silt, sandy greenish-brown glauconitic very micaceous		
235-240 Clay, slightly silty brownish-black carbonaceous waxy		

240-245 Silt, sandy dark-greenish-gray glauconitic; claystone, tan glauconitic
245-255 Clay, silty light-gray slightly glauconitic
255-260 Claystone, dark-brown slightly glauconitic very hard
260-270 Silt, sandy dark-greenish-black very micaceous fairly glauconitic
270-275 Clay, slightly silty light-gray
275-285 Silt, sandy dark-greenish-gray glauconitic

Tallahatta formation ....

LISBON FORMATION, CLAIBORNE SERIES

The Claiborne series is represented in Mississippi by four formations—Meridian, Tallahatta, Lisbon, and Yegua (Cockfield). Of these, only the Lisbon crops out in Tallahatchie County, although the Tallahatta is present on McSwine Creek, within a mile of the southeast corner. The outcrops of the two Lisbon units present, the Winona sand member and the Zilpha clay member, are shown on the areal map (Pl. 1).

The term Lisbon formation was first used by Smith[10] in 1907 to designate a group of beds called "Lisbon Bluff" or "Lisbon," which overlay the Tallahatta "buhrstone" of Clarke County, Alabama. In Mississippi, the Lisbon formation is recognized as having four members—Winona sand, Zilpha clay, Kosciusko sand, and Wautubee marl. The latter, which appears to be the lithologic and faunal equivalent of the Lisbon of Alabama,[11] is not known to crop out northwest of Newton County.

The lower members of the Lisbon under consideration, Winona and Zilpha, form a broad belt of outcrop extending from Clarke County, on the Alabama line, northwest at least as far as Batesville, Panola County, 35 miles farther north than Grenada, where the unit was formerly believed to terminate. Tallahatchie County lies within this northern extension of the outcrop belt, in an area formerly mapped as the Grenada formation, as remarked above.

WINONA SAND MEMBER—GENERAL

In 1919 Lowe[12] gave the name Winona to a "highly ferruginous, bright red, glauconitic sand" which crops out in the vicinity of Winona, Montgomery County. He recognized its stratigraphic position above the Tallahatta "buhrstones" and beneath the Kosciusko quartzites and wisely suggested that it be considered the basal member of the Lisbon formation. However, it is now evident that the thickness of 350 feet which Lowe assigned to it is far too great, and that he was combining the lower Kosciusko sands with the Winona sand, failing to recognize the importance of the Zilpha clay which he saw in the vicinity of Winona[13] but which he evidently considered an insignificant bed in a great thickness of sand. Actually, the sand has a thickness of only 70 or 80 feet at Winona,[14] having thickened from 32 feet in southwest Lauderdale County[15] to 50 or 60 feet in Newton County.[16] The thickness of the outcrop in Tallahatchie County cannot be directly determined because of the loess and gravel mantle, but studies of water well logs and cuttings from oil tests show subsurface thicknesses of 100 feet near Charleston, 100 feet in the southeast corner of the county, 110 feet near Phillipp in the south part, and 185 feet near the Sunflower County line.

Just as the Winona member thickens northward along the belt of outcrop and down-dip to the west, the lithology undergoes a marked change. At the type locality, recent studies[17] show that the Winona sand is readily divided into three portions: (1) a basal, non-glauconitic non-fossiliferous iron-stained quartz sand containing thin discontinuous clay lenses, having a thickness of 20 feet; (2) a middle, slightly glauconitic sparingly fossiliferous ferruginous quartz sand about 30 to 40 feet in thickness; and (3) an upper, very glauconitic fairly fossiliferous very ferruginous quartz sand about 20 feet in thickness which contains numerous small claystone nodules. The glauconitic weathers easily, stains the whole unit a brick red, and produces abundant limonite for cementing the sand into numerous rough, warty sandstone ledges which characterize the upper part. Similarly, the claystone weathers to a plastic clay and provides sufficient bonding material to support nearly vertical walls of sand.

In contrast to the sand at the type locality, the Winona sand of Tallahatchie County has a more varied lithology and is not known to contain fossils. At the only known outcrop, in the southeast corner of the county, the lower part of the sand looks much the same as lower beds of the upper division of the unit near Winona. But here the similarity ends, for there are, in addition to thick quartz sands, distinct beds of clay and silt, and an even higher content of glauconite and claystone, especially in the upper part.

Because of the segregation of most of the glauconite and claystone, the Winona sand of Tallahatchie County is divided into an upper and lower part. The division is well shown in the sample log of the Young-Ogilvie well near Charleston, reproduced above. There, the thickness of the lower and upper divisions are 70 and 30 feet respectively. The thickness of the upper part seems to be nearly uniform, but that of the lower portion is greater in well logs down-dip to the southwest and on the outcrop in northwest Yalobusha County.

WINONA MEMBER—LOWER DIVISION

The lower division of the Winona sand consists of quartz sand, glauconitic silts, carbonaceous clays, and glauconitic claystones, named in the order of their abundance. Unweathered samples, such as those taken from test holes, show the sand to be fine-grained to medium-grained and greenish buff to buff in color; the glauconitic silts, greenish brown to greenish black; the carbonaceous clays, brown to black; and the glauconitic claystones, buff or tan. One-fourth mile east of the southeast corner of Tallahatchie County, in Grenada County, bluffs along McSwine Creek show the lower Winona sand resting with conformity on greenish-black carbonaceous sands of the Tallahatta formation. The following is a section of this exposure, adapted from pages 10 and 11, Mississippi Geological Society manual for Claiborne-Wilcox field trip, March 9-10, 1940:

EXPOSURE IN BLUFF ON MCSWINE CREEK (SW. 1/4, SEC. 30, T.23 N., R.4 E.) ABOUT 8 MILES NORTHWEST OF THE TOWN OF GRENADA

	Feet	Feet
7. Loess and soil to top of bluff		10.0
Winona sand, Lower division		37.2
6. Sand, clayey brick-red slightly glauconitic; thin seams of limonite	5.0	
5. Clay, silty gray-tan thinly laminated	1.0	
4. Sandstone, fine-grained yellow-brown very limonitic	0.7	
3. Sand, fine-grained to medium-grained gray-brown to yellow-brown; clay partings; glauconitic near base	27.5	
2. Sand, fine-grained to medium-grained semi-indurated greenish-brown; stringers of dark carbonaceous clay	3.0	
Tallahatta formation		11.3
1. Sand, medium-grained very compact greenish-black slightly glauconitic; small carbonaceous clay inclusions	11.3	
At the west end of this bluff, a black carbonaceous shaly clay lenses in at the top of bed 1.		

A mile to the northwest, in a roadcut (NW. 1/4, SW. 1/4, SE. 1/4, Sec. 24, T.23 N., R.3 E.), just west of the bridge over the same creek, is the only good exposure of lower Winona sand in Tallahatchie

County (Pl. 1). The section, which totals 29 feet, begins approximately at the top of the McSwine bluff outcrops described above. The sands and clays are deeply weathered. Most of the glauconite is altered to limonite, which has stained the whole red or brown and has provided the cementing material for warty sandstone ledges and for hollow cylindrical sandstone concretions, as shown in the following section:

SECTION OF LOWER WINONA SAND IN ROADCUT, WEST VALLEY WALL OF McSWINE CREEK

	Feet	Feet
Soil reddish-brown silty clay		4.1
Winona member, lower portion		29.0
7. Sand, brick-red clayey	5.2	
6. Sandstone, brownish-red coarse limonitic; contains glauconite on fresh fracture	0.8	
5. Sand, brick-red coarse; contains numerous hollow cylindrical coarse-grained sandstone concretions lying at nearly all angles and varying from 0.1 to 0.6 foot in diameter and from 0.5 to 3.0 feet in length	7.3	
4. Clay, reddish-brown silty	3.4	
3. Silt, reddish-brown clayey	2.9	
2. Sand, brick-red grit-bearing ferruginous, glauconitic	7.3	
1. Clay, reddish-brown silty	2.1	

Still higher beds of the lower division of the Winona sand crop out in west Yalobusha County A sharp roadcut (NE. 1/4, NW. 1/4, Sec. 8, T.24 N., R.4 E.) on U. S. Highway 51, one mile south of Tillatoba and a mile east of the Tallahatchie line, shows 7.9 feet of glauconitic sand overlain by pipe-like ferruginous sand concretions and gravelly Citronelle sandstone (Fig. 6). Test H116, drilled to a depth of 20.9 feet at the base of this cut, shows medium-grained non-glauconitic greenish-buff sand. The records of this test and of other test holes mentioned in further discussions are grouped in a latter part of this report, under the title "Test Hole Records."

On the outcrop, in northwest Yalobusha County, the same non-glauconitic sands are much thicker. Measurements, along road cuts and on steep hillsides in Sections 21, 23, and 24, T.11 S., R.6 W., show thicknesses in excess of 60 feet, indicating either a thickening of the whole Winona unit or a thickening of the lower part at the expense of the very glauconitic upper division.

Figure 6.—Glauconitic Winona sand overlain by Citronelle sandstone in road cut, United States Highway 51, Yalobusha County. August, 1940.

WINONA MEMBER—UPPER DIVISION

The upper division of the Winona sand is strikingly similar to the upper part of the unit at the type locality in Montgomery County, much more so than is the lower part. Unfortunately, due to faulting, the upper Winona does not crop out in the county but is well exposed within short distances of the line in Grenada County to the south. However, because it is near the surface in some areas, and because its top is a good datum for mapping subsurface structure, the upper Winona became the object of much test hole drilling, especially in the area comprising the northeast part of T.24 N., R.3 E., and the southeast portion of T.25 N., R.3 E.

By comparing the information obtained from these test holes with the Grenada County exposures and with water well and oil test records, the upper part of the Winona sand was determined to be 25 to 40 feet thick. Its thickness in the Young-Ogilvie test is 30 feet. The division consists, in the order of abundance, of glauconitic silty sands, layers of glauconitic claystone nodules, and thin beds of brown slightly silty clay. In the upper part of the division, the glauconite is very abundant but decreases with depth and is partly replaced by the clays. In contrast, the claystones increase toward the top where they produce prominent though discontinuous layers. Individual nodules vary in size and shape—from 0.1 to 1.5 feet across and from nearly perfect spheres to flattened knobby masses of intergrown spheres. This distinct lithology can be seen to best advantage in adjacent Grenada County, in cut banks (N. 1/2, Sec. 3, T.22 N., R.3 E.) of Long Creek about one-fourth mile southeast of the Tallahatchie County line. Here, at low water, from 5 to 10 feet of gently west-dipping beds show slightly weathered dark glauconitic silty sand and several discontinuous ledges of limonite-coated knobby claystone nodules (Fig. 7).

Figure 7.—Contact of Winona sand and Zilpha clay. Long Creek, Grenada County. August, 1940.

Conformably overlying the uppermost layer of nodular claystones, are dark clays and glauconitic silts of the lower (marine) division of the Zilpha member. Several test holes, starting at this contact, had to be abandoned because impenetrable claystone layers were encountered before the full thickness of the upper Winona division was measured, as in H70 which is the deepest of these tests.

WINONA-ZILPHA CONTACT

There are several other exposures of the upper Winona sand and of beds of the overlying Zilpha member in Grenada County within a few miles of the Tallahatchie County line, but none in the county itself. Thus on a small unnamed creek, tributary to the Yalobusha River, cut banks (SE. 1/4, SE. 1/4, SE. 1/4, Sec. 5, T.22 N., R.3 E.) show approximately 40 feet of strata—30 feet of Winona sand overlain conformably by Zilpha beds. However, the bluffs of Long Creek expose the best contact as shown by the following record, which is a composite of sections measured where the bluff is accessible and of test holes drilled where the overhang prevented measuring. This bluff overlies Test H70, the log of which is cited above.

COMPOSITE RECORD OF MEASURED SECTION AND TEST HOLES, BLUFF OF LONG CREEK, GRENADA COUNTY ON THE MRS. ESTES CALHOUN PROPERTY

	Feet	Feet
Above Test H70		
13. Soil and loess, buff to brown		15.1
Citronelle formation		7.1
12. Silt, very sandy very light-gray; large white chert pebbles	2.4	
11. Silt, sandy brownish-yellow; small chert pebbles	3.7	
10. Silt, clayey buff to yellow	1.0	
Zilpha, Upper (continental)		7.3
9. Silt, clayey light grayish-tan; conchoidal fracture	3.8	
8. Clay, slightly silty chocolate-brown carbonaceous; thin partings of gray lignitic, micaceous silt	2.1	
7. Clay, brownish-black carbonaceous; weathering tan; thin partings of gray lignitic, micaceous silt	1.4	
Zilpha, Lower (marine)		15.8
6. Clay, silty grayish-black thinly laminated; numerous glauconitic sandy nodules	1.1	
5. Laminated clay and silty clay; clay is chocolate brown weathering grayish brown; silty clay is dark gray weathering light gray	4.9	
4. Clay, fairly silty, dark grayish-brown; drying grayish tan; conchoidal fracture; gypsum filled cracks	1.6	
3. Laminated silty clay and sand, greenish-black to greenish-gray fairly glauconitic, very micaceous, pyritiferous; pyrite weathered to melanterite; small nodules of buff non-glauconitic claystone	5.2	
2. Laminated clay and silty clay, dark greenish-black to dark-gray; pyrite altering to melanterite	3.0	
Winona sand member—Top of Test H70		10.2
1. Sand, fine-grained to silty brownish-green to dark greenish-gray very glauconitic, fairly micaceous; several distinct layers of very large glauconitic claystone nodules	10.2	

As seen from this record, the lower part of the Zilpha member contains fairly glauconitic silts, glauconitic sandy silts, and beds of carbonaceous clays similar to those in the upper Winona, as shown in the record of Test H70. Although the lithology suggests a continuation of Winona conditions of deposition, the abundance of large glauconitic claystone nodules bedded in unusually glauconitic sands, as in Sample 13 of the above record, clearly distinguish the top of the Winona sand from the overlying less glauconitic lower (marine) Zilpha beds which contain but few claystones.

This contact is also well illustrated in the records of H80 (NE. 1/4, SE. 1/4, NE. 1/4, Sec. 10, T.24 N., R.3 E.) and H85 (NW. 1/4, SE. 1/4, NE. 1/4, Sec. 35, T.25 N., R.3 E.), both of which were drilled in the area cited as having the Winona comparatively near the surface

ZILPHA CLAY MEMBER—GENERAL

These lower marine beds and the overlying continental strata, the base of which is represented by beds 7, 8, and 9 of the foregoing section, bear some resemblance to the much thinner Zilpha of Montgomery and Carroll Counties, a few miles north of Zilpha Creek in northwest Attala County, whence the member was named by Raymond Moore,[18] formerly of the Arkansas Fuel Oil Company.

Recent studies in Montgomery County[19] show that the Zilpha clay member can be divided into two parts: a lower (marine) fairly glauconitic clay, 1 to 2 feet in thickness, containing small claystone nodules; and an upper (continental) well bedded tan to chocolate-brown carbonaceous slightly silty clay having a maximum thickness of 28 feet. Whereas the beds of the lower division weather to a reddish-brown sandy clay, the clays of the upper division, which locally contain plant impressions, bleach gray white and develop a blocky fracture. Although the Zilpha appears to rest conformably on the upper Winona glauconitic sands and ferruginous sandstones in Montgomery County, the contact with the overlying Kosciusko sand is distinctly non-conformable, resulting in a great variation in the thickness of the member. In all exposures noted in Carroll and Montgomery Counties, this contact is marked by one or more layers of yellowish-brown hard and brittle siltstone which probably represents deposition at the close of a period of erosion which was sufficient in length to have removed the upper part of the Zilpha at some places and to have completely eroded it at others.

In Tallahatchie County, both the lower (marine) and the upper (continental) divisions are recognized, although their lithology is much more varied.

ZILPHA MEMBER—LOWER DIVISION

The lower Zilpha crops out in small areas in extreme east Tallahatchie County, on hillsides in adjoining parts of Sections 35 and 36, T.25 N., R.3 E. and in stream banks in Sections 3, 10, and 11, T.24 N., R.3 E. At these places, as at the Grenada County localities cited in the discussion of the Winona-Zilpha contact, the division consists of thinly laminated tan-colored clays or silty clays, interbedded with glauconitic silts and sands or with grayish-black clayey silts. The contact with the overlying non-marine beds is at most places marked by a thin shelly layer of yellowish-brown limonitic siltstone, as shown in the record of Test H80. Similar slightly glauconitic silts and silty sands were found at a depth of 99 feet in Test H2 (N. 1/2, NE. 1/4, SW. 1/4, Sec. 3, T.26 N., R.2 E.); at 118 feet in H123 (SE. 1/4, NE. 1/4, NW. 1/4, Sec. 33, T.26 N., R.3 E.), and at 100 feet in H10 (NW. 1/4, SW. 1/4, SE. 1/4, Sec. 36, T.24 N., R.2 E.). Likewise, the samples from 175 to 185 feet of the Young-Ogilvie test, drilled in the delta a few miles west of the hill bluff, belong to the lower (marine) division of the Zilpha.

ZILPHA MEMBER—UPPER DIVISION

In contrast to the thinly laminated somewhat glauconitic silty sands and clays of the lower division, the beds of the upper division of the Zilpha clay are more massive, are non-marine, and have a more varied lithology. The probable maximum thickness is 275 feet. In places this division contains a single bed of greenish-gray to dark-gray lignitic clay and silt 150 or more feet in thickness, but at other localities the silts and clays contain, at various horizons, lenses of plastic clay, silty sand, coarse sand, beds of lignite or reworked lignite, and thin fine-grained quartzites. The whole is so cross-bedded and so complicated by faulting that it is impossible to submit a generalized column for this upper division; consequently, cross-section diagrams are relied on to present local variations in both the northern and southern parts of the hill area (Figs. 8 and 9 respectively).

These diagrams are based on data of a number of test holes and of a few water wells, surface outcrops being inadequate. They represent simplified west-east cross-section profiles in which little attempt has been made to align the test holes (Inset maps). The horizontal scale is, consequently, distorted, but not nearly as much as would be the case had a greater number of tests been used. In contrast, the relative thickness of beds in adjacent tests is proportional.

A study of the figures, coupled with a close investigation of the test hole records, shows that the upper Zilpha beds are continental deposits. Evidence is based on the absence of glauconite and marine fossils and on the abundance of plant leaf impressions, large fragments of lignitized wood, and beds of pure lignite. Whereas the bedded lignite points toward accumulation in a swampy environment, the rest of the sediments, toward deposition in water, most probably in constantly shifting small and shallow basins. The shifting is indicated by the lens-shape of some of the beds; the smallness, by the extreme lithologic changes in short lateral distances; and the shallowness, by abundant cross-bedding, apparent beach or bar deposits of well-sorted coarse-grained quartz sand, and root-marked fine-grained quartzites. Subsidence and more shifting are indicated by the erosion of some of the bedded lignite and by subsequent re-deposition nearby as re-worked lignite and as carbonaceous clays. These clays and those of the nearly white plastic variety are thought to have been deposited in quiet or deeper waters than the silts and silty clays which are highly cross-bedded and contain large fragments of lignitized wood. This contrast leads to the supposition that much of the Zilpha may have been deposited as fluviatile material, the silt and silty clay in the currents of distributaries and the clay in the quieter deeper lagoons between the distributaries.

In point of abundance, the types of sediments of the upper Zilpha are: (1) silts, silty clays, and silty sands of the distributary type; (2) light-colored clays of the lagoonal type; (3) brownish-black carbonaceous clays; (4) coarse-grained sands, presumably laid down as beach deposits; (5) bedded lignites; (6) re-worked lignites; and (7) fine-grained quartzites. In the following discussion of the beds of the upper division, the various types will be treated in the above order.

DISTRIBUTARY TYPE SEDIMENTS

The distributary type silts (and enclosed lenses of silty clays and silty sands) are most prevalent near the base of the upper division (Figs. 8 and 9). In some areas they are separated from strata of the lower (marine) division by thin beds of carbonaceous clay, light-colored clay, lignite, or sand; and in a few areas they occupy a position higher in the section, above the coarse-grained sand lenses indicated in the diagrams. Although the silts are recognized in over half the 128 hand-auger holes in the hill region, they

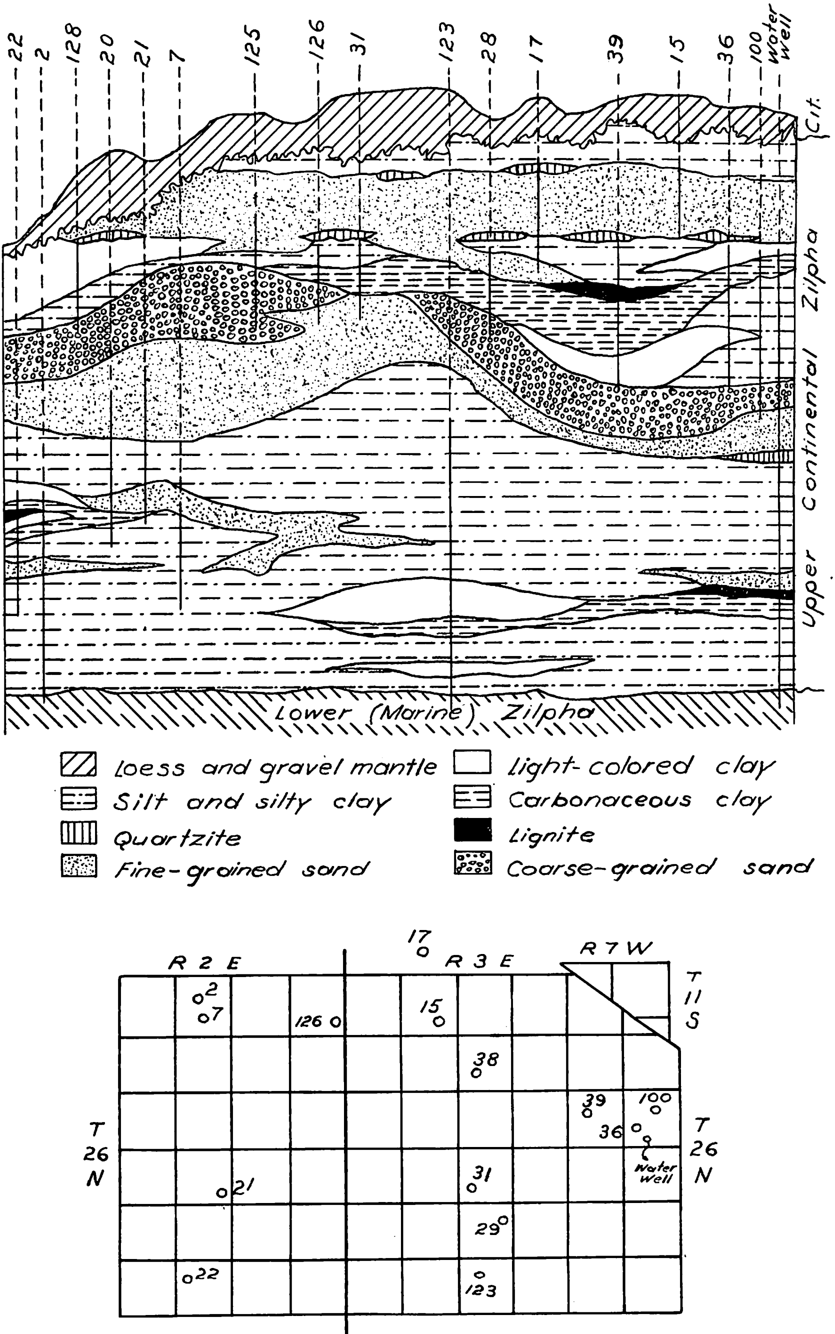

Figure 8.—Generalized east-west cross-section of upper (continental) Zilpha beds in northeast Tallahatchie County.

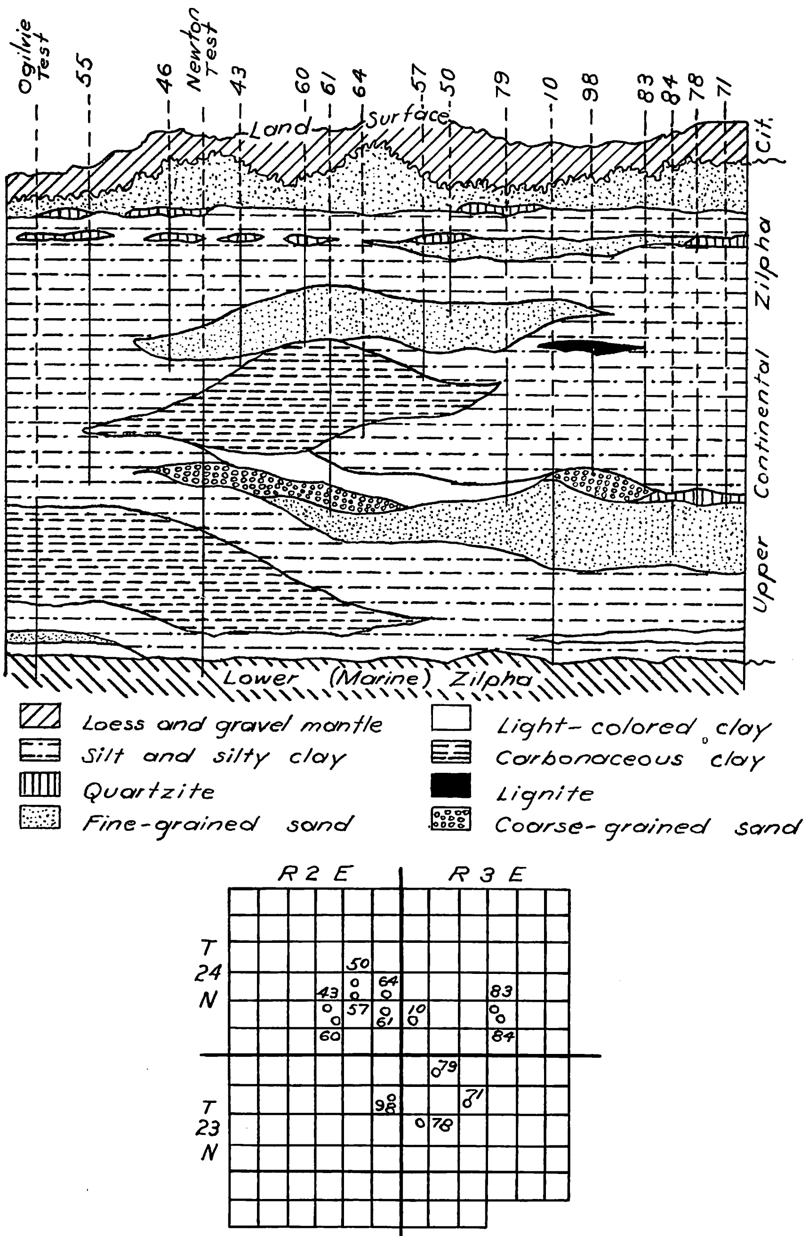

Figure 9.—Generalized east-west cross-section of upper (continental) Zilpha beds in southeast Tallahatchie County. (Test hole 10 should be in NW. 1/4, SW. 1/4, SE. 1/4, Sec. 36, T.24 N., R.2 E.).

are thickest in the following areas: (1) in the drainage area of the North Fork of Tillatoba Creek, northeast of Charleston; (2) at or near the base of the loess bluff from Charleston south to Paynes; (3) along the banks of Young Creek from near Paynes southeast to Cascilla; (4) in the extreme northeast corner of the county, in the vicinity of Enid; and (5) at or near the base of the loess bluff from Charleston north to the Panola County line (Pl. 1).

In the first named area, Test H123 (SE. 1/4, NE. 1/4, NW. 1/4, Sec. 33, T.26 N., R.3 E.), drilled at the south end of a cut bank on an unnamed creek, penetrated 107.6 feet of greenish-gray clayey silt

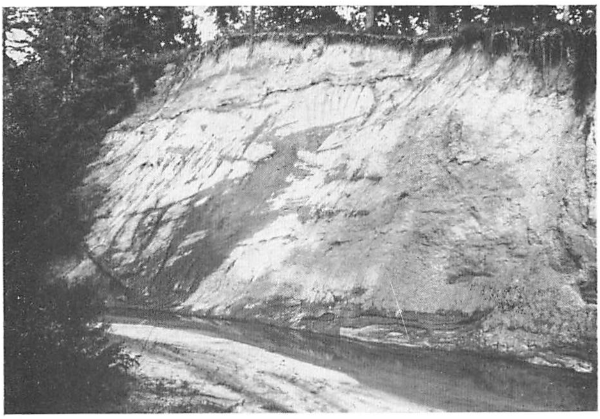

Figure 10.—Upper Zilpha Clayey silts overlain unconformably by Citronelle gravel. Here, test hole H123 was drilled to a depth of 120.5 feet. September, 1940.

containing large fragments of lignitized wood, like the 12 feet of material exposed in the bluff above the test (Fig. 10).

Similarly, in the second area, a water well recently drilled at Camp Tallaha (NE. 1/4, NW. 1/4, Sec. 11, T.24 N., R.2 E.) encountered 140 feet of upper Zilpha beds, the upper 110 feet of which were greenish-gray silts and clayey silts containing lignitized wood. At the base of the bluff, for several miles to the south and to the north of the camp, hand-auger tests 60 to 75 feet in depth failed to pass through the silt. However, 5 miles south-southeast of Paynes, in a ravine south of Stonefield Church (SW. 1/4, SE. 1/4, Sec. 13, T.23 N., R.2 E.), several tests, started beneath a bed of lignite, penetrated but 50 feet of greenish-gray silt and silty clay before encountering coarse beach sand (Test H98). In contrast, 3 miles due north, a section of similar strata 80 feet in thickness was measured in Tests H10 and H11, which were drilled at the base of a cut bank (SW. 1/4, SE. 1/4, Sec. 36, T.24 N., R.2 E.) of Young Creek in an effort to ascertain whether apparent dips were actual or were merely cross-bedding.

In the Enid area, the silty beds have a position near the top of the Zilpha section. Test H100 (S. 1/2, SW. 1/4, NE. 1/4, Sec. 13, T.26 N., R.3 E.), drilled half a mile northeast of Enid, encountered 31.4 feet of the silty material enclosing elongated cylindrical bodies

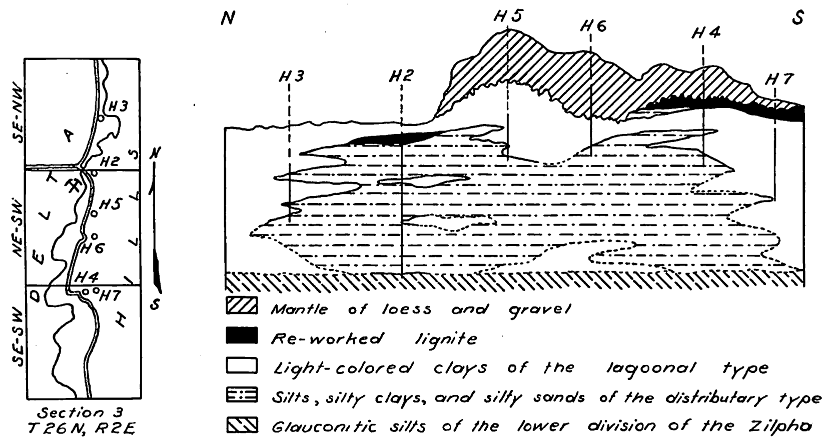

Figure 11.—Interfingering of clays and silts in the Crevi area, 10 miles north of Charleston.

of lignitic clayey silt near the base. However, in Test H36, at the Gaines cotton gin in Enid, the silty zone is split by a lens of carbonaceous clay extending from the west.

In the last named area, north of Charleston, samples from 11 deep tests show that beds of greenish-gray silt of various thicknesses interfinger with light-colored clays of the lagoonal type, with tan to brown carbonaceous clays, and with beds of lignite or re-worked lignite. This condition is especially noticeable at Crevi, at the base of the bluff, 10 miles north of Charleston, where the lagoonal light-colored "Enid" clays have been mined. To test these clays, all of which are in Section 3, T.26 N., R.2 E., Tests 2 to 7, inclusive, were drilled in a general north-south line at or near the base of the bluff. The accompanying cross-section (Fig. 11) shows the lateral variation and alternate lithology discovered in the test holes and produced, it is believed, by continuous deposition in constantly shifting lagoonal and distributary environments. In Tests H3 and H7 the typical lagoonal clays are thickest, while in Test H2 the distributary silts predominate. Figure 12 shows a roadside exposure of the "Enid" clay above Test H3 at Crevi, overlain by re-worked lignite.

Figure 12.—Exposure of upper (continental) Zilpha clay in the base of the bluff at Crevi. A thin bed of re-worked lignite, part of which has slipped down—the lower left of the picture. August, 1940.

LAGOONAL TYPE SEDIMENTS

These light-colored lagoonal clays are the second most abundant type of sediment of the upper (continental) Zilpha, for in addition to the outcrops of the Crevi area, they are exposed at several other localities in the north part of the hill section. Outcrops have been tested by Holes H125, H126, H127, H128, H31, and H24, drilled respectively along Buntyn Creek (NE. 1/4, Sec. 14, T.26 N., R.2 E.); on Deese Creek and its tributaries (SE. 1/4, Sec. 1, T.26 N., R.2 E., and SW. 1/4, Sec. 6, T.26 N., R.3 E.); along the creeks in the southwest part of Section 8, T.26 N., R.3 E.; along a small creek in the southwest part of Section 21, T.26 N., R.3 E.; and along Mitchell Creek (on the common line of Sections 1 and 2, T.25 N., R.2 E.). Many of these exposures are apparently those cited in the discussion of previous investigations.

Whereas most of the lagoonal clays contain no impurities other than small amounts of silt, some locally contain marcasite, kaolinitic clay, gypsum, and pockets of well-sorted medium-grained or coarse-grained sand. Although the marcasite, which had hiterto been called pyrite, is also a sulphide of iron, FeS_2, it belongs to the orthorhombic system whereas pyrite belongs to the isometric system. The marcasite is found in the clays as flattened concretions or as thin vertical columns. Although the concretions are common in sediments, the columns are rather rare. The columns are jointed, and the branching near the top suggests that they may represent a replacement of plants by percolating ground water after the plants were covered by sediments. The kaolinitic clays, which are usually white and in thin beds of limited extent, evidently represent re-deposition of nearby strata which originally marked erosional unconformities, since it is doubtful that the kaolinite could have been transported directly from an igneous or metamorphic mass whose decomposition was responsible for its formation. Likewise, the presence of the gypsum (variety selenite) which fills joint cracks in the clays of the Crevi area is not easily explained since the clays themselves are non-calcareous and, therefore, could not provide the lime necessary for concentration by ground waters. Similarly, it is unlikely that rising ground waters could have been responsible for the selenite since the only source of lime would have been the upper slightly marly beds of the Winona member which, however, on the outcrop in nearby Grenada County do not contain much lime. The explanation of the gypsum, therefore, must lie in its concentration by downward percolating waters, the waters having derived their lime content from the overlying somewhat calcareous loess. In support of this contention, the greater abundance of selenite is found in joint cracks near the present surface of the clays, especially where they are directly overlain by loess and exposed to alternate wetting by rains and cracking by the sun. Another feature which presents a problem, and for which no solution can be easily found, is the existence of "nests" of white or gray coarse-grained sand in otherwise pure clay. As observed in the Crevi area, the deposits are oblong or crescentic in shape, are notably thicker off their centers, and have long axes of 5 to 12 inches and thicknesses of 2 to 8 inches. Although probably contorted subsequent to deposition, their shapes suggest accumulation as small and widely separated masses of water-transported sand, deposited in the lee of vegetation during intense storms which washed away and redeposited sand bars.

CARBONACEOUS CLAYS

The carbonaceous clays are third in point of abundance of the several types of sediments which comprise the upper (continental)

Zilpha of Tallahatchie County. At places the clays are brownish black and very waxy, whereas at other localities they are gray tan or gray and contain variable amounts of silt. The impressions of leaves are abundant wherever the waxy clays are thinly laminated, but few prints are found where the clay is thickly bedded. Similarly, wherever the waxy clays are thinly laminated they are dry, for they do not slough away even when fragments torn from outcrops are washed into streambeds. An example of this unusual resistivity to water is recorded in Test H61 which was drilled 1 1/2 miles east of Paynes on the bank of Young Creek, within 15 feet of the water's edge. This hole was dry through the full thickness of the waxy clay and encountered water only when a bright yellow silty clay was reached. The waxy clays weather gray tan and eventually bleach gray except where they are covered by water as at the site of Test H100, a mile northeast of Enid. In fact, the thick clays of the Young Creek area would not have been recognized had not a summer downpour washed fresh blocky fragments down the creek.

Although thin beds of carbonaceous clays crop out at several points in the hill section and at a few places at or near the bluff south of Charleston, thick sections are rare. In the Askalmore Creek-Young Creek area, a combined thickness of 48.2 feet of non-waxy slightly silty carbonaceous clay was encountered in Tests H58 and H59, along the south bank of Askalmore Creek just west of Gentry Ford bridge (E. 1/2, NE. 1/4, SW. 1/4, Sec. 29, T.24 N., R.3 E.). Two and one-half miles to the west, in Test H61 on the west bank of Young Creek and H68 on the east bank (both in NW. 1/4, Sec. 36, T.24 N., R.2 E.), the brownish-black waxy clay measures 43.9 feet and 36.2 feet, respectively. Although several other tests were drilled in the same area, the full thickness could not be ascertained, since all of them were started beneath the contact with the overlying sediments. To the southwest, just north of Leverett, an outcrop in a small stream at the side of an abandoned road (S. 1/2, NW. 1/4, SW. 1/4, Sec. 2, T.23 N., R.2 E.) shows several feet of waxy brownish-black carbonaceous clay. Test H114 at this point passed through 19 feet of the clay which directly overlies coarse-grained white sand. This locality and the site of Test H100 previously mentioned are the best for collecting leaves. At H100, a cut bank one mile downstream from (northeast of) Enid (S. 1/2, SW. 1/4, NE. 1/4, Sec. 13, T.26 N., R.3 E.) exposes several feet of bright-yellow ochreous clay overlying the carbonaceous clay. Here an interval of 12.9 feet of brownish-black waxy clay is underlain by gray-tan slightly silty clay. At Enid a silty phase of the carbonaceous clay was noted in the drilling of Test H36 (NW. 1/4, SW. 1/4, SW. 1/4, Sec. 13, T.26 N., R.3 E.) and again in Test H39 (SE. 1/4, SE. 1/4, NW. 1/4, Sec. 14, T.26 N., R.3 E.), three-quarters of a mile west of Enid.

A study of the diagram of the north part of the hill section (Fig. 8) shows that this thick waxy carbonaceous clay is actually a single lens near the top of the upper Zilpha. However, in the south part there are two lenses, one in the mid-portion of the Zilpha and the other near its base (Fig. 9). The lower of these is shown in the sample study of the Young-Ogilvie oil test previously recorded, and in the driller's log of the Charleston Oil and Gas Company—Newton test (SW. 1/4, Sec. 36, T.24 N., R.2 E.). In contrast to the thick beds, the thinner carbonaceous clays are less waxy and lighter in color. They are encountered in the lower parts of Holes H2, H10, H31, and H123 and in the upper parts of H59 and H36, all of which have been previously cited.

COARSE-GRAINED SAND

Lenses of coarse-grained sands of the upper (continental) Zilpha are interbedded with, or overlie, fine-grained sands in both the north and south portions of the hill section. However, few outcrops are recognized with certainty, for these sands are easily confused with recent terrace sands which are of considerable thickness at several places along the bluff north of Charleston and along the south valley wall of Askalmore Creek southeast of Paynes. At these places land slips and roadcut exposures show a maximum of 30 feet of coarse-grained gray-white fairly micaceous sand. At several points (SE. 1/4, Sec. 26, T.24 N., R.2 E.), just east of Askalmore Creek bridge and half a mile south of Paynes, recent landslips at the roadside expose nearly vertical badly weathered beds of brown carbonaceous silt overlying coarse-grained gray-white sand. This contact of sand and overlying clay, which closely resembles that in Test H114 north of Leverett, is in the only unquestionable exposure of the coarse-grained sand in the south part of the hill section.

In the north portion of the hill section are two thick lenses of coarse-grained sand: one, a little above the middle of the Zilpha member in the Deese Creek area, a short distance north of Teasdale (H125, SE. 1/4, SW. 1/4, SW. 1/4, Sec. 8, T.26 N., R.3 E.); the other, in the mid-portion of the Zilpha in the Enid area, beneath a lens of carbonaceous clay (H39, SE. 1/4, SE. 1/4, NW. 1/4, Sec. 14, T.26 N., R.3 E.). In contrast, in the south part of the hill section, the coarse-grained sands have a position in the lower one-third of the continental Zilpha. In Test H114, near Leverett, the sand immediately underlies the upper lens of carbonaceous clay, but in Test H68 (N. 1/2, NE. 1/4, NW. 1/4, Sec. 36, T.24 N., R.2 E.), 2 1/2 miles to the northeast, it is separated from the carbonaceous clay by a greenish-gray silty clay. But 3 miles southeast of Leverett, the coarse sand underlies 10 feet of silty to fine-grained sand which is in turn overlain by 45 feet of silts of the distributary type (H96 and H97, SE. 1/4, Sec. 13, T.23 N.,

Figure 13.—Cross-bedded fine-grained sands in the lower part of the continental Zilpha. South bank of Rattlesnake Creek, 2 miles south of Cascilla. September, 1940.

R.2 E. and H98, NW. 1/4, Sec. 12, T.23 N., R.2 E.). The overlying sands in H98 are highly colored, similar to the much thicker sands in Test H84 (NW. 1/4, NW. 1/4, NE. 1/4, Sec. 2, T.24 N., R.3 E.) 11 miles to the northeast. They presumably overlie a coarse-grained lens or constitute a part of it. The same sands are exposed along high bluffs on the south bank of Rattlesnake Creek (Fig. 13) 2 miles south of Cascilla, where several tests were drilled to provide the composite test record H91 (SW. 1/4, SW. 1/4, NE. 1/4, Sec. 29, T.23 N., R.3 E.). Although most of the 54.8-foot interval of sand is fine-grained, a similar section 2 1/2 miles to the southeast in adjacent Grenada County contains thin beds of very coarse sand. Here (Center, NW. 1/4, NW. 1/4, Sec. 3, T.22 N., R.3 E.), a few hundred feet upstream from the juncture of Rattlesnake Creek with Long Creek, tests on the high bluffs on the south bank and at their bases showed a total of 57 feet of sand overlying 33 feet of silt, which in turn overlies the lower (marine) Zilpha.

LIGNITE

Lignite is of much less abundance than the silts, the lagoonal clays, the carbonaceous clays, and the sands of the upper (continental) Zilpha. It was discovered on the outcrop and in the test holes in both the north and south portions of the hill sections, although it is most prevalent in the upper beds of the Zilpha at or near the base of the bluff north of Charleston. The lignite is either bedded (autochthonous) or re-worked.

The best outcrop of autochthonous lignite is 5 miles north of Charleston in Starck Hollow (NW. 1/4, SE. 1/4, NW. 1/4, Sec. 34, T.26 N., R.2 E.), 0.3 mile east of the north-south gravel road at the foot of the bluff. In the bed of a small stream in the hollow, large fragments of carbonized tree trunks and tree branches form a waterfall two feet in height. However, this bed, though persistent locally, is eroded immediately to the north and south, but appears to be represented by a bed of re-worked lignite as exposed in Mitchell Creek (NW. 1/4, NW. 1/4, SW. 1/4, Sec. 1, T.25 N., R.3 E.) 2 1/2 miles to the southeast. Here, a large slump block, comprising 2.3 feet of silty well-laminated lignite overlain by bedded Citronelle sands and gravels and underlain by poorly bedded greenish-gray silts, rests at a high angle in the bed of the creek.

However, a mile to the north, on the same creek, at the site of test H122 (NE. 1/4, NE. 1/4, SE. 1/4, Sec. 35, T.26 N., R.2 E.) the autochthonous lignite, 1.8 feet in thickness, is in position and is overlain by Citronelle gravel and underlain by carbonaceous clay and light-colored lagoonal clay.

Similarly, thin beds of autochthonous lignite crop out on Shelton Creek (Secs. 3 and 10, T.26 N., R.2 E.) a short distance southeast of Crevi. But at Crevi, at the pits in the lagoonal clay, only a silty micaceous re-worked lignite 2.4 feet in thickness can be found.

Likewise, in the vicinity of Charleston, both types of lignite are present, but at no place are they one above the other. Autochthonous lignite for use in smithys was formerly mined at the base of the bluff on the south bank of the South Fork of Tillatoba Creek (SE.

Cor., Sec. 26, T.25 N., R.2 E.) and from the northwest bank of the North Fork of Tillatoba Creek (W. 1/2, SE. 1/4, NE. 1/4, Sec. 27, T.25 N., R.2 E.) just west of the road bridge and a short distance north of the railroad depot. Unfortunately, the construction of a levee destroyed the exposure at the former locality and the silting up and the recent changing of the North Fork covered up the latter. However, the apparent counterparts of these beds are represented by re-worked lignites at the base of the bluff adjacent to the road a mile north of Charleston (NE. 1/4, Sec. 22, T.25 N., R.2 E.) and in ravines south of Camp Tallaha (N. 1/2, Sec. 11, T.24 N., R.2 E.) 2 miles south of Charleston.

Although re-worked lignites were discovered in Tests H42 and H59, along Askalmore Creek a mile east of Paynes, the only outcrop of autochthonous lignite located south of Charleston is in a deep ravine south of Stonefield Church at the site of Test H96 (NW. 1/4, SW. 1/4, SE. 1/4, Sec. 13, T.23 N., R.2 E.). Here, a thickness of 3.7 feet of poorly bedded large chunks of carbonized wood was measured, but its original thickness must have been greater since the top has been removed by erosion and it is now unconformably overlain by Citronelle gravel.

All these lignites lie near the base of the upper half of the upper (continental) Zilpha, but one or more very silty beds of the re-worked type are near its top, in the zone of thin lensing silts, sands, carbonaceous clays, and light-colored clays. In the north part of the hill section (H31, SW. 1/4, SE. 1/4, SW. 1/4, Sec. 21, T.26 N., R.3 E.) 2 miles southeast of Teasdale, this upper re-worked lignite, 1.8 feet thick, was encountered at a depth of 28.0 feet. Similarly (H14, NE. 1/4, SW. 1/4, SE. 1/4, Sec. 5, T.26 N., R.3 E.) 2 1/2 miles northeast of Teasdale clayey lignite, 9.4 feet thick, was topped at a depth of 24.2 feet. The counterpart of these beds seems to be absent in the south part of the hill section unless it is represented by 5.8 feet of silty brownish-black lignitic clay, topped at 20.4 feet in Test H50 (W. 1/2, SE. 1/4, SW. 1/4, Sec. 26, T.24 N., R.2 E.) which was drilled half a mile southeast of Paynes, on a small stream tributary to Askalmore Creek.

As inferred during the discussion of previous investigations, several of the autochthonous lignites have long been known. In 1907, Professor Calvin S. Brown, in reviewing the lignites of Mississippi, noted exposures at or near the base of the bluff north of Charleston.[20]

The bed mentioned on Mr. B. M. Baker's place (Sec. 3, T.25 N., R.2 E.) is of the re-worked type, which accounts for the high percentage of impurities as shown by analysis. The second exposure described, 3 miles north of Charleston, is now completely covered by slump and could not be located even with an auger. However, the "thin layers" reported southeast of Paynes are evidently the same bed already described at Test H96 (N W.1/4, SW. 1/4, SE. 1/4, Sec. 13, T.23 N., R.2 E.).

QUARTZITES

Quartzites, although the least important quantitatively, are one of the most important lithologic types in the upper (continental) Zilpha of Tallahatchie County. Actually they are light-gray massive slightly micaceous fine-grained quartzitic sandstones or coarse quartzitic siltstones, rather than true quartzites. Consequently, they must not be confused with the metamorphosed sandstones of parts of the Appalachian region, for neither heat nor pressure from stresses has had anything to do with their formation.

Instead, they seem to be a product of weathering, since prominent ledges on hill slopes have been shown, through test-hole drilling, to be represented by non-indurated sand or sandy silt of equal thickness in the unweathered part of the hill. Presumably most of the sands or sandy silts carried siliceous waters that were lost at the outcrops through natural drainage or through evaporation, with the consequent precipitation of silica. The silica, impregnating the beds at their outcrops, sealed them against further water movement and produced ledges which are fairly resistant to further weathering.

The quartzitic sandstones or siltstones are mostly confined to the upper one-third of the upper Zilpha. There are probably 3 or 4 of them, depending on the topographic conditions which brought about their development from water-bearing silts and sands. Consequently outcrops of individual quartzites are local and traceable for but a few miles at most. In general, exposures are confined to the northeast corner of the hill section (T.26 N., R.3 E.) and to the Paynes-Leverett area (Southeastern, T.24 N., R.2 E.) just south of Askalmore Creek and adjacent to the delta. The nature and location of several of the quartzites and their probable stratigraphic position are discussed as follows:

The most prominent ledge crops out at the road forks (H36, NW. 1/4, SW. 1/4, SW. 1/4, Sec. 13, T.26 N., R.3 E.) at the northwest corner of Enid and in the stream bottoms half a mile to the northwest (H39, SE. 1/4, SE. 1/4, NW. 1/4, Sec. 14, T.26 N., R.3 E.). Presumably the same ledge forms the bottom of a stream 1 1/2 miles west of Enid (SW. 1/4, SW. 1/4, NE. 1/4, Sec. 22, T.26 N., R.3 E.). At these localities the quartzite has a nearly uniform thickness of 2.0 feet. Tests beneath outcropping ledges showed it to be immediately underlain by light-colored clays and grayish-green silts. Stratigraphically, this bed lies about 175 feet above the Winona-Zilpha contact.

In contrast, a quartzite farther west (H38, NW. 1/4, NE. 1/4, SW. 1/4, Sec. 9, T.26 N., R.3 E.) and farther northwest (H33, SW. 1/4, SW. 1/4, SE. 1/4, Sec. 33, T.27 N., R.3 E., Panola County) is underlain by light-colored silts and sands, suggesting a different ledge than that in the Enid area. It is also noticeably thinner and forms an alternately swollen and constricted ledge which at no place exceeds 1.0 to 1.5 feet in thickness. Its stratigraphic position appears higher than the "Enid" quartzite, probably 200 feet above the Winona-Zilpha contact.

Still another prominent quartzite, 1.3 to 2.0 feet in thickness, crops out at several other points in the northern hill section. It is best seen: in a ravine just north of "Brazil Springs" (NW. 1/4, SW. 1/4, NE. 1/4, Sec. 32, T.26 N., R.3 E.); in the west bank of a creek on the property of C. E. Buntin (E. 1/2, NE. 1/4, NE. 1/4, Sec. 28, T.26 N., R.3 E.); and along the bluffs overlooking an un-named creek on the James Tool property (NE. 1/4, SW. 1/4, SE. 1/4, Sec. 5, T.26 N., R.3 E.). Tests 26, 29, and 15, beneath ledges at these places, encountered thick beds of carbonaceous silt, sand, and clay differing lithologically from those beneath the other quartzites. From its apparent position above all other beds in the northern hill section, this quartzite lies about 225 feet above the Winona-Zilpha contact.

In the Paynes-Leverett area are two quartzites, but, due to considerable faulting, it is impossible to establish their relative ages. One, underlain by light-colored silts and sands, caps the higher hills and forms ledges on the hillsides in the northeast part of Section 35, T.24 N., R.3 E., and lines the banks of a few streams at much lower elevations in the southeast of Section 34 of the same township. The other quartzite, which crops out in streams at the base of the hills in the southwest part of Section 26, is underlain by dark-colored silts and carbonaceous silty sands.

CITRONELLE FORMATION

The Citronelle formation of Pliocene or early Pleistocene age unconformably overlies the Lisbon beds in Tallahatchie County, just as it overlies all Tertiary beds bordering the Yazoo Delta from Vicksburg north to Memphis. Although these beds have been termed gravels in Tallahatchie County and in the counties immediately to the north and to the south, the gravels comprise but 25 percent of the total thickness of the unit. The balance is made up of fine-grained to coarse-grained micaceous quartz sands interbedded with thin lenses of slightly silty to non-silty clays. At most places the

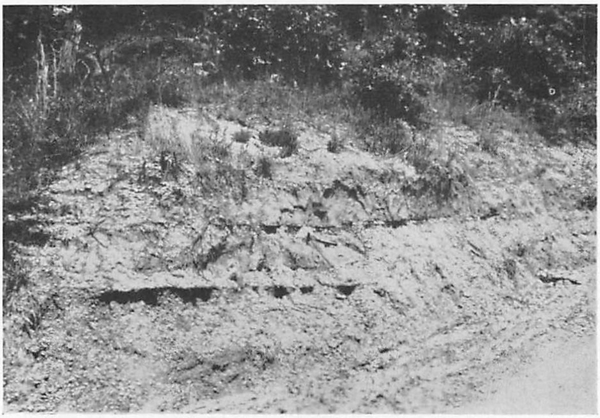

Figure 14.—Roadcut exposure of Citronelle gravel. Two miles north of Charleston. September, 1940.

gravel is present as 1 to 4 lenses at or near the base of the unit. During the investigation in Tallahatchie County, each attempt at zoning the formation proved futile.

The Citronelle formation in Tallahatchie County has a maximum thickness of 75 to 80 feet, near the bluff which separates the hill section from the delta. The maximum thickness in any test hole was at H122 (SW. 1/4, NW. 1/4, NW. 1/4, Sec. 20, T.26 N., R.3 E.) where an 8.6-foot bed of very coarse chert gravel underlies 45.7 feet of thick silty sand interbedded with thin clays. The test was abandoned because the gravel was too large to be removed with an 8-inch auger, but from its location at the base of a steep hill it is probable that the full thickness of the Citronelle in this area should measure about 80 feet.

The best exposures of the lower part of the unit are near the crests of the bluffs immediately overlooking the delta. Here, along the small local road recently completed from Thompson's store east to the Charleston-Teasdale road (S. 1/2, SE. 1/4, NE. 1/4, Sec. 22, T.25 N., R.2 E.), purplish-red clays are interbedded with lenses of fine to coarse gravel (Fig. 14).

EXPOSURE IN ROADCUT 2 MILES NORTH OF CHARLESTON

(S. 1/2, SE. 1/4, NE. 1/4, SEC. 22, T.25 N., R.2 E.)

	Feet	Feet
Loess and soil to top of bluff		4.9
Citronelle formation		23.7
Clay, slightly silty gray-buff very plastic	2.1	
Gravel, fine to medium gray to brown cherty	1.8	
Clay, brownish-purple very plastic	2.0	
Gravel, medium to coarse gray cherty	0.3	
Silt, sandy purplish-red very micaceous	5.9	
Clay, slightly silty purplish-red micaceous	3.1	
Gravel, fine to medium brown cherty	2.7	
Sand, fine-grained brownish-buff micaceous	5.8	

South of Charleston the bluffs overlooking the delta for a distance of one-half mile south of the South Fork of Tillatoba Creek have been worked for their gravel content. Formerly a railroad spur was run to the base of these bluffs. Here, the gravel beds are unusually thick, but it was impossible to measure them due to an unusual amount of slumping on the face of the old pit walls. However, two beds, each 15 feet in thickness, are reported, separated by 5 to 10 feet of thin-bedded sands and silts. Although the gravel at the juncture of Sherman Creek with the delta (W. 1/2, SW. 1/4, SE. 1/4, Sec. 22, T.26 N., R.2 E.) has a greater thickness, it is poorly bedded and is consequently considered to be a fluviatile concentration.

The upper part of the Citronelle formation is less gravelly and has produced, through weathering, a hard-pan consisting of a heterogenous mixture of sand, silt, clay, and fine gravel. This material, which may actually represent colluvium formed before the deposition of the loess, gullies badly and is responsible for much of the wasted land in the extreme north part of the hill section east of Teasdale, and in the extreme south part of the hill section in the vicinity of Cascilla. In the former area, thicknesses of 30 to 50 feet of the hard-pan are exposed, whereas in the southern area the thicknesses encountered are 25 to 35 feet. In both areas some of the streams have been incised deeply in the hard-pan, making precipitous walls 15 to 25 feet in height.

Whereas most of the sediments of the Citronelle formation are unconsolidated, there are a few beds of ferruginous sandstones. These are the ridge-formers mentioned in the treatment of physiography. Thus, a 5-foot bed caps the long narrow divide which passes east-west through Sections 2, 3, 4, 5, T.25 N., R.3 E., and another sandstone, composed of well cemented fine-grained to coarse-grained quartz sand and chert pebbles, forms steep banks in a ravine which heads near a gravel road in the E. 1/2, NE. 1/4, NW. 1/4, Sec. 11, T.25 N., R.2 E. A similar ledge forms steep cliffs two miles to the northwest on the south bank of Sherman Creek, immediately to the south of the road fork (S. 1/2, SE. 1/4, SE. 1/4, Sec. 22, T.26 N., R.2 E.) and east of the large gravel pit cited above.

The distribution and origin of the Citronelle formation have long been points of interest to southern geologists. In Mississippi the unit is thickest nearest the Yazoo Delta or bordering the present Gulf Coast but thins progressively and disappears to the east and to the north. This change is noticeable in Tallahatchie County, for the beds decrease in number and thickness to the east and are absent in the vicinities of Coffeeville and Water Valley in adjacent Yalobusha County. Nevertheless, there is ample evidence for the original extension of the formation beyond the present limits, for a recent investigation in Montgomery County revealed that the gravels cap a structure just north of Kilmichael, a point some 25 miles east of the nearest outcrop in Carroll County.

The gravels of the formation are composed of gray or brown chert and subordinate amounts of white to gray chalcedony, quartzite, and vein quartz. At no place in Tallahatchie County nor in the surrounding counties have either metamorphic or igneous pebbles been found (except for the vein quartz mentioned)—suggesting that the source of the material is in a non-igneous region. However, a few fossils are found in the chert which makes up part of the gravel. These are the impressions of Spirifer, and crinoid stems and corals. In addition, some of the cherts contain siliceous oolites. On the basis of these characteristics, the cherts were probably derived from the Devonian and Mississippian limestones of central Tennessee and northwest Alabama. Although Citronelle gravels form a considerable part of the alluvial fill of the delta, a surprising amount is composed of metamorphic and igneous rock fragments washed down the Mississippi River from glaciated Wisconsin, Illinois, and Ohio.

LOESS

Unconformably overlying the Citronelle formation in Tallahatchie County is a leached deposit of loess of varying thickness, part of the same blanket which borders the Mississippi River Valley through most of its length. In north Mississippi, the loess extends far to the east of the gravels in an ever thinning mantle, in some places as far as the Alabama line. This progressive thinning, the

Figure 15.—Roadcuts in loess. Ten miles north of Charleston. September, 1940.

small grain size of the particles, the lack of bedding, the lime content when unleached, and its stratigraphic position suggest that the loess is silt and clay of glacial origin, blown from dried up mud flats which had been deposited in the Mississippi River bottoms either near the close of the glacial stages or during early interglacial time.

In Tallahatchie County and in the adjacent counties to the north and south, the loess is a gray-buff slightly silty to silty deposit from which most of the lime has been leached. It is devoid of true bedding but has a characteristic vertical jointing which makes it so unusually resistant to weathering that very steep roadcuts stand for years. The loess is thickest near the bluffs overlooking the delta, where at several points it measures 30 to 40 feet, although some of the greater thicknesses may be attributed to creep down hill slopes. Such is the case in the hills just east of Crevi, near the base of the bluffs 10 miles north of Charleston, where road cuts exposing 20 to 30 feet of loess are common (Fig. 15). Although the loess in these cuts is not bedded, two or three discontinuous spring or seep zones mark either several stages of creeps down the hills or several distinct deposits separated by small erosional unconformities, similar to other spring and seep zones observed in cuts being made during the construction of Mississippi Highway 32 in the hills 8 miles northeast of Charleston. If these seeps are truly erosional breaks in the deposition of the material, they might represent the succession of glacial and interglacial stages which are so well marked in the more northern states. Further, the deepest hole drilled to test the loess, H66, located above and to the east of a roadcut to the south of the South Fork of Tillatoba Creek (NE. 1/4, SE. 1/4, NE. 1/4, Sec. 34, T.25 N., R.2 E.) one-half mile south of Charleston, showed two zones of leaching comparable to the seep zones. In this test, a thickness 36.0 feet of gray to gray-buff silty loess was penetrated before fine-grained to coarse-grained sand was reached. Each of the more leached portions overlies zones of lime concentration similar to those shown in the normal weathering profile of soils.

STRUCTURAL GEOLOGY

GENERAL

Since Tallahatchie County and adjacent counties have been the scene of considerable drilling activity during the last two decades, and especially since several large areas are now under lease to make additional oil tests, it is deemed advisable to devote a proportionally greater part of this report to geologic structure than has been done in previously published county reports.

Structurally, northwest Mississippi lies within the great Mississippi embayment area, a now filled former arm of the Gulf of Mexico, which extended from the present Gulf Coast north as far as the site of Cape Giradeau, Missouri. The bottom of this narrow seaway intermittently sank to accommodate several thousands of feet of sediments which were constantly being deposited during the course of millions of years. Since the axis of this long depression rather closely follows the present course of the Mississippi River, Tallahatchie County lies on its east limb and the beds of sands, clays, and lignites dip to the west in keeping with the regional west dip in the northwest part of the state.

Actually, the normal dip in Tallahatchie County is west-southwest and any departure from the normal was carefully noted during the course of this investigation, since a reverse (or east dip) is suggestive of a structure favorable to the accumulation of oil or gas. With this possibility in mind, a detailed discussion of structure is presented: first, with regard to the regional elements of a group of northwest Mississippi counties adjacent to and including Tallahatchie County; and second, the structural elements of Tallahatchie County itself.

REGIONAL STRUCTURE

Any discussion of the structure of Tallahatchie County and the adjacent counties is limited to observations based chiefly on logs of a number of water wells and oil tests in the delta, and on data from water wells and oil tests augmented by a comparatively few satisfactory rock exposures and several test hole records in the loess and gravel mantled hill area. This information has been assembled in the accompanying regional structure map (Pl 2), contoured at 100-foot intervals on the known or calculated elevations of the contact of the Winona and Zilpha members of the Lisbon formation.

LOCATIONS OF THE 48 NUMBERED CONTROL POINTS WITH KNOWN OR CALCULATED ELEVATIONS ON THE WINONA-ZILPHA CONTACT, LISTED BY COUNTIES

	Sec.	Township	Range	Winona Zilpha contact
Quitman County				
(1). Marks Hospital (water well)	34	28N	1W	—103
(2). Lambert (water well)	15	27N	1W	— 87
(3). Lambert State Farm (water well)	1	26N	1W	— 26
(4). Sledge (water well)	35	7S	10W	—107
Coahoma County				
(5). Clarksdale (water well)	24	27N	4W	—462
Panola County				
(6). Batesville (water well)	7	9S	7W	+140
(7). Central Academy (water well)	5	9S	6W	+285
(8). Gravel pit (water well)	33	10S	7W	+178
Shallow test wells of Tallahatchie County				
(9). Test hole H2	3	26N	2E	+ 98
(10). Collins-Buntin oil test	28	26N	3E	+153
(11). Scroggins-Bardwell oil test	32	26N	3E	+142
(12). Rice-Noel oil test	12	25N	2E	+112
(13). Charleston (water well)	26	25N	2E	+ 74
(14). Young-Ogilvie oil test	32	25N	2E	— 25
(15). Test hole H85	35	25N	3E	+216
(16). Test hole H80	10	24N	3E	+216
(17). Test hole H10	36	24N	2E	+119
(18). Charleston-Newton oil test	36	24N	2E	+130

(19). Leverett (water well)	10	23N	2E	+ 28
(20). Sumner (water well)	2	24N	2W	—180
(21). Glendora (water well)	18	23N	1W	— 93
(22). La Rue-Westbrook oil test	18	23N	2W	— 89
(23). Phillipp Stave Mill (water well)	21	22N	1E	—132
(24). Gulf Cason oil test	2	21N	1W	—187
Yalobusha County				
(25). Oakland (water well)	8	25N	4E	+278
(26). Frost (Tallahatta-Winona contact)	22	11S	6W	+410
Sunflower County				
(27). J. E. Oliver (water well)	1	24N	4W	—352
(28). Sunflower Plantation (water well)	32	23N	4W	—487
(29). Drew (water well)	32	23N	3W	—216
(30). Sunflower (water well)	5	19N	3W	—465
(31). Noel Morgan (water well)	34	20N	3W	—420
(32). Inverness (water well)	2	17N	4W	—530
Leflore County				
(33). Schlater (water well)	25	21N	2W	—205
(34). Exchange-Wildwood oil test	6	20N	1E	—165
(35). Greenwood (water well)	15	19N	1E	—215
Grenada County				
(36). U. S. Highway 51 (Tallahatta-Winona contact)	10	23N	4E	+332
(37). McSwine Creek bluffs (Tallahatta-Winona contact)	30	23N	4E	+305
(38). S. J. Bridges estate (water well)	34	23N	3E	+124
(39). Mrs. Estes Calhoun (Tallahatta-Winona contact)	3	22N	3E	+192
(40). Papadakis-Holcomb oil test	13	22N	2E	+ 80
(41). J. C. Cunningham (Winona-Zilpha contact)	9	22N	3E	+190
(42). Hilltop S. W. of Grenada (Tallahatta-Winona contact)	7	22N	5E	+423
Carroll County				
(43). North Carrollton (water well)	7	19N	4E	+142
(44). Outcrop (Winona-Zilpha contact)	29	21N	5E	+391
(45). McCarley (Winona-Zilpha contact)	12	19N	4E	+260
(46). John Long (water well)	23	20N	2E	— 5
Montgomery County				
(47). Outcrop (Winona-Zilpha contact)	12	20N	5E	+415
(48). Outcrop (Winona-Zilpha contact)	36	20N	6E	+504

The map shows a regional west dip of 15 to 25 feet a mile broken by several nosings and re-entrants described below:

1. A major northwest nosing whose axis trends northwest from a point near Batesville in southeast Panola County to the northwest corner of Quitman County.

2. A major west nosing whose axis trends west-southwest from the midpoint of the Tallahatchie-Yalobusha County line to Drew in north Sunflower County.

3. A minor nosing whose axis trends west from Enid in northeast Tallahatchie County through south Panola County to the vicinity of Clarksdale in Coahoma County.

4. A minor nosing whose axis trends west-southwest from the vicinity of Grenada through west Grenada and north Leflore Counties to near Sunflower in Sunflower County.

5. Re-entrants between these major and minor nosings.

6. A major fault or fault zone, upthrow on the southeast, trending southwest from Enid in northeast Tallahatchie County to Charleston.

7. A major fault or fault zone, upthrow on the south and southeast, trending southwest from north Grenada County and curving west to Phillipp in the extreme south of Tallahatchie County.

Although several major oil companies have recently conducted seismograph, magnetometer, and gravity surveys in the region, their findings are confidential, and it is not known how well their results compare with those of this investigation. However, the map, Plate 2, compares favorably with supplementary maps contoured on the much deeper Clayton and Eutaw horizons, and shows the Grenada-Sunflower nosing (No. 4) on which the Exchange-Wildwood (NW. 1/4, SE. 1/4, NE. 1/4, Sec. 6, T.20 N., R.1 E.)and the Gulf-Cason (150 ft. west of center of NE. 1/4, Sec. 2, T.21 N., R.1 W.) oil tests were drilled in the summer of 1940. Likewise, the Larue-Westbrook test (SE. 1/4, SE. 1/4, SE. 1/4, Sec. 18, T.23 N., R.2 W.), drilled on a magnetometer-igneous "high" at about the same time in southwest Tallahatchie County, is located on the axis of the Tallahatchie-Yalobusha-Drew nosing (No. 2).

TALLAHATCHIE COUNTY STRUCTURE

As intimated in the discussion of previous investigations, Tallahatchie County structure has been a subject of considerable investigation: first, as a natural consequence of the search for clays; and second, as a result of the interest of a few citizens in testing for oil especially as a means of exploiting cut-over timber lands. During the course of this search, thousands of acres in the hill area were several times leased, based on the advice of several geologists, among them Mr. H. D. Easton, known in Mississippi as the discoverer of the Amory Gas Field in Monroe County, and Mr. J. V. Howell, who was then associated with the Marland Oil Company. From personal conversation with Mr. Ned R. Rice of Charleston, and from reports of investigations and maps in his possession, the following resume of structural investigations and consequent oil activity in Tallahatchie County is reconstructed.

In 1919 was reported the "Charleston prospect," an indefinite structure some 20 miles in length bounded on the east by a fault extending from Enid (Sec. 13, T.25 N., R.3 E.) south-southwest to Leverett (Sec. 11, T.23 N., R.2 E.). The fault and accompanying reversals of dip involved "Grenada-Wilcox beds," now recognized as Zilpha, and "lower Claiborne buhrstones" which are identified with the quartzitic sandstones described in this report as lying near the top of the Zilpha. The structure was first tested by the Charleston Oil and Gas Company-Newton No. 1 (NW. 1/4, SE. 1/4, SW. 1/4, Sec. 36, T.24 N., R.2 E.) 7 miles south of Charleston. According to the published driller's record,[21] the well was started July 27, 1920 and abandoned as a dry hole at 2,700 feet on August 15, 1921.

In the following year (1922) Howell reported several secondary faults, described several synclines and anticlines, and suggested that the eastern boundary of the "Charleston structure" was not a single fault but was actually a fault zone at least two miles in width. Further, he advocated drilling on the axis of an anticlinial fold a test well, to be located either in the east part of Section 23 or in the northwest part of Section 26 (both in T.24 N., R.2 E.), to the west of a deep syncline and far enough west of the Newton test to avoid striking the Enid-Leverett fault. However, the test was never drilled and interest shifted to the more northern portion of the hill section.

There, following a further report of the "Charleston structure" by Easton in 1922, the Neil Scroggins-Dr. Bardwell No. 1 test (SW. 1/4, SW. 1/4, SW. 1/4, Sec. 32, T.26 N., R.3 E.) was started 5 miles north-northeast of Charleston, October 15, 1923. Despite several gas and oil showings in the "Ripley horizon," as shown by the driller's log, the test was abandoned March 28th, 1924, after the casing stuck and the derrick was pulled down in an effort to remove the casing. On the basis of these favorable shows, the Ned R. Rice-Noel No. 1

(SW. 1/4, NW. 1/4, SW. 1/4, Sec. 12, T.25 N., R.2 E.) was drilled 2 1/2 miles to the southwest. It was spudded in, December 1924, and abandoned at 2,707 feet, February 1925, without encountering either the gas or oil showings expected in the Ripley sands. Then, thinking that production lay updip, nearer the Bardwell test, a north offset was drilled (NW. 1/4, SW. 1/4, SW. 1/4, Sec. 32, T.26 N., R.3 E.), known as the Tallahatchie Oil Company-Dr. Bardwell No. 2.[22] But as this effort showed only a little gas and some oil residue, a location was made 2 1/4 miles to the northeast, still farther updip. This well, the R. E. Collins-Buntin (E. 1/2, SE. 1/4, NE. 1/4, Sec. 28, T.26 N., R.3 E.), was started November 6, 1933, and was abandoned at a depth of 2,287 feet, May 1, 1934, having encountered but little gas and no oil.

Following this series of dry holes, interest died until the proving of Tinsley Dome, September 5, 1939, as a direct result of surface investigations conducted by a similar Clay-Mineral Survey in Yazoo County. Thereupon, field work was again undertaken in the hills of Tallahatchie County, resulting in further defining the "Charleston" structure and in advocating additional drilling near the Scroggins-Bardwell No. 1 test. Accordingly, much of the hill section and an adjacent part of the delta was leased anew, and a trade was made with the Roesser and Pendleton Oil Company, which, on October 10, 1940, started the M. R. Young-Ogilvie test (C., SE. 1/4, SW. 1/4, Sec. 32, T.25 N., R.2 E.) in the delta 3 1/2 miles west-southwest of Charleston. However, it was abandoned October 30, 1940, at a depth of 3,976 feet without encountering a show of either gas or oil.

Following this last failure, and on the completion of the field work of this report, the Mississippi State Geological Survey, Sponsor of the project, was requested to make a report on the structure possibilities of the county. Accordingly, the following memorandum for the press, "Paynes and Enid Structural Prospects," was released.

MISSISSIPPI STATE GEOLOGICAL SURVEY

University, Mississippi

MEMORANDUM FOR THE PRESS

IMMEDIATE RELEASE
FEBRUARY 11, 1941

Paynes and Enid Structural Prospects

The value and extent of the mineral resources in Tallahatchie County, Mississippi, will appear in a bulletin to be published as soon as the ceramic testing laboratories at the University of Mississippi can finish the tests now in progress, but certain completed phases of the field investigations dealing with geologic structures favorable to oil and gas can now be released according to Dr. William Clifford Morse, State Geologist.

The field work of this mineral survey, begun by Frederic F. Mellon, now an independent consulting geologist, has just recently been completed by Dr. Richard R. Priddy for the WPA, the Mississippi State Geological Survey, and the citizens of Charleston and Tallahatchie County.

It will require at least five additional weeks to fire the hundreds of test pieces of clay, to perform other routine tests, and to conduct research experiments on the beneficiation of the clays, some of which are strategic minerals in National Defense. After the tests and experiments have been completed, it will take still additional weeks to write the report and publish it as a bulletin on the mineral resources of Tallahatchie County.

Because of the time so required and especially because of the active drilling search for oil and gas in the county, it is deemed advisable to present, in the form of a memorandum for the press, the results of the completed field investigations on geologic structures insofar as these refer to the two most favorable prospects.

The interpretation of these prospects must be considered suggestive rather than conclusive, because: (1) of scarcity of outcrops, (2) of a thick loess and gravel mantle, and (3) of the inability of hand augers to penetrate such a thick mantle. Accordingly, core drilling is not only desirable but imperative.

Both prospects are located in the hilly eastern portion of Tallahatchie County, where the normal dip of the beds is west-southwest. One is a mile southeast of Paynes (or 6 miles due south of Charleston); the other, 3 miles southwest of Enid (or 6 miles northeast of Charleston).

Paynes Prospect

The Paynes Prospect (NW. 1/4, Sec. 35, T.24 N., R.2 E.—Phillipp topographic map, obtainable from the U. S. Geological Survey, Washington) is suggested by the intersection of two faults updip to the northeast. On the north, one of these faults extends eastward for 4 or 5 miles up Askalmore Creek. Its upthrow is on the south, where lower Kosciusko sands and quartzites and upper Zilpha black clays lie at the level of middle Kosciusko sands. On the southeast, the other fault extends northeast from Leverett (Sec. 11, T.23 N., R.2 E.) and intersects the Askalmore Creek fault in the center of Sec. 25, T.24 N., R.2 E. The upthrow is on the east, where lower Zilpha silty clays abut upper black Zilpha clays. To the east of this fault the silty shales dip sharply southeast.

Enid Prospect

These faults, having throws of 50 to 75 feet, may effectively seal possible oil sands, provided other structures further west have not already halted updip migration. However, before actual drilling, the prospect should be verified by core-drilling the top of the Winona sand which should be encountered at depths ranging from 100 to 250 feet.

The Enid Prospect (Common corner Secs. 27, 28, 33, 34, T.26 N., R.3 E.—No topographic map available) is suggested by: (1) a northeast-southwest fault or fault zone, (2) northeast dipping beds near Enid, (3) local faulting in creeks to the southeast, and (4) the encouraging shows of gas and oil in several oil tests drilled in the vicinity. The fault can be seen at places for a distance of 6 miles (or along a line from Sec. 1, T.25 N., R.2 E., to Sec. 23, T.26 N., R.3 E.). The upthrow is on the southeast, where lower Zilpha silty shale abuts middle Kosciusko quartzites and sands, indicating a throw of 75-100 feet. Here again, the top of the Winona sand should be core-drilled in order to prove the existence of vital east dip on the upthrow side of the fault. The sand should be encountered at 115 to 150 feet on the upthrow side; probably at depths of 175 to 225 feet on the down throw side.

Inasmuch as statements in this article are contingent on the context, abbreviations may lead to erroneous conclusions. For this reason and because of the great cost of drilling, the Mississippi Geological Survey releases the article only on the condition that it be used in its entirety.

MISSISSIPPI STATE GEOLOGICAL SURVEY

University, Mississippi

MEMORANDUM FOR THE PRESS

IMMEDIATE RELEASE
JANUARY 28, 1942

Paynes and Enid Structural Prospects Supplement

Since the release on February 11, 1941, of the Press Memorandum on the "Paynes and Enid Structural Prospects" additional information acquired in the course of the survey of Tallahatchie County warrants a supplementary press notice in order to help in National Defense.

This additional survey disclosed:

2. A major west nosing whose axis trends west-southwest from the midpoint of the Tallahatchie-Yalobusha Counties line to Drew in north Sunflower County.

3. A minor nosing whose axis trends west from Enid in northeast Tallahatchie County through south Panola County to the vicinity of Clarksdale in Coahoma County.

5. Re-entrants between the major and minor nosings.

6. A major fault or fault zone trending southwest from Enid in northeast Tallahatchie County to Charleston, upthrow on the southeast.

7. A major fault or fault zone trending southwest from north Grenada County and curving west to Phillipp in the extreme south of Tallahatchie County, upthrow on the south and southeast.

From this additional information to the memorandum on February 11, 1941, which appears in press, Dr. Richard Randall Priddy is enabled to summarize his results on structure as follows:

The first (No. 2) is the sharp west nosing whose axis trends west-southwest from the mid-point of the Tallahatchie-Yalobusha County line through Leverett towards Drew in north Sunflower County. The northwest limb of this nosing is proven conclusively by west dipping upper beds of the lower (marine) Zilpha clay, as shown by exposures and in test holes and water wells in T.25 N., R.3 E., and in T.25 N., R.4 E. in adjacent Panola County, and in water wells drilled in Charleston. The dip is terminated by the Enid fault or fault zone (number 6 of the major structural elements) which extends southwest from Enid to Charleston, as described in the Enid Prospect. Since there are minor reverses of dip and numerous north-south faults exposed in some of the stream beds in adjacent parts of T.26 N., R.3 E. and T.25 N., R.2 E., it is probable that at depth there could be enough offsetting of beds of a closure against the plane of the Enid-Charleston fault to provide a trap for gas or oil migrating up dip. This, then, is the basis for suggesting the Enid prospect despite the poor showing of the Collins-Buntin test (E. 1/2, SE. 1/4, NE. 1/4, Sec. 28, T.26 N., R.3 E.) which is believed to have been drilled on the northwest (downthrow) side of the Enid-Charleston fault. It is also believed that the minor north-south faults and the reverse dips, referred to, constitute at least the more northern portion of the Enid-Leverett fault or fault zone by which Easton and Howell limit the "Charleston structure" on the east. Actually, on the basis of the lack of faults east of Charleston, along a line which should connect Enid with the disturbed Leverett area, there is no evidence for postulating such a long fault or even a fault zone.

The Leverett area cannot be shown in detail. It is bounded on the southwest by Leverett (Sec. 11, T.23 N., R.2 E.) and on the northwest by Paynes (Sec. 27, T.24 N., R.2 E.) and extends east into the hills a distance of 6 miles. In addition to the two major faults which intersect in the Paynes prospect, there are numerous poorly exposed faults and flexures which have great divergences in strike, suggesting that here, as everywhere in Tallahatchie County, all investigations preparatory to locating an oil test should include core drilling.

The southeast limb of the Charleston-Drew nosing is as well established by dip as is the northwest flank. Southerly dips prevail south of Leverett in T.23 N., R.2 E., and southwest dips to the east in T.23 N., R.3 E. The limb is terminated by the major faults or narrow fault zone which trends southwest across the southeast corner of the county and curves west across northwest Grenada County towards Phillipp. (Regional element No. 7).

This fault, whose upthrow is on the southeast, involves Tallahatta, Winona, and lower Zilpha strata. Its existence is indicated by a comparison of exposures and water well and test hole data and by minor faulting and unusual dips in the beds of Long and Rattlesnake Creeks and their tributaries immediately to the north and to the south of the Grenada County line. Although fault planes are exposed in Sections 34 and 35, T.23 N., R.3 E. and in Sections 3, 4, and 9, T.22 N., R.3 E., no direct measurements are available on the throw of the fault. However, as the Winona-Zilpha contact is exposed at an elevation of 192 feet on Rattlesnake Creek at the site of test hole H70 (N. 1/2, SE. 1/4, NW. 1/4, Sec 3, T.22 N., R.3 E.), and an elevation of 155 feet in a water well at the V. A. Bridgers estate home half a mile to the north, it is evident that the throw is at least 60 feet.

From this area of greatest disturbance, the fault line is traceable northeast across the southeast corner of Tallahatchie County (Secs. 24, 25, and 26, T.23 N., R.3 E.) as far as a point on United States Highway 51 about 6 miles north-northwest of Grenada. To the west-southwest it is traceable, in a few stream exposures, as far as the edge of the delta where its physiographic expression is a sharp re-entrant into the hills.

Too long for the press is a mimeographed list of 16 shallow test holes, giving the Winona-Zilpha contact elevations, which may be obtained from the office of the Mississippi Geological Survey, Dr. William Clifford Morse, State Geologist, announced.

Additional data, collected since the writing of this memorandum, show that whereas the structure discussed is correct, a minor stratigraphic error needs revision. Since it is now evident that the Kosciusko member of the Lisbon formation does not crop out in Tallahatchie County, the beds so named constitute the uppermost part of the Zilpha and lie even higher stratigraphically than the "upper black Zilpha clays."

Likewise, the Paynes and Enid prospects are now recognized as secondary to three of the broader structural elements, numbers 2, 6, and 7 (Discussion of the structural map, Plate 2). The first, number 2, is the sharp west nosing, whose axis trends west-southwest from the mid-point of the Tallahatchie-Yalobusha County line through Leverett toward Drew in north Sunflower County. The northwest limb of this nosing is proven conclusively by west dipping upper beds of the lower (marine) Zilpha clay, as shown by exposures and in test holes and water wells in T.25 N., R.3 E. and in T.25 N., R.4 E. in adjacent Panola County, and in water wells drilled in Charleston. The dip is terminated by the Enid fault or fault zone, number 6 of the major structural elements, which extends southwest from Enid to Charleston, as described in the Enid prospect. Since there are minor reverses of dip and numerous north-south faults exposed in some of the stream beds in adjacent parts of T.26 N., R.3 E. and T.25 N., R.2 E., it is probable that at depth there could be enough offsetting of beds or a closure against the plane of the Enid-Charleston fault to provide a trap for gas or oil migrating up dip. This, then, is the basis for suggesting the Enid prospect despite the poor showing of the Collins-Buntin test (E. 1/2, SE. 1/4, NE. 1/4, Sec. 28, T.26 N., R.3 E.) which is believed to have been drilled on the northwest (downthrow) side of the Enid-Charleston fault. It is also believed that the minor north-south faults and the reverse dips referred to constitute at least the more northern portion of the Enid-Leverett fault or fault zone by which Easton and Howell limit the "Charleston structure" on the east. Actually, on the basis of the lack of faults east of Charleston, along a line which should connect Enid with the disturbed Leverett area, there is no evidence for postulating such a long fault or even a fault zone.

Because of the small scale of Plate 2, the Leverett area can not be shown in detail. It is bounded on the southwest by Leverett (Sec. 11, T.23 N., R.2 E.) and on the northwest by Paynes (Sec. 27, T.24 N., R.2 E.) and extends east into the hills a distance of 6 miles. In addition to the two major faults which intersect in the Paynes prospect, there are numerous poorly exposed faults and flexures which have great divergences in strike, suggesting that here, as everywhere in Tallahatchie County, all investigations preparatory to locating an oil test should include core drilling.

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This fault, whose upthrow is on the southeast, involves Tallahatta, Winona, and lower Zilpha strata. Its existence is indicated by a comparison of exposures and water well and test hole data and by minor faulting and unusual dips in the beds of Long and Rattlesnake Creeks and their tributaries immediately to the north and to the south of the Grenada County line. Although fault planes are exposed in Sections 34 and 35, T.23 N., R.3 E. and in Sections 3, 4, and 9, T.22 N., R.3 E., no direct measurements are available on the throw of the fault. However, as the Winona-Zilpha contact is exposed at an elevation of 192 feet on Rattlesnake Creek at the site of Test hole H70 (N. 1/2, SE. 1/4, NW. 1/4, Sec. 3, T.22 N., R.3 E.) and at an elevation of 155 feet in a water well at the home of the V. A. Bridgers estate half a mile to the north, it is evident that the throw is at least 60 feet.

From this area of greatest disturbance, the fault line is traceable northeast across the southeast corner of Tallahatchie County (Secs. 24, 25, and 26, T.23 N., R.3 E.) as far as a point on U. S. Highway 51 about 6 miles north-northwest of Grenada. To the west-southwest it is traceable, in a few stream exposures, as far as the edge of the delta where its physiographic expression is a sharp re-entrant into the hills.

COMMERCIAL BOND CLAYS*

Although many samples of clay were collected by Dr. Priddy from the numerous test holes, many of which were bored for stratigraphic and structural information, no sample was obtained from commercial pits. In order that these commercial clays that are being marketed might also be tested, the State Geologist and the Ceramic Engineer on May 9, 1942, collected samples from the properties of the five commercial producers to complete this study.

One sample was obtained from the Paul L. Mitchell pit 10 miles north of Charleston and 1/4 mile south of the Crevi cross roads, where the following section was measured:

SECTION OF PAUL L. MITCHELL CLAY PIT

	Feet	Feet
Pliocene		
Citronelle formation		12.0
Gravel, coarse, and sand. Some pebbles 0.2 foot long; some irregular pieces 0.5 foot long	7.0	
Sand, gray and yellow; irregular lens. This sand lies at the same elevation as the shale interval described below	5.0	
Zilpha clay		18.0
Shale, blue clay and black lignitic, both interstratified with thin sand. Grades downward into black lignitic clay shale and thin sand. Because of its irregular upper surface this interval lies at the same elevation as the sand interval described above	5.0	
Shale, black clay, interstratified with thin sand; both micaceous. This material is almost a lignite or lignitic clay. Small sample	5.0	
Clay, light bluish-gray massive plastic. "Bond clay," Sample HD	6.0	
Interval, more or less covered, to pit water and road level	2.0	

Inasmuch as the pits were filled with water, the other samples were collected from the storage sheds of the four other commercial producers. The five properties and operators are:

1. The old Bramlett Pit, at the Crevi cross roads, 10 miles north of Charleston, operated by F. H. Womack of Crenshaw, Sample HA.

* By William Clifford Morse and Thomas Edwin McCutcheon, authors.

2. The new Paul Mitchell Pit, 1/4 mile south of the Crevi cross roads, operated by Paul Mitchell of Enid, Sample HD.

3. The Pickle Clay Mining Co., Shelton Creek Pit, about 3/4 mile east of the River Bluffs, operated by A. B. Johnston of Enid, Sample HC.

4. The Tallahatchie Clay Co., Creek Pit near Jackson Grove School, operated by Mr. Field of Charleston, Sample HE.

5. The old Southern Ball Clay Co., Creek Pit also near Jackson Grove School, operated by Mr. Mills of Glendora, Sample HB.

The clay is mined by hand in open pits, and almost all the impurities are removed by hand scraping. It is then placed in open sheds to dry after which much of it is hauled by truck to Enid for rail shipment on the Illinois Central Railroad. Because of its splendid plasticity, the clay readily slumps, with other material, into the pits, thereby causing an enormous amount of waste removal. By cooperation or by a combination of the different operators, the overburden of larger areas might be removed and much of the slumping prevented.

Although all but one of the clay pits were filled with water or slumped material and although equipment was not available for bore tests on May 9, 1942, nevertheless the outcrops of this well known Enid (Upper Zilpha) bond clay along the base of the Mississippi River bluffs, along one branch of Shelton Creek, and along an unnamed tributary of Yocona River that heads at Bethel Church near Teasdale—all in northern Tallahatchie County within 2 miles of the Panola County line—are sufficiently wide-spread to warrant the statement that an abundance of this excellent material may be won for industrial use.

TEST HOLE RECORDS

P. L. MITCHELL PROPERTY

TEST HOLE RECORD H2

Location: T.26 N.. R.2 E., Sec. 3, N. 1/2, NE. 1/4, SW. 1/4; 50 feet from north line, 600 feet from east line; 30 feet northeast of road in clay pit, 240 feet S. 77° E of road fork, 262 feet N. 30° W. of southern road fork.

Drilled: February 29, 1940

Elevation: 197 feet | Water level: 23 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	11.7	11.7	Clay, whitish-gray buff mottled plastic tough
2	17.4	5.7	Lignite, clayey and silty brownish-black friable; reworked dark-gray clay laminae
3	31.7	14.3	Silt, clayey medium-gray to dark-gray
4	37.5	5.8	Silt, slightly lignitic medium-gray to dark-gray
5	39.5	2.0	Silt, medium-gray to dark-gray
6	49.5	10.0	Silt, slightly clayey medium-gray to dark-gray
7	59.5	10.0	Silt, medium-gray to dark-gray
8	99.0	39.5	Silt, slightly clayey medium-gray to dark-gray
			Top lower (marine) Zilpha
9	100.5	1.5	Sand, very silty medium-gray to dark-gray slightly micaceous slightly glauconitic

P. L. Mitchell Property

Test Hole Record H3

Location: T.26 N., R.2 E., Sec. 3, SE. 1/4, SE. 1/4, NW. 1/4; 535 feet from south line, 500 feet from east line; 25 feet east of road at road curve, in clay pit

Drilled: October 4, 1940

Elevation. 201 feet

Water level: 41.4 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	6.6	6.6	Clay, slightly silty light-gray yellow mottled plastic very tough gypsiferous
2	7.4	0.8	Clay, slightly silty strawberry-red plastic tough gypsiferous
3	8.1	0.7	Clay, slightly silty light-gray plastic tough gypsiferous
4	11.7	3.6	Clay, silty dark-yellow iron-stained semi-plastic very tough; small pebbles of ferruginous sandstone
5	24.1	12.4	Clay, slightly silty light-gray yellow mottled plastic very tough very gypsiferous; silty laminae
6	25.6	1.5	Clay, very silty yellow iron-stained plastic very tough gypsiferous
7	31.3	5.7	Clay, very silty light-gray yellow mottled plastic very tough gypsiferous
8	34.2	2.9	Clay, very silty yellow mottled semi-plastic gypsiferous; grades downward into bluish-gray silty clay
9	37.2	3.0	Clay, silty dark-gray plastic tough gypsiferous
10	58.9	21.7	Clay, silty dark-gray gypsiferous; small fragments of lignite; small flattened marcasite nodules
			Rock, hard

P. L. MITCHELL PROPERTY

TEST HOLE RECORD H4

Location: T.26 N., R.2 E., Sec. 3, N. 1/2, SE. 1/4, SW. 1/4; 50 feet from north line, 600 feet from west line; 75 feet east of road on hillside (40 feet southeast of test hole H7) Drilled: October 28, 1939

Elevation: 235 feet Water level: 16.7 feet

No.	Depth	Thick.	Description of strata and designations of samples
1	0.4	0.4	Soil—silt, sandy light-gray
			Citronelle formation
2	2.5	2.1	Sand, fine-grained light-yellow; coarse chert gravel
3	11.1	8.6	Sand, fine to coarse-grained gray-buff; coarse chert gravel
4	13.3	2.2	Sand, coarse-grained yellow buff mottled
			Upper (continental) Zilpha
5	14.8	1.5	Clay, very silty yellow light-gray mottled micaceous
6	16.7	1.9	Silt, slightly clayey brown gray mottled lignitic; much marcasite
7	17.0	0.3	Sand, fine-grained light-gray very micaceous
8	23.3	6.3	Lignite (re-worked), dark-brown gray mottled; laminae of micaceous silt; marcasite nodules
9	43.3	20.0	Clay, slightly silty gray micaceous gypsiferous; fragments of lignite; scattered gravel in upper part
10	45.3	2.0	Clay, silty light-bluish-gray micaceous
11	56.6	11.3	Clay, slightly silty light-bluish-gray plastic very tough micaceous

P. L. MITCHELL PROPERTY

TEST HOLE RECORD H5

Location: T.26 N., R.2 E., Sec. 3, N. 1/2, NE. 1/4, SW. 1/4; 400 feet from north line, 600 feet from east line, on hillside 200 feet east of road curve

Drilled: May 29, 1940

Elevation: 262 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
1	0.4	0.4	Soil, sandy gray
			Pleistocene
2	4.6	4.2	Loess, silty reddish-yellow
			Citronelle formation
3	8.8	4.2	Chert gravel and sand, red oxidized
4	23.2	14.4	Sand, clayey red; pebbles of whitish-gray plastic clay
			Upper (continental) Zilpha
5	32.3	9.1	Silt, sandy and lignitic mottled dark-gray and dark-brown micaceous; flattened nodules of pyrite
6	37.7	5.4	Sand, fine-grained slightly clayey dark-gray; pebbles of lignite
7	40.7	3.0	Clay very slightly silty white and gray mottled; a few small particles of lignite; C1A
8	43.7	3.0	Clay, whitish-gray; C1B
9	46.7	3.0	Clay, whitish-gray; C1C
10	49.7	3.0	Clay, very slightly silty whitish-gray; C1D
11	52.7	3.0	Clay, slightly silty whitish-gray; minute flecks of lignite; C1E
12	55.7	3.0	Clay, slightly silty whitish-gray; C1F
13	58.7	3.0	Clay, silty whitish-gray; C1G
14	61.7	3.0	Clay, silty whitish-gray; C1H
15	64.7	3.0	Clay, slightly silty whitish-gray; C1I
16	67.7	3.0	Clay, slightly silty whitish-gray; C1J
17	70.7	3.0	Clay, very silty whitish-gray; C1K
18	73.7	3.0	Clay, silty whitish-gray; C1L
19	76.7	3.0	Clay, slightly silty whitish-gray; C1M
20	79.7	3.0	Clay, silty whitish-gray; C1N
21	82.7	3.0	Clay, very silty whitish-gray; C1O

P. L. MITCHELL PROPERTY

TEST HOLE RECORD H6

Location: T.26 N., R.2 E., Sec. 3, SE. 1/4, NE. 1/4, SW. 1/4; 500 feet from south line, 500 feet from east line, 120 feet east of road near top of hill

Drilled: May 4, 1940

Elevation: 246 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
1	0.2	0.2	Soil—silt, clayey gray-buff
2	27.0	26.8	Loess, silty gray-buff yellow mottled gypsiferous
			Citronelle formation
3	43.6	16.6	Sand, fine to medium-grained red-buff; thin beds of fine white chert gravel; single bed of coarse chert gravel at base
			Upper (continental) Zilpha
4	50.5	6.9	Clay, whitish-gray blue mottled gypsiferous very plastic
5	54.7	4.2	Clay, yellow-buff grading into light-bluish-gray very plastic tough gypsiferous
6	60.0	5.3	Clay, slightly silty light-bluish-gray blue mottled micaceous plastic tough; branching columns of marcasite

P. L. Mitchell Property

Test Hole Record H7

Location: T.26 N., R.2 E., Sec. 3, N. 1/2, SE. 1/4, SW. 1/4; 25 feet from north line, 575 feet from west line, 30 feet east of road at base of thick lignite

Drilled: May 22, 1940

Elevation: 216 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Citronelle formation
1	4.8	4.8	Sand and gravel, grayish-yellow
2	6.6	1.8	Sand, whitish-gray micaceous
			Upper (continental) Zilpha
3	16.0	9.4	Lignite, silty brownish-black laminated micaceous; re-worked
4	19.0	3.0	Clay, grayish-white very plastic; C1A
5	22.0	3.0	Clay, slightly silty grayish-white plastic; C1B
6	25.0	3.0	Clay, grayish-white plastic; C1C
7	28.0	3.0	Clay, grayish-white plastic; C1D
8	31.0	3.0	Clay, grayish-white very plastic; C1E
9	34.0	3.0	Clay, slightly silty white; C1F
10	37.0	3.0	Clay, silty white; C1G
11	40.0	3.0	Clay, silty grayish-white; C1H
12	43.0	3.0	Clay, silty grayish-white; C1I
13	46.0	3.0	Clay, silty white; C1J
14	49.0	3.0	Clay, slightly silty white; C1K
15	52.0	3.0	Clay, silty grayish-white; C1L
16	55.0	3.0	Clay, silty grayish-white; C1M
17	58.0	3.0	Silt, clayey grayish-white semi-plastic; C1N
18	61.0	3.0	Clay, silty grayish-white semi-plastic; C1O
19	64.0	3.0	Silt, clayey medium gray semi-plastic; C1P
20	65.4	1.4	Silt, clayey medium to dark gray semi-plastic; C1Q
21	67.5	2.1	Silt, medium to dark gray semi-plastic; C2

W. N. Baker Property

Test Hole Record H10

Location: T.24 N., R.2 E., Sec. 36, NW. 1/4, SW. 1/4, SE. 1/4; 450 feet from west line, 400 feet from north line, on north bank of Young Creek, 150 feet west of H11

Drilled: March 1, 1940

Elevation: 219 feet

Water level: 4 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	10.0	10.0	Silt, sandy light-gray; laminae of medium-gray silty clay
2	20.0	10.0	Sand, silty light-gray micaceous; laminae of medium-gray clayey silt
3	30.0	10.0	Silt, sandy gray-buff
4	40.0	10.0	Sand, silty medium-gray
5	50.0	10.0	Sand, silty medium-gray
6	60.0	10.0	Silt, very sandy dark-gray
7	70.0	10.0	Silt, sandy medium-gray; laminae of gray-tan silty clay
8	80.0	10.0	Silt, very sandy medium-gray
9	88.2	8.2	Silt, sandy medium-gray; laminae of brownish-gray silty clay
10	100.0	11.8	Clay, fairly silty gray-tan
			Top lower (marine) Zilpha
11	104.0	4.0	Silt, fairly sandy very dark-gray; green and brown tint; slightly glauconitic; non-glauconitic claystones

W. N. Baker Property

Test Hole H11

Location: T.24 N., R.2 E., Sec. 36, NW. 1/4, SW. 1/4, SE. 1/4; 150 ft. due E. of H10, 600 ft. from W. line, 400 ft. from N. line, N. bank

Drilled: March 1, 1940

Elevation: 217 ft.

Water level: 2 ft.

No.	Depth	Thick.	Description of strata and designations of samples
1	88.0	88.0	Laminated clay, silt, and sand; grayish, with streaks of yellow iron stain and brownish lignite. Semi-plastic, micaceous, slightly pyritiferous
2	100.2	12.2	Clay, silty dark-brownish-black plastic. Contaminated with sand caving from above
3	101.7	1.5	Sand, green very glauconitic. Becomes clayey in lower portion

JAMES TOOL PROPERTY

TEST HOLE H14

Location: T.26 N., R.3 E., Sec. 5, NE. 1/4, SW. 1/4, SE. 1/4; approximately 165 ft. E. of creek bridge, 15 ft. N. of road Drilled: May 23, 1940

Elevation: 260 ft. Water level: 26.5 ft.

No.	Depth	Thick.	Description of strata and designations of samples
1	2.0	2.0	Topsoil, loess and loam
2	4.0	2.0	Sand and gravel; dark-gray oxidized
3	5.2	1.2	Quartzite, siliceous grayish-white very hard
4	11.2	6.0	Sand and clay, yellow mottled micaceous oxidized
5	15.1	3.9	Sand, silt and clay, white to cream semi-plastic oxidized
6	24.8	9.7	Clay, silty tan semi-plastic micaceous oxidized
7	34.2	9.4	Clay, silty chocolate-gray semi-plastic lignitic slightly micaceous oxidized
8	34.5	0.3	Sand and clay, chocolate-tan oxidized

JAMES TOOL PROPERTY

TEST HOLE RECORD H15

Location: T.26 N., R.3 E., Sec. 5, S. 1/2, NE. 1/4, SE. 1/4; base of quartzite ledge, 660 feet from west line, 450 feet from south line, north side of road

Drilled: June 3, 1940

Elevation: 272 feet Water level: 24.5 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	1.8	1.8	Quartzitic sandstone, fine-grained gray
2	4.2	2.4	Sand, slightly clayey gray and buff mottled micaceous
3	12.9	8.7	Silt, sandy white to cream-colored micaceous
4	15.7	2.8	Clay, silty light-tan micaceous
5	25.7	10.0	Clay, silty chocolate-brown fairly micaceous; scattered lignite pellets
6	28.0	2.3	Silt, sandy chocolate-tan micaceous
7	39.8	11.8	Silt, sandy light-gray micaceous
8	40.0	0.2	Sand, silty dark-gray

John Martin Property

Test Hole H17

Location: T.27 N., R.3 E., Sec. 32, NW. 1/4, NW. 1/4, SE. 1/4; above hole 18, 200 feet from N. line, 200 ft. from W. line, 400 ft. NW. of Ed Stogner home

Drilled: June 3, 1940

Elevation: 261 ft. Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
1	10.8	10.8	Loess, red oxidized
2	11.6	0.8	Quartzite, siliceous grayish-white dense hard. In discontinuous bed

J. G. Thompson Property

Test Hole H20

Location: T.25 N., R.2 E., Sec. 15, SW. 1/4, SW. 1/4, NE. 1/4; 500 feet E. 150 feet N. of Thompson's Store Drilled: June 19, 1940

Elevation: 247 ft. Water level: dry

No.	Depth	Thick	Description of strata and designations of samples
1	18.5	18.5	Sand, fine-grained buff clean oxidized very micaceous
2	21.0	2.5	Sand, medium-grained buff clean very micaceous
3	25.4	4.4	Sand, medium-grained buff clean very micaceous
4	33.6	8.2	Sand, coarse semi-indurated yellow-buff very micaceous
5	36.0	2.4	Sand, coarse semi-indurated yellowish-brown ferruginous micaceous
6	46.5	10.5	Clay, sandy cream to buff semi-plastic slightly micaceous
7	55.3	8.8	Silt, sandy buff to yellow very micaceous
8	64.0	8.7	Sand, silty buff very micaceous
9	68.3	4.3	Sand, fine-grained buff very micaceous
10	70.5	2.2	Clay, sandy mottled cream to yellow semi-plastic. Contains large fragments of lignite
11	80.9	10.4	Silt, sandy dark-gray, mixed with clay. Contains large fragments of lignite
12	88.2	7.3	Silt, sandy dark-gray, mixed with clay

WALTHALL PETERS PROPERTY

TEST HOLE H21

Location: T.26 N., R.2 E., Sec. 22, SW. 1/4, SE. 1/4, SE. 1/4; S. bank of Sherman Creek 500 ft. W. of bridge Drilled: June 14, 1940

Elevation: 211 ft. Water level: 2 ft.

No.	Depth	Thick.	Description of strata and designations of samples
1	7.8	7.8	Sandstone, coarse ferruginous micaceous
2	17.8	10.0	Silt, clayey buff iron stained slightly micaceous
3	27.8	10.0	Silt, sandy cream to buff slightly micaceous
4	31.4	3.6	Sand, fine-grained white to yellow oxidized
5	31.6	0.2	Sand, fine-grained white slightly micaceous

MRS. LEON WILSON PROPERTY

TEST HOLE H22

Location: T.26 N., R.2 E., Sec. 34, NW. 1/4, NW. 1/4, SE. 1/4, NW. 1/4; in fork of stream in bed of lignite over waterfall about 1/4 mile E. of gravel Highway Drilled: June 12, 1940

Elevation: 215 ft. Water level: 39 ft.

No.	Depth	Thick.	Description of strata and designations of samples
1	2.5	2.5	Topsoil, sandy gray
2	3.5	1.0	Clay, silty dark-bluish-gray plastic tough micaceous. Contains small pebbles of lignite
3	5.4	1.9	Lignite, black nearly pure autochthonous. Composed of large wood fragments 6 inches in diameter
4	12.0	6.6	Clay, slightly silty grayish-white plastic tough
5	16.7	4.7	Clay, silty plastic tough grayish-white greenish-tinted slightly micaceous
6	24.5	7.8	Silt, clayey brownish-gray plastic tough slightly micaceous. Contains lignitic roots
7	27.9	3.4	Silt, slightly sandy brownish-gray semi-plastic tough slightly micaceous
8	42.2	14.3	Silt, sandy dark-gray non-plastic slightly micaceous

C. O. Howard Property

Test Hole Record H24

Location: T.25 N., R.2 E., Sec. 2, SE. 1/4, NE. 1/4, SE. 1/4; 20 feet from east line, 375 feet from south line, 15 feet west of clay pit

Drilled: June 26, 1940

Elevation: 251 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
1	0.8	0.8	Soil—silt, sandy dark-gray
			Citronelle formation
2	6.5	5.7	Sand and gravel, red
			Upper (continental) Zilpha
3	7.0	0.5	Lignite, silty dark-gray to black (probably re-worked)
4	12.0	5.0	Clay, silty white yellow mottled semi-plastic; C1A
5	17.0	5.0	Clay, slightly silty white plastic; C1B
6	22.0	5.0	Clay, white buff mottled plastic; C1C
7	24.0	2.0	Clay, dark-gray very plastic; C1D
8	27.0	3.0	Clay, dark-gray very plastic; thin laminae of lignite; C1E
9	32.0	5.0	Clay, slightly silty gray; thin laminae of lignite; C1F

Ernest Brasher Property

Test Hole Record H26

Location: T.26 N., R.3 E., Sec. 32, NW. 1/4, SW. 1/4, NE. 1/4; 500 feet east of west line, 400 feet south of north line (Sulphur Springs)

Drilled: June 28, 1940

Elevation: 260 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	1.3	1.3	Quartzitic sandstone, fine-grained light-gray
2	2.5	1.2	Sand, fine-grained yellow-buff slightly micaceous
3	7.8	5.3	Silt, white buff mottled fairly micaceous
4	10.4	2.6	Silt, clayey chocolate-brown fairly micaceous; small pockets of white fine-grained sand
5	12.6	2.2	Sand, silty light-chocolate-tan micaceous; very fluffy texture
6	17.5	4.9	Clay, silty dark-gray; a few small reddish pellets
7	19.4	1.9	Silt, sandy dark-gray micaceous; a few coarse grains of quartz sand
8	22.5	3.1	Sand, fine-grained grayish-white very micaceous

GUY BURKHALTER PROPERTY

TEST HOLE H28

Location: T.26 N., R.3 E., Sec. 33, NW. 1/4, SW. 1/4, SE. 1/4; 400 ft. E. of W. line, 200 ft. S. of N. line, in bed of N. fork Tillatoba Creek, 250 ft. upstream from bridge

Drilled: July 3, 1940

Elevation: 232 ft.

Water level: 3 ft.

No.	Depth	Thick.	Description of strata and designations of samples
1	10.0	10.0	Clay, silty laminated dark-greenish-gray semi-plastic hard slightly micaceous incipiently oxidized
2	16.4	6.4	Silt, dark-greenish-gray non-plastic hard fairly micaceous. Contains small fragments of lignite
3	17.9	1.5	Clay and silty clay, laminated dark-grayish-green semi-plastic to plastic hard. Contains small fragments of lignite

C. E. BUNTIN PROPERTY

TEST HOLE RECORD H29

Location: T.26 N., R.3 E., Sec. 28, E. 1/2, NE. 1/2, NW. 1/4; 660 feet from north line, 200 feet from east line

Drilled: July 3, 1940

Elevation: 270 feet

Water level: 6 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	2.0	2.0	Quartzitic sandstone, fine-grained light-gray
2	5.6	3.6	Silt, cream to buff fairly micaceous
3	9.8	4.2	Clay, silty chocolate-tan; laminae of chocolate-brown clay
4	10.0	0.2	Sand, fine-grained very dark-gray slightly micaceous fairly lignitic; water bearing
5	16.6	6.6	Lignite, silty brownish-black re-worked; so dry it had to be cored
6	41.1	24.5	Clay, silty brownish-black fairly micaceous
7	48.7	7.6	Clay, silty grayish-brown gray mottled slightly micaceous
8	50.5	1.8	Silt, sandy very dark-gray slightly micaceous; laminae of dark-gray clay

MRS. C. D. HOWARD

TEST HOLE RECORD H31

Location: T.26 N., R.3 E., Sec. 21, SW. 1/4, SE. 1/4, SW. 1/4; 300 feet from west line, 125 feet from south line, 100 feet west of bridge on north side of road

Drilled: July 19, 1940

Elevation: 272 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	10.0	10.0	Clay, slightly silty light-gray yellow and red mottled very plastic very tough; C1
2	13.7	3.7	Clay, very slightly silty light-gray yellow mottled very plastic very tough; C2
3	14.6	0.9	Silt, clayey gray, yellow, and pink mottled semi-plastic
4	16.9	2.3	Silt, light-gray yellow mottled fairly micaceous
5	20.0	3.1	Clay, silty mottled light-gray and dark-gray semi-plastic slightly micaceous
6	27.5	7.5	Silt, light-gray fairly micaceous
7	28.0	0.5	Silt, sand, and clay, grayish-tan slightly micaceous
8	29.8	1.8	Clay, silty dark-brownish-black lignitic
9	33.0	3.2	Clay, silty dark-brown lignitic
10	35.4	2.4	Clay, silty chocolate-brown
11	45.0	9.6	Silt, clayey chocolate-brown slightly micaceous

LUCY BURKHALTER PROPERTY

TEST HOLE RECORD H33

Location: T.27 N., R.3 E., Sec. 33, SW. 1/4, SW. 1/4, SE. 1/4; 200 feet from west line, 300 feet from south line at rock ledge

Drilled: July 22, 1940

Elevation: 277 feet

Water level: 12 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	0.8	0.8	Quartzitic sandstone, fine-grained light-gray
2	9.2	8.4	Silt, clayey grayish-white yellow mottled; minute white flecks
3	20.0	10.8	Silt, grayish-white white flecked
4	28.6	8.6	Silt, sandy grayish-white white flecked
5	35.1	6.5	Sand, silty buff pink mottled and white flecked

S. H. GAINES PROPERTY

TEST HOLE RECORD H36

Location: T.26 N., R.3 E., Sec. 13, NW. 1/4, SW. 1/4, SW. 1/4; 350 feet from west line, 100 feet from north line, 50 feet north of road fork on west side of road in Enid Drilled: July 26, 1940

Elevation: 301 feet Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	1.0	1.0	Quartzitic sandstone, fine-grained light-gray hard
2	12.3	11.3	Clay, silty buff yellow and red mottled semi-plastic
3	16.5	4.2	Silt, clayey grayish-tan slightly plastic micaceous
4	18.5	2.0	Clay, silty dark-gray semi-plastic slightly micaceous
5	19.0	0.5	Silt, clayey light-tan micaceous
6	36.0	17.0	Silt, clayey dark-gray slightly micaceous
7	42.9	6.9	Silt, clayey dark-gray

D. T. NEWMAN PROPERTY

TEST HOLE RECORD H38

Location: T.26 N., R.3 E., Sec. 9, NW. Corner SE. 1/4, SW. 1/4; gully wash 300 feet southeast of Newman home Drilled: July 10, 1940

Elevation: 293 feet Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	1.1	1.1	Quartzitic sandstone, fine-grained light-gray
2	5.4	4.3	Clay, slightly silty grayish-white yellow mottled
3	11.0	5.6	Silt, grayish-white fairly micaceous
4	11.6	0.6	Clay, silty pinkish-gray fairly micaceous
5	23.5	11.9	Silt, slightly clayey light-gray slightly micaceous
6	25.7	2.2	Clay, fairly silty light-buff yellow mottled; laminae of dark-gray plastic clay
7	30.0	4.3	Sand, silty buff yellow and brown mottled fairly micaceous
8	35.9	5.9	Sand, fine to medium-grained yellow-buff to tan fairly micaceous; thin layers of fine-grained white sand
9	39.3	3.4	Sand, fine-grained buff slightly micaceous
10	43.4	4.1	Sand, medium-grained light-gray micaceous

ALLEN HOPE PROPERTY

TEST HOLE RECORD H39

Location: T.26 N., R.3 E., Sec. 14, corner of SE. 1/4, SE. 1/4, NW. 1/4; 50 feet from south line, 110 feet from east line, at rock ledges in gully

Drilled: December 2, 1940

Elevation: 304 feet

Water level: 4 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	2.0	2.0	Quartzitic sandstone, fine-grained light-gray hard
2	10.3	8.3	Silt, clayey white buff mottled semi-plastic; oxidized
3	12.0	1.7	Silt, clayey buff yellow mottled semi-plastic
4	18.6	6.6	Clay, silty, chocolate-tan; P4
5	28.2	9.6	Clay, fairly silty grayish-tan; P5
6	32.4	4.2	Clay, silty gray-buff; laminae of dark-gray clay; P6
7	38.9	6.5	Clay, fairly silty gray-tan; nodules of white silt; P7
8	47.0	8.1	Clay, fairly silty dark-greenish-gray slightly micaceous; elongated cylindrical bodies of dark-gray slightly silty clay; small fragments of white kaolinitic clay; P8
9	58.1	11.1	Clay, fairly silty medium-gray; P9
10	61.0	2.9	Silt, sandy grayish-tan
11	64.3	3.3	Silt, fairly clayey medium-gray; fragments of kaolinitic clay
12	76.2	11.9	Sand, fine-grained to medium-grained gray (color due to muddy water)
13	78.2	2.0	Sand, medium-grained gray (color due to muddy water); a few very coarse sand grains

Willie Rice Property

Test Hole 43

Location: T.24 N., R.2 E., Sec. 26, W. 1/2, NW. 1/4, SE. 1/4; 500 ft. from W. line, 600 ft. from N. line, in creek bed, 400 ft. S. of road

Drilled: August 6, 1940

Elevation: 203 ft.

Water level: 16 ft.

No.	Depth	Thick.	Description of strata and designations of samples
1	3.5	3.5	Fluviatile material
2	13.5	10.0	Silt, clayey gray greenish tinted semi-plastic slightly micaceous, fragments of lignite
3	16.2	2.7	Silt, clayey greenish-gray semi-plastic slightly micaceous slightly lignitic
4	17.0	0.8	Clay, silty yellow brown mottled fairly plastic slightly micaceous. Contains fine sand grains and fragments of limonitic sandstone. Probable unconformity
5	22.0	5.0	Sand, fine-grained yellow brown mottled micaceous
6	23.5	1.5	Sand, fine-grained cream micaceous
7	24.2	0.7	Clay, silty cream fairly plastic fairly micaceous
8	28.0	3.8	Sand, fine-grained to medium-grained yellow. Contains a few large fragments of mica
9	31.0	3.0	Sand, medium-grained cream slightly micaceous
10	32.8	1.8	Sand, fine-grained to medium-grained cream slightly micaceous

George Payne Property

Test Hole 44

Location: T.24 N., R.2 E., Sec. 26, NW. 1/4, SW. 1/4, SE. 1/4; 500 ft. from W. line, 50 ft. from N. line. In clay at juncture E. and W. forks creek, 1,000 ft. S. of road

Drilled: November 28, 1940

Elevation: 206 feet

Water level: 12 ft.

No	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	9.4	9.4	Clay, silty greenish-gray; P1
2	19.6	10.2	Clay, fairly silty greenish-gray; P2
3	21.0	1.4	Clay, silty medium-gray; P3
4	25.4	4.4	Silt, fairly clayey tannish-gray fairly micaceous
5	27.6	2.2	Silt, silty clayey grayish-tan fairly micaceous
6	29.7	2.1	Laminated silty clay and sandy silt. Silty clay is dark-tannish-gray. Sandy silt is yellow, ochreous and fairly micaceous
7	31.7	2.0	Laminated sand and silty clay. Sand is fine-grained, yellow-buff, and fairly micaceous Clay is light-greenish-yellow
8	35.5	3.8	Sand, fairly silty dark-greenish-gray, with very thin laminae of brown and black carbonaceous material; very micaceous

T. J. DENMAN ESTATE PROPERTY

TEST HOLE RECORD H46

Location: 2.24 N., R.2 E., Sec. 34, NE. 1/4, SE. 1/4, SE. 1/4; 150 feet from east line, 300 feet from north line at base of bluff, 500 feet north of Poplar Spring

Drilled: October 18, 1940

Elevation: 204 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	3.5	3.5	Sand, medium-grained brown micaceous
2	7.8	4.3	Clay, slightly silty white buff and red mottled plastic; calcareous fragments found at outcrop of this bed; P2
3	10.4	2.6	Clay, slightly silty chocolate-brown gray mottled
4	12.8	2.4	Quartzitic sandstone, fine-grained light-gray hard
5	14.3	1.5	Silt, clayey gray-buff yellow mottled
6	16.8	2.5	Silt, slightly clayey white yellow mottled
7	22.3	5.5	Clay, very slightly silty white very plastic; P7
8	23.2	0.9	Clay, fairly silty light grayish-white fairly plastic
9	23.5	0.3	Silt, grayish-white
10	24.8	1.3	Silt, semi-indurated light-grayish-white
11	30.2	5.4	Sand, very fine-grained white very micaceous

WILLIE RICE PROPERTY

TEST HOLE RECORD H50

Location: T.24 N., R.2 E., Sec. 26, W. 1/2, SE. 1/4, SW. 1/4; 300 feet from North line, 100 feet from west line, west bank of north flowing stream

Drilled: August 12, 1940

Elevation: 212 feet

Water level: 12 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	1.8	1.8	Quartzitic sandstone, fine-grained light gray
2	6.2	4.4	Sand, medium-grained tan slightly micaceous
3	10.7	4.5	Sand, fine-grained yellow-buff slightly micaceous; laminae of white silty clay
4	15.6	4.9	Silt, clayey grayish-tan slightly micaceous
5	20.4	4.8	Silt, sandy gray to dark-gray
6	26.2	5.8	Clay, silty brownish-black
7	39.3	13.1	Silt, slightly clayey gray to dark-gray fairly micaceous

JOHN DENMAN PROPERTY

TEST HOLE RECORD H55

Location: T.24 N., R.2 E., Sec. 26, SE. 1/4, SE. 1/4, SE. 1/4; 300 feet from south line, 300 feet from north line, south bank of stream tributary to Young Creek, about 300 feet west of juncture Drilled: November 8, 1940

Elevation: 225 feet Water level: 17 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	8.1	8.1	Silt, slightly clayey buff yellow mottled; P1
2	16.4	8.3	Silt, clayey dark-gray yellow mottled; P2
3	24.0	7.6	Silt, clayey dark-greenish-gray; cream-colored mottling; P3
4	25.8	1.8	Silt, very sandy dark-greenish-gray; P4
5	26.8	1.0	Sand, silty dark-greenish-gray slightly micaceous; P5
6	29.0	2.2	Silt, sandy dark-greenish-gray slightly micaceous; P6
7	37.1	8.1	Silt, fairly clayey greenish-gray; P7
8	47.8	10.7	Clay, fairly silty light-greenish-gray lignitic; P8
9	61.0	13.2	Silt, clayey dark-greenish-gray slightly lignitic; laminae of slightly micaceous fine-grained sand
10	65.5	4.5	Clay, silty dark-greenish-gray; laminae of light-gray silty sand
11	70.2	4.7	Silt, sandy light-gray slightly micaceous; laminae of brownish-black carbonaceous silt
12	72.0	1.8	Sand, slightly silty light-gray

WILLIE RICE PROPERTY

TEST HOLE 57

Location: T.24 N., R.2 E., Sec. 26, W. 1/2, SE. 1/4, SW. 1/4; 300 ft. from N. line, 50 ft. from W. line, bank of small stream at base of bluff

Drilled: September 3, 1940

Elevation: 196 ft. Water level:

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	4.5	4.5	Clay, slightly silty light-tan; P1
2	9.0	4.5	Silt, sandy dark-gray slightly micaceous; P2
3	38.1	29.1	Sand, very silty dark-gray micaceous pyritiferous; P3
4	46.0	7.9	Clay, very dark-brown to black carbonaceous; contaminated by sand
5	46.2	0.2	Silt, clayey dark-brownish-black slightly micaceous

Ernest Mitchell Property

Test Hole Record H58

Location: T.24 N., R.3 E., Sec. 29, E. 1/2, NE. 1/4, SW. 1/4; 600 feet west of Gentry Ford bridge, 13 feet above south bank of Askalmore Creek

Drilled: August 20, 1940

Elevation: 227 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	5.0	5.0	Clay, very slightly silty cream-colored buff mottled; P1
2	6.3	1.3	Clay, slightly silty buff tan mottled; P2
3	12.3	6.0	Clay, slightly silty chocolate-tan red mottled; P3
4	13.5	1.2	Clay, slightly silty grayish-tan

Ernest Mitchell Property

Test Hole Record H59

Location: T.24 N., R.3 E., Sec. 29, E. 1/2, NE. 1/4, SW. 1/4; 500 feet west of Gentry Ford bridge, 4 feet above south bank of Askalmore Creek

Drilled: September 16, 1940

Elevation: 215 feet

Water level: 41.8 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	6.1	6.1	Clay, slightly silty dark-grayish-tan; P1
2	17.7	11.6	Clay, slightly silty very dark-grayish-tan; P2
3	25.3	7.6	Clay, very slightly silty dark-grayish-tan; P3
4	39.3	14.0	Clay, slightly silty grayish-tan; P4
5	41.0	1.7	Clay, very slightly silty grayish-tan; laminae of light-gray micaceous silt; P5
6	41.5	0.5	Lignite, blocky fracture
7	41.8	0.3	Silt, slightly clayey dark-gray slightly lignitic slightly micaceous
8	44.0	2.2	Silt, clayey very dark-brown to black spongy slightly micaceous; laminae of dark carbonaceous clay

LEWIS NEWTON ESTATE PROPERTY

TEST HOLE 60

Location: T.24 N., R.2 E., Sec. 35, S. 1/2, SE. 1/4, NE. 1/4; beneath quartzite in small flowing stream. Drilled: August 26, 1940

Elevation: 244 ft. Water level: 18 ft.

No.	Depth	Thick.	Description of strata and designations of samples
1	3.0	3.0	Quartzite, yellowish-gray dense hard
2	6.6	3.6	Claystone, white gray mottled hard weathered
3	11.5	4.9	Clay, fairly silty, light tan when wet, drying to buff with white and yellow mottling. Slightly micaceous, weathered
4	17.8	6.3	Silt, clayey buff slightly micaceous
5	18.8	1.0	Laminated silty sand and clay. The clay is white with yellow mottling; the sand is yellow and micaceous. Oxidized (probable unconformity)
6	19.6	0.8	Silt, clayey salmon pink purplish mottled slightly micaceous
7	22.4	2.8	Silt, sandy white yellow mottled slightly micaceous
8	26.0	3.6	Sand, medium-grained to coarse-grained yellow
9	29.9	3.9	Sand, medium-grained to coarse-grained buff micaceous
10	31.3	1.4	Sand, medium-grained to coarse-grained yellow
11	34.4	3.1	Sand, medium-grained yellow

LEWIS NEWTON ESTATE PROPERTY

TEST HOLE RECORD H61

Location: T.24 N., R.2 E., Sec. 36, SE. 1/4, SW. 1/4, NW. 1/4; west bank Young Creek, juncture of small gully with creek Drilled: September 3, 1940

Elevation: 207 feet Water level: 31 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	2.5	2.5	Clay, very slightly silty dark-brown dark-gray mottled carbonaceous
2	30.2	27.7	Clay, very slightly silty dark-brown to black carbonaceous; thinly laminated; P2
3	36.1	5.9	Clay, slightly silty dark-grayish-tan; P3
4	43.9	7.8	Clay, slightly silty dark-gray; P4
5	44.4	0.5	Clay, very silty bright yellow
6	44.5	0.1	Siltstone, yellowish-brown limonitic
7	44.6	0.1	Sand, very fine-grained yellow

SPENCER HALL PROPERTY

TEST HOLE 64

Location: T.24 N., R.2 E., Sec. 36, NW. 1/4, NW. 1/4, SW. 1/4; 150 ft. NW. of Hall home near head of dry ravine Drilled: September 14, 1940

Elevation: 277 ft. Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
1	10.2	10.2	Loess, buff to brown weathered
2	14.6	4.4	Loess and gravel, reddish-brown
3	17.6	3.0	Pebble conglomerate cemented by brown limonite
4	27.2	9.6	Sand, medium-grained to coarse-grained brown micaceous oxidized
5	29.2	2.0	Sand, medium-grained buff to yellow micaceous oxidized
6	30.3	1.1	Sandstone, loosely cemented; gray, weathering buff; jointed, joints filled with limonitic conglomerate

JOHN DENMAN PROPERTY

TEST HOLE 65

Location: T.24 N., R.2 E., Sec. 26, SE. 1/4, SE. 1/4, SE. 1/4; near crest of steep hill 175 ft. from S. line, 300 ft. from E. line

Drilled: September 18, 1940

Elevation: 295 ft. Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
1	14.9	14.9	Loess, gray-brown
2	16.6	1.7	Loess and gravel; Ferruginous sandstone at base (Probably base of Citronelle)
			Upper (continental) Zilpha
3	24.1	7.5	Clay, fairly silty light-gray pink mottled plastic; P3
4	24.8	0.7	Silt, clayey buff pink mottled
5			Rock (?)

ANDREW HILL PROPERTY

TEST HOLE RECORD H66

Location: T.25 N., R.2 E., Sec. 34, NE. 1/4, SE. 1/4, NE. 1/4; at top of roadcut through loess bluff 100 feet north of cemetery

Drilled: September 23, 1940

Elevation: 210 feet

Water level: 36 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Loess formation
1	3.0	3.0	Loess, silty light-gray-buff; well leached
2	6.3	3.3	Loess, slightly silty gray-buff; leached
3	9.2	2.9	Loess, slightly silty light-buff; leached
4	12.0	2.8	Loess, very slightly silty light-buff
5	15.0	3.0	Loess, very slightly silty buff slightly limey
6	18.0	3.0	Loess, very slightly silty limey; red-buff ferruginous concretions
7	21.3	3.3	Loess, silty light-gray; leached
8	24.0	2.7	Loess, slightly silty light-gray-buff; leached
9	27.3	3.3	Loess, very slightly silty gray-buff
10	30.0	2.7	Loess, slightly silty gray-buff
11	33.0	3.0	Loess, very slightly silty buff slightly limey
12	35.1	2.1	Loess, slightly silty buff fairly limey
13	36.0	0.9	Loess, silty red-buff; ferruginous concretions
14	37.5	1.5	Sand, fine to coarse-grained light gray; poorly sorted

JOHN DENMAN PROPERTY

TEST HOLE RECORD H68

Location: T.24 N., R.2 E., Sec. 36, N. 1/2, NE. 1/4, NW. 1/4; 50 feet from north line, 500 feet from west line, ridge top on west bank of small creek tributary to Young Creek Drilled: December 20, 1940

Elevation: 244 feet Water level: 26 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Loess formation
1	13.8	13.8	Loess, silty yellowish-brown
2	15.4	1.6	Loess, silty bright yellow ochreous
3	19.1	3.7	Loess, silty yellowish-brown
4	19.9	0.8	Loess, silty reddish-brown
5	24.7	4.8	Loess, silty yellowish-brown
			Citronelle formation
6	25.3	0.6	Sand, medium-grained buff; coarse chert gravel
			Upper (continental) Zilpha
7	26.7	1.4	Clay, fairly silty light-greenish-gray yellow mottled; P7
8	35.4	8.7	Clay, very slightly silty chocolate-tan; P8
9	38.6	3.2	Clay, slightly silty chocolate-brown; P9
10	40.3	1.7	Clay, slightly silty brownish-black; P10
11	62.9	22.6	Clay, slightly silty chocolate-brown to brownish-black; P11
12	71.7	8.8	Clay, slightly silty dark-bluish-gray
13	71.9	0.2	Sand, medium-grained white

MRS. ESTES CALHOUN PROPERTY

TEST HOLE RECORD H70

Location: T.22 N., R.3 E., Sec. 3, N. 1/2, SE. 1/4, NW. 1/4; (Grenada County) 300 feet from north line, 500 feet from east line at Winona-Zilpha contact, at base of bluff of south side of Rattlesnake Creek, few feet above water's edge

Drilled: September 10, 1940

Elevation: 192 feet

Water level: 8 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Top Winona member
1	10.2	10.2	Sand, fine-grained to silty brownish-green very glauconitic fairly micaceous; several distinct layers of glauconitic claystone nodules; P1
2	22.3	12.1	Sand, silty greenish-black fairly glauconitic slightly micaceous; P2
3	25.4	3.1	Sand, silty dark-gray slightly glauconitic fairly micaceous; interlaminated with chocolate-brown carbonaceous silty clay
4	26.0	0.6	Sand, slightly silty dark-greenish-brown very glauconitic slightly micaceous
5	27.6	1.6	Clay, slightly silty carbonaceous chocolate-tan; interlaminated dark-gray very micaceous silty sand
6	32.3	4.7	Sand, fine-grained dark-greenish-gray slightly glauconitic very micaceous

A. G. THOMAS PROPERTY

TEST HOLE 71

Location: T.24 N., R.3 E., Sec. 27, S. 1/2, NE. 1/4, SW. 1/4; 500 ft. from E. line, 150 ft. from S. line, on N. bank of Thomas Creek (Dry Creek)

Drilled: September 23, 1940

Elevation: 276 feet   Water level: Perched water table at 13.8 and at 37.2

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	5.3	5.3	Silt, sandy buff yellow mottled micaceous incipiently oxidized; P1
2	13.8	8.5	Silt, slightly clayey light-gray slightly micaceous; P2
3	18.1	4.3	Silt, sandy grayish-white micaceous; laminae of darker gray clayey silt
4	31.2	13.1	Silt and silty clay, dark-gray slightly micaceous slightly lignitic
5	32.9	1.7	Clay, fairly silty grayish-white yellow mottled slightly micaceous
6	34.0	1.1	Clay, fairly silty greenish-yellow yellow mottled
7	37.1	3.1	Clay, fairly silty bright-yellow ochreous
8	37.2	0.1	Sandstone, limonitic ferruginous
9	42.0	4.8	Sand, silty buff to yellow micaceous

Mrs. Estes Calhoun Property

Test Hole 74

Location: T.22 N., R.3 E., Sec. 3, N. 1/2, SE. 1/4, NW. 1/4; 300 ft. from N. line, 525 ft. from E. line, composite outcrop and test hole samples from face of bluff above H-70 Drilled: September 10, 1940

Elevation: 234 ft. Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
1	15.1	15.1	Soil and loess, brown
			Citronelle formation
2	17.5	2.4	Silt, very sandy very light-gray; large white chert pebbles
3	21.2	3.7	Silt and sand, brownish-yellow; small chert pebbles
4	22.2	1.0	Silt, clayey buff to yellow; small clay pebbles
			Upper (continental) Zilpha
5	26.0	3.8	Silt, clayey light-grayish-tan; conchoidal fracture; P5
6	28.1	2.1	Clay, chocolate-brown; thin partings of gray lignitic micaceous silt; P6
7	29.5	1.4	Clay, brownish-black; thin partings of gray lignitic micaceous silt
			Top lower (marine) Zilpha
8	30.6	1.1	Laminated clay and silty clay, grayish-black; numerous glauconitic sandy nodules; P8
9	35.5	4.9	Laminated clay and silty micaceous clay; clay is chocolate-brown drying grayish-brown; silty clay is dark-gray drying light-gray; P9
10	37.1	1.6	Clay, fairly silty dark-grayish-brown; conchoidal fracture; gypsum filled fractures; P10
11	42.3	5.2	Laminated silty clay and sand, greenish-black glauconitic very micaceous; contains melanterite; nodules of buff claystone; P11
12	45.2	2.9	Laminated clay and silty clay, dark-greenish-black; contains melanterite; P12

AUTREY RICE PROPERTY

TEST HOLE 78

Location: T.23 N., R.3 E., Sec. 3, S. 1/2, SW. 1/4, SW. 1/4; 50 ft. from S. line, 300 ft. from W. line bed of NW. flowing stream

Drilled: October 30, 1940

Elevation: 269 ft. Water level:

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	4.5	4.5	Silt, slightly sandy dark-gray slightly micaceous; P1
2	7.2	2.7	Silt, slightly sandy dark-gray slightly micaceous slightly lignitic; P2
3	8.6	1.4	Silt, dark-gray; P3
4	10.0	1.4	Silt, slightly clayey dark-gray slightly lignitic; P4
5	15.0	5.0	Silt, slightly clayey dark-gray; P5
6	17.6	2.6	Silt, fairly clayey medium-gray; P6
7	20.1	2.5	Silt, slightly clayey brownish-gray; P7
8	22.3	2.2	Laminated silt and silty clay; clay is dark-brownish-gray; silt is greenish-gray, slightly micaceous; P8
9	23.4	1.1	Silt, fairly clayey dark-greenish-gray slightly micaceous; P9
10	26.4	3.0	Laminated silt and silty clay; silt is greenish-gray; clay is very dark-gray; P10
11	28.1	1.7	Silt, fairly clayey dark-greenish-gray; P11
12	30.0	1.9	Silt, fairly clayey dark-greenish-gray; contains small pellets of grayish-white clay; P12
13	31.7	1.7	Silt, fairly clayey dark-greenish-gray pyritiferous; P13
14	33.6	1.9	Laminated silt and silty clay; silt is dark-greenish-gray; clay is very dark-gray; P14
15	34.8	1.2	Silt, greenish-gray; P15
16	35.5	0.7	Laminated silt, clayey silt and silty sand; clayey silt and silt are greenish-gray; silty sand is grayish-white and yellow mottled; P16
17	36.4	0.9	Laminated silt and silty clay, light bluish-gray; P17
18	37.2	0.8	Silt, fairly clayey light-gray; P18
19	37.9	0.7	Clay, slightly silty light-bluish-gray
20	38.8	0.9	Clay, fairly silty light-gray; P20
21	39.3	0.5	Laminated silt and clay; silt is sandy and bright-yellow; clay is light gray; P21
22	40.0	0.7	Sandstone, silty and limonitic; more limonitic portions are brownish-tan; less limonitic portions are fine-grained and bright-yellow
23	(?)	(?)	Clay, white

M. G. GENTRY PROPERTY

TEST HOLE 79

Location: T.24 N., R.3 E., Sec. 21, SE. 1/4, SW. 1/4, SE. 1/4; 50 ft. from E. line, 300 ft. from S. line, on S. side of creek, 50 ft. west of bridge

Drilled: September 18, 1940

Elevation: 247 ft.

Water level: 12 ft.

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	8.1	8.1	Silt, clayey grayish-white yellow and red mottled oxidized; P1
2	19.0	10.9	Silt, clayey dark-grayish-tan slightly micaceous; P2
3	21.2	2.2	Silt, slightly clayey grayish-white buff and yellow mottled micaceous oxidized
4	23.0	1.8	Silt, clayey grayish-white yellow mottled micaceous oxidized
5	23.1	0.1	Limonite, bright-yellow to dark-brown
6	24.3	1.2	Clay, very silty bright-yellow ochreous micaceous
7	26.1	1.8	Silt, clayey cream-colored buff and purple mottled slightly micaceous
8	28.0	1.9	Clay, fairly silty buff yellow and purple mottled
9	29.1	1.1	Silt, sandy cream-colored buff and purple mottled
10	30.5	1.4	Sand, silty buff micaceous
11	33.0	2.5	Sand, fine-grained white cream mottled slightly micaceous
12	36.1	3.1	Sand, medium-grained to coarse-grained light-buff very slightly micaceous

JOHN PENDERGRAST PROPERTY

TEST HOLE RECORD H80

Location: T.24 N., R.3 E., Sec. 10, NE. 1/4, SE. 1/4, NE. 1/4; 400 feet from north line, 400 feet from east line; on north bank of creek

Drilled: September 20, 1940

Elevation: 230 feet

Water level: 8 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Top lower (marine) Zilpha
1	0.8	0.8	Claystone, limonitic yellowish-brown
2	5.2	4.4	Silt and silty clay, dark grayish-tan to chocolate-brown; thinly laminated; P1
3	5.9	0.7	Sand, silty dark-greenish-gray slightly glauconitic slightly micaceous
4	7.2	1.3	Silt, fairly clayey dark-gray-tan
5	9.2	2.0	Silt, clayey dark-greenish-gray; numerous aggregates of very glauconitic sand grains
6	9.6	0.4	Silt, clayey dark-grayish-green very glauconitic
7	13.5	3.9	Silt, clayey dark-greenish-gray; numerous aggregates of very glauconitic sand; P6
8	17.4	3.9	Silt, fairly clayey grayish-black
9	18.0	0.6	Silt, slightly clayey grayish-black
10	19.0	1.0	Silt, clayey dark-greenish-gray; numerous aggregates of very glauconitic sand
11	22.5	3.5	Silt, slightly clayey nearly black micaceous; small nodules of grayish-tan claystone
			Top Winona member
12	27.4	4.9	Sand, silty greenish-black very glauconitic slightly micaceous; large nodules of grayish-tan glauconitic claystone
13	40.3	12.9	Sand, slightly silty nearly black fairly glauconitic fairly micaceous

George Jones Property
Test Hole Record H83

Location: T.24 N., R.2 E., Sec. 2, NW. 1/4, NW. 1/4, NE. 1/4; at base of gravel near head of gully wash, 250 feet from west line, 600 feet from north line

Drilled: October 1, 1940

Elevation: 286 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	7.1	7.1	Silt, slightly clayey gray-buff; P1
2	12.2	5.1	Silt, slightly clayey gray-buff yellow mottled slightly micaceous; P2
3	19.0	6.8	Silt, gray-buff slightly micaceous; small pellets of lignite; P3
4	21.0	2.0	Silt, slightly clayey gray-buff; P4
5	26.6	5.6	Silt, gray-buff; P5

G. G. Jones Property
Test Hole Record H84

Location: T.24 N., R.3 E., Sec. 2, NW. 1/4, NW. 1/4, NE. 1/4; foot of gully wash, 200 feet from north line, 350 feet from west line

Drilled: October 14, 1940

Elevation: 263 feet

Water level: 15 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	4.5	4.5	Silt, slightly clayey gray-buff, yellow mottled slightly micaceous
2	5.8	1.3	Sand, fine-grained cream-colored slightly micaceous
3	7.5	1.7	Sand, silty buff slightly micaceous
4	8.5	1.0	Sand, silty yellow-buff slightly micaceous; laminae of grayish-white yellow mottled silty clay
5	9.4	0.9	Sand, fine-grained yellow fairly micaceous; laminae of grayish-white silty clay
6	13.9	4.5	Sand, silty cream to buff slightly micaceous
7	17.5	3.6	Sand, fine-grained to medium-grained salmon-pink fairly micaceous
8	19.0	1.5	Sand, medium-grained to coarse-grained deep salmon-pink micaceous
9	19.5	0.5	Sand, medium-grained to coarse-grained pinkish-buff slightly micaceous
10	20.2	0.7	Sand, fine-grained to medium-grained flesh-pink fairly micaceous
11	28.3	8.1	Sand, medium-grained flesh-colored fairly micaceous
12	36.0	7.7	Sand, fine-grained to medium-grained flesh-pink fairly micaceous

J. H. CALDWELL PROPERTY

TEST HOLE RECORD H85

Location: T.25 N., R.3 E., Sec. 35, NW. 1/4, SE. 1/4, NE. 1/4; at top of hill 75 feet south of farm road on creek bank, 400 feet from west line, 500 feet from north line — Drilled: October 4, 1940
Elevation: 260 feet — Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
1	5.4	5.4	Soil—silt, grayish-tan
2	8.2	2.8	Loess, silty gray-brown oxidized
			Upper (continental) Zilpha
3	9.2	1.0	Silt, clayey gray-buff root-marked
4	10.8	1.6	Clay, silty gray-brown slightly micaceous; thinly laminated; P4
5	12.2	1.4	Clay, silty yellow-brown yellow mottled thinly laminated
6	17.0	4.8	Clay, silty brownish-tan grayish-tan mottled; P6
7	19.3	2.3	Clay, fairly silty yellowish-brown; much selenite
8	19.8	0.5	Silt, clayey greenish-black glauconitic; laminae of brown silty clay; much selenite
9	20.0	0.2	Silt, sandy brown; laminae of yellow silty clay; much selenite
10	20.2	0.2	Silt, sandy brownish-green very glauconitic; some selenite; a few gray clay pellets
11	20.4	0.2	Sand, silty greenish-black glauconitic; small pellets of ferruginous sandstone
12	22.2	1.8	Sand, silty brownish-green very glauconitic; pellets of glauconitic claystone
			Rock, hard

J. H. CALDWELL PROPERTY

TEST HOLE RECORD H87

Location: T.25 N., R.3 E., Sec. 35, SE. 1/4, SE. 1/4, NE. 1/4; base of hill in small stream, 400 feet from south line, 400 feet from east line
Drilled: October 8, 1940
Elevation: 233 feet — Water level: 8 feet

No.	Depth	Thick.	Description of strata and designations of samples
1	3.1	3.1	Soil—loess and gravel, gray-buff
			Lower (marine) Zilpha
2	6.0	2.9	Clay, silty chocolate-tan iron-stained; laminae of tan clayey silt; P2
3	7.8	1.8	Clay-shale, slightly silty chocolate-tan micaceous; P3
4	16.8	9.0	Clay, slightly silty dark-greenish-gray; P4
5			Rock, hard

G. W. Cox Property
Test Hole 89

Location: T.23 N., R.3 E., Sec. 10, NW. 1/4, NW. 1/4, NW. 1/4; 50 ft. from N. line, 300 ft. from W. line, in bed of small N. flowing stream

Drilled: October 28, 1940

Elevation: 287 ft. Water level: 7 ft.

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	4.0	4.0	Silt, fairly clayey yellow-buff slightly micaceous; P1
2	5.0	1.0	Silt, slightly clayey buff yellow mottled fairly lignitic; P2
3	10.0	5.0	Silt, fairly clayey greenish-gray slightly lignitic; P3
4	11.7	1.7	Clay, fairly silty dark-gray; P4
5	14.3	2.6	Silt, slightly clayey greenish-gray; P5

J. H. Caldwell Property
Test Hole Record H90

Location: T.25 N., R.3 E., Sec. 35, NE. 1/4, NE. 1/4, SE. 1/4; at head of ravine at base of gravel, 400 feet from north line, 50 feet from east line

Drilled: October 14, 1940

Elevation: 272 feet Water level: 25 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	5.8	5.8	Silt, slightly sandy buff yellow mottled fairly micaceous; P1
2	7.6	1.8	Silt, clayey dark-greenish-gray slightly micaceous slightly lignitic; P2
3	10.1	2.5	Silt, slightly clayey gray-buff yellow mottled fairly micaceous; P3
4	11.3	1.2	Silt, sandy buff slightly micaceous
5	12.5	1.2	Silt, slightly clayey gray-buff yellow mottled slightly micaceous; P5
6	14.5	2.0	Clay, fairly silty dark-gray slightly micaceous; P6
7	15.3	0.8	Sand, silty dark-gray fairly micaceous
8	16.8	1.5	Clay, fairly silty dark-gray slightly micaceous; P8
9	19.1	2.3	Clay, fairly silty dark-greenish-gray fairly micaceous lignitic; small limonite pebbles; P9
10	20.7	1.6	Clay, silty medium-gray slightly micaceous; silty laminae; P10
11	22.6	1.9	Silt, sandy buff yellow mottled very micaceous; P11
12	23.5	0.9	Silt, buff yellow mottled slightly micaceous; P12
13	24.5	1.0	Sand, fine-grained buff slightly micaceous; pellets of limonite-coated clay
14	29.5	5.0	Sand, fine-grained slightly micaceous
15	32.5	3.0	Silt, sandy white slightly micaceous

Guy Whitten Property

Test Hole Record H91

Location: T.25 N., R.3 E., Sec. 29, SW. 1/4, SW. 1/4, NE. 1/4; south bank of Rattlesnake Creek at top of sand bluff, 50 feet from west line, 300 feet from south line

Drilled: October 14, 1941

Elevation: 284 feet

Water level: 53 feet

No.	Depth	Thick.	Description of strata and designations of samples
1	7.8	7.8	Loess, silty gray-tan
			Citronelle formation
2	15.4	7.6	Gravel, coarse cherty
			Upper (continental) Zilpha
3	30.2	14.8	Sand, fine-grained to medium-grained grayish-white mottled fairly micaceous
4	30.4	0.2	Clay, slightly silty buff to tan
5	35.5	5.1	Sand, very fine-grained grayish-white yellow and buff mottled slightly micaceous
6	49.7	14.2	Sand, very fine-grained yellowish-cream slightly micaceous
7	59.7	10.0	Sand, fine-grained slightly silty buff yellow mottled
8	61.1	1.4	Sand, medium-grained bright yellow slightly micaceous
9	70.2	9.1	Sand, medium-grained to coarse-grained yellow buff slightly micaceous

Mrs. C. O. Howard Property

Test Hole Record H93

Location: T.26 N., R.3 E., Sec. 21, SW. 1/4, NE. 1/4, SW. 1/4; west bank of creek above a yellow ochre bed, 350 feet from south line, 250 feet from north line

Drilled: November 22, 1940

Elevation: 272 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	1.3	1.3	Clay, slightly silty gray-buff yellow mottled root-marked; P1
2	2.6	1.3	Clay, slightly silty yellow-buff root-marked; P2
3	4.7	2.1	Clay, fairly silty brownish-yellow gray mottled ochreous; P3
4	7.5	2.8	Clay, very slightly silty pinkish-white very plastic; P4
5	9.7	2.2	Clay, very slightly silty white pinkish mottled very plastic; P5
6	12.1	2.4	Clay, very slightly silty white yellow mottled very plastic; P6
7	14.8	2.7	Clay, slightly silty white yellow mottled fairly plastic; P7
8	16.8	2.0	Clay, slightly silty white buff mottled fairly plastic; P8
9	19.7	2.9	Clay, slightly silty pinkish-white buff mottled fairly plastic; P9
10	21.0	1.3	Silt, slightly clayey grayish-white; pyritiferous at base
11	23.5	2.5	Clay, fairly silty grayish-white buff mottled; P11
12	25.5	2.0	Clay, slightly silty grayish-white; P12
13			Silt, indurated

JOE E. MULLEN PROPERTY

TEST HOLE RECORD H96

Location: T.23 N., R.2 E., Sec. 13, NW. 1/4, SW. 1/4, SE. 1/4; at top of lignite in bed of deep gully, 600 feet southwest of Stonefield Church

Drilled: October 17, 1940

Elevation: 294 feet

Water level: 1 foot

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	3.7	3.7	Lignite, brownish-black pyritic; weathered; silty laminae
2	9.9	6.2	Clay, fairly silty bluish-gray; dries light-gray; P2
3	12.1	2.2	Clay, fairly silty dark-gray slightly lignitic slightly micaceous; dries light-gray; P3
4	14.4	2.3	Clay, fairly silty medium-gray slightly lignitic; dries light-gray; P4
5	17.5	3.1	Clay, fairly silty dark-gray fairly lignitic; dries light-gray; laminae of ochreous and micaceous clay; P5
6	19.5	2.0	Clay, fairly silty medium-gray lignitic; dries light-gray; P6
7	21.7	2.2	Clay, fairly silty medium-gray lignitic; dries light-gray; abundant lignitic leaves; P7

JOE E. MULLEN PROPERTY

TEST HOLE RECORD H97

Location: T.23 N., R.2 E., Sec. 13, W. 1/2, SW. 1/4, SE. 1/4; in silt outcrop at west bank of small stream about 900 feet southwest Stonefield Church

Drilled: October 16, 1940

Elevation: 273 feet

Water level: 10 feet

No.	Depth	Thick.	Description of strata and designations of samples
1	3.1	3.1	Loess and weathered shale, gray-buff
			Upper (continental) Zilpha
2	8.2	5.1	Clay, silty greenish-gray; dries light-gray; laminae of brownish-gray very lignitic clayey silt; P2
3	11.5	3.3	Silt, slightly clayey greenish-gray slightly micaceous; P3
4	15.3	3.8	Clay, fairly silty medium-gray; P4

Joe E. Mullen Property

Test Hole Record H98

Location: T.23 N., R.2 E., Sec. 13, S. 1/2, SW. 1/4, SE. 1/4; in silty clay outcrop on east bank of stream, about 1200 feet southwest of Stonefield Church

Drilled: October 17, 1940

Elevation: 258 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	9.1	9.1	Silt, slightly clayey greenish-gray slightly lignitic fairly micaceous; P1
2	14.0	4.9	Silt, fairly clayey medium-gray to dark-gray slightly lignitic fairly micaceous; dries light-gray; P2
3	15.4	1.4	Silt, slightly clayey dark-greenish-gray lignitic slightly micaceous; P3
4	17.2	1.8	Silt, slightly clayey gray-buff; ferruginous sandstone partings; P4
5	22.0	4.8	Sand, slightly silty flesh-pink fairly micaceous
6	24.2	2.2	Sand, fine to silty buff to pink fairly micaceous
7	28.3	4.1	Sand, fine-grained to medium-grained salmon-pink fairly micaceous; thin clay partings
8	33.5	5.2	Sand, medium-grained to coarse-grained gray-buff slightly micaceous
9	43.6	10.1	Sand, unusually coarse pure white; grains angular

L. D. WHEAT PROPERTY

TEST HOLE RECORD H100

Location: T.26 N., R.3 E., Sec. 13, S. 1/2, SW. 1/4, NE. 1/4; at narrow loop of creek showing yellow ochre, 450 feet from south line, 600 feet from east line

Drilled: November 18, 1940

Elevation: 277 feet

Water level: 20 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	1.8	1.8	Clay, slightly silty bright yellow ochreous; P1
2	3.9	2.1	Clay, very slightly silty brownish-black; numerous leaf prints; P2
3	7.2	3.3	Clay, very slightly silty brownish-black; numerous leaf prints; P3
4	10.6	3.4	Clay, very slightly silty brownish-black; numerous leaf prints; P4
5	14.7	4.1	Clay, very slightly silty brownish-black; numerous leaf prints; P5
6	20.0	5.3	Clay, slightly silty dark-tannish-gray; P6
7	24.1	4.1	Silt, fairly clayey greenish-gray; P7
8	27.2	3.1	Clay, silty medium-gray; laminae of clayey silt; P8
9	31.2	4.0	Clay, fairly silty dark-greenish-gray; elongated cylindrical bodies of dark-tannish-gray clay about 1 inch in diameter; P9
10	35.3	4.1	Silt, fairly clayey dark-greenish-gray elongated cylindrical bodies of dark-tannish-gray clay about 1 inch in diameter; P10
11	41.0	5.7	Clay, silty dark-greenish-gray; cylindrical bodies of medium-gray slightly lignitic clayey silt; P11
12	46.1	5.1	Clay, fairly silty dark-greenish-gray slightly lignitic fairly micaceous; P12

M. B. Black Property

Test Hole H107

Location: T.23 N., R.2 E., Sec. 14, NE. 1/4, NE. 1/4, NW. 1/4; base of a gully on the face of bluff, 500 ft. from north line, 500 ft. from east line

Drilled: November 13, 1940

Elevation: 206 ft. Water level: 17 ft.

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	5.4	5.4	Silt, slightly sandy grayish-white yellow mottled
2	7.0	1.6	Silt, grayish-white yellow mottled
3	9.6	2.6	Silt, clayey buff yellow mottled; P3
4	12.1	2.5	Silt, clayey light-tan slightly micaceous; P4
5	12.5	0.4	Clay, fairly silty chocolate-tan slightly micaceous; P5
6	15.3	2.8	Clay, fairly silty dark-brown; P6
7	20.5	5.2	Silt, fairly clayey dark-greenish-gray slightly micaceous; P7
8	27.1	6.6	Sand, slightly silty greenish-gray; lignitic and micaceous laminae
9	27.5	0.4	Sand, fine-grained greenish-tan micaceous; laminae of brownish-black lignite
10	29.5	2.0	Sand, fine-grained buff slightly micaceous
11	35.6	6.1	Sand, fine-grained cream-colored slightly micaceous
12	41.0	5.4	Sand, slightly silty grayish-white fairly micaceous
13	42.5	1.5	Silt, fairly sandy grayish-white fairly micaceous
14	45.4	2.9	Sand, slightly silty grayish-white slightly micaceous
15	51.6	6.2	Silt, fairly sandy cream-colored
16	53.2	1.6	Silt, cream-colored slightly micaceous; laminae of sandy silt and clayey silt

Robert Ford Property

Test Hole 111

Location: T.24 N., R.2 E., Sec. 3, W. 1/2, NE. 1/4, SE. 1/4; 50 ft. from W. line, 600 ft. from N. line, S. bank of Hubbard Creek in an outcrop of clay

Drilled: October 26, 1940

Elevation: 200 ft. Water level: 30 ft.

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	11.1	11.1	Silt, fairly clayey medium-gray slightly micaceous slightly lignitic; P1
2	20.2	9.1	Clay, fairly silty dark-gray; P2
3	37.2	17.0	Clay, fairly silty dark-gray slightly micaceous; P3

WILLIAM ADAMS PROPERTY

TEST HOLE 113

Location: T.25 N., R.3 E., Sec. 23, NE. 1/4, NE. 1/4, SE. 1/4; in west bank of creek at foot of bluff, 150 ft. from N. line, 600 ft. from E. line

Drilled: November 19, 1940

Elevation: 307 ft. Water level: 7 ft.

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	5.8	5.8	Laminated clay and clayey silt, light-gray; buff mottled along the laminae; slightly micaceous; oxidized; P1
2	7.0	1.2	Laminated clay and silt, light-gray yellowish-brown mottled oxidized; P2
3	8.5	1.5	Silt, clayey cream-colored buff mottled oxidized; P3
4	9.4	0.9	Laminated clay and silt, buff red mottled; chert gravel (a contamination?)
5	10.6	1.2	Sand, slightly silty pinkish-buff fairly micaceous
6	15.4	4.8	Sand, fairly silty yellowish-brown slightly micaceous; contains ferruginous sandstone pebbles with black coating
7	17.1	1.7	Laminated clay and silt; clay is light gray; silt is reddish-buff and micaceous
8	17.6	0.5	Clay, fairly silty light-gray
9	21.7	4.1	Silt, fairly clayey grayish-white slightly micaceous
10	22.5	0.8	Clay, very slightly silty light-gray
11	24.0	1.5	Silt, sandy grayish-white fairly micaceous
12	26.4	2.4	Laminated silty clay and silt, light-gray, red mottled along laminae
13	31.7	5.3	Laminated silty clay, light-gray, yellow mottled along laminae
14	37.1	5.4	Silt, slightly clayey cream-colored slightly micaceous
15	39.1	2.0	Clay, slightly silty light-gray; contaminated with silt from above
16	39.7	0.6	Sand, fine-grained light-gray fairly micaceous
17	40.4	0.7	Laminated clay and silt; clay is light-gray; silt is yellowish-brown and micaceous
18	42.7	2.3	Silt, sandy grayish-white fairly micaceous
19	53.3	10.6	Laminated clay and silty sand; clay is light to medium-gray and very plastic; sand is yellow and fairly micaceous

Charles Anderson Property

Test Hole Record 114

Location: T.23 N., R.2 E., Sec. 2, S. 1/2, NW. 1/4, SW. 1/4; in clay bed east side of old road, 400 feet from south line, 400 feet from west line

Drilled: December 18, 1940

Elevation: 197 feet

Water level: 8 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	9.6	9.6	Clay, slightly silty dark-brownish-gray; impressions of leaves
2	16.3	6.7	Clay, very slightly silty dark-brownish-gray
3	19.0	2.7	Clay, slightly silty dark-brown; impressions of leaves
4	24.3	5.3	Sand, medium-grained to coarse-grained white (discolored by brown water from above); coarse fragments of lignite

W. V. MOORE PROPERTY

TEST HOLE 115

Location: T.25 N., R.4 E., Sec. 29, NW. 1/4, SW. 1/4, SW. 1/4; 100 ft. from W. line, 200 ft. from N. line, in clay bank 120 ft. E. of Highway 51

Drilled: November 4, 1940

Elevation: 288 ft. Water level: 23 ft.

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	2.8	2.8	Clay, silty light-gray buff mottled; P1
2	5.1	2.3	Silt, clayey grayish-white; P2
3	7.1	2.0	Silt, gray-buff yellow mottled; P3
4	7.7	0.6	Silt, sandy yellowish-buff slightly micaceous
5	10.2	2.5	Clay, very slightly silty light-greenish-gray waxy; P5
6	11.8	1.6	Silt, sandy grayish-white slightly micaceous
7	13.8	2.0	Silt, fairly clayey grayish-white slightly micaceous; P7
8	14.0	0.2	Sandstone, fine-grained yellowish-brown limonitic
9	16.7	2.7	Sand, fine-grained to medium-grained cream to buff slightly micaceous
10	20.1	3.4	Sand, fine-grained to medium-grained gray-buff pink tinted slightly micaceous
11	21.3	1.2	Sand, fine-grained buff slightly micaceous
12	23.4	2.1	Sand, fine-grained to medium-grained yellow-buff
13	23.8	0.4	Laminated clay and silt; clay is light-greenish-gray; silt is buff, micaceous, and fairly lignitic
14	26.0	2.2	Sand, fine-grained grayish-white fairly micaceous
15	27.2	1.2	Laminated sand and silty clay; sand is medium-grained and yellowish-buff; clay is yellowish-brown and lignitic
16	31.3	4.1	Laminated silt and silty clay, light-greenish-gray; P16
17	31.6	0.3	Laminated clay and silt; clay is greenish-gray; silt is yellowish-brown
18	33.9	2.3	Clay, silty mauve-colored; P18
19	36.3	2.4	Sand, fine-grained to medium-grained yellowish-brown

Jesse Tillman Property

Test Hole Record H116

Location: T.24 N., R.4 E., Sec. 8, E. 1/2, NE. 1/4, NW. 1/4; (Yalobusha County), at base of road cut on east side of U. S. Highway 51, 1 mile south of Tillatoba and 100 feet south of bridge

Drilled: November 4, 1940

Elevation: 302 feet

Water level: 15 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Winona sand
1	6.5	6.5	Sand, fine-grained brown micaceous
2	9.3	2.8	Sand, medium-grained rusty-red fairly micaceous; thin partings of ferruginous sandstone
3	10.3	1.0	Sand, fine-grained to medium-grained buff dark-flecked fairly micaceous
4	10.6	0.3	Sand, fine-grained to medium-grained flesh-pink very micaceous; light-greenish-gray flecks
5	17.0	6.4	Sand, fine-grained light-greenish-buff slightly micaceous
6	20.9	3.9	Sand, fine-grained to medium-grained dark-greenish-buff fairly micaceous

RAYMOND BUNTIN PROPERTY

TEST HOLE RECORD H122

Location: T.26 N., R.3 E., Sec. 20, NW. 1/4, SW. 1/4, NW. 1/4; at north side of road, 100 feet east of bridge, 300 feet from north line, 300 feet from west line

Drilled: November 28, 1940

Elevation: 334 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
1	1.5	1.5	Loess, silty gray-tan
			Citronelle formation
2	4.8	3.3	Silt, sandy tan slightly micaceous
3	6.7	1.9	Sand, silty tan purple mottled slightly micaceous
4	7.4	0.7	Silt, clayey grayish-white buff mottled
5	8.8	1.4	Sand, fine-grained to coarse-grained yellowish-tan fairly micaceous
6	14.4	5.6	Sand, medium-grained to coarse-grained salmon-pink
7	16.5	2.1	Sand, fine-grained red-buff; laminae of mulberry colored clayey silt
8	19.0	2.5	Sand, medium-grained to coarse-grained flesh-colored slightly micaceous; a few chert pebbles
9	23.6	4.6	Sand, medium-grained to coarse-grained flesh-colored
10	25.9	2.3	Sand, fine-grained to coarse-grained salmon-pink fairly micaceous; fine chert gravel
11	31.4	5.5	Sand, fine-grained light-pink fairly micaceous; fine chert gravel
12	34.0	2.6	Clay, silty dark-pink; laminae of medium-grained to coarse-grained sand
13	45.7	11.7	Sand, medium-grained to coarse-grained flesh colored; abundance of white cherty gravel
14	54.3	8.6	Gravel, very coarse chert

Guy Burkhalter Property

Test Hole Record H123

Location: T.26 N., R.3 E., Sec. 33, SE. 1/4, NE. 1/4, NW. 1/4; at south end of clay cliff as exposed on east bank of creek, 5 feet from south line, 400 feet from east line

Drilled: December 16, 1940

Elevation: 249 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Pleistocene and Citronelle
1	5.5	5.5	Loess and gravel
			Upper (continental) Zilpha
2	7.4	1.9	Silt, fairly clayey light-greenish-gray yellow mottled
3	32.6	25.2	Silt, slightly clayey light-gray
4	34.5	1.9	Silt, slightly clayey greenish-buff buff mottled
5	44.6	10.1	Silt, slightly clayey dark-greenish-gray
6	68.1	23.5	Silt, fairly clayey dark-greenish-gray
7	83.9	15.8	Clay, fairly silty light-greenish-gray
8	93.9	10.0	Clay, slightly silty light-greenish-gray
9	95.5	1.6	Silt, clayey dark-greenish-gray lignitic
10	107.6	12.1	Clay, fairly silty light-greenish-blue
11	111.5	3.9	Silt, fairly clayey light-brown thinly laminated slightly micaceous
12	116.4	4.9	Silt, dark-brown fairly micaceous; laminae of tan silty clay
			Top lower (marine) Zilpha
13	118.0	1.6	Silt, fairly clayey light-brown slightly micaceous; small fragments of tan claystone; a few scattered grains of glauconite
14	120.5	2.5	Sand, silty greenish-brown very glauconitic; fragments of tan claystone; laminae of light-brown silt

J. W. STOGNER PROPERTY

TEST HOLE RECORD H125

Location: T.26 N., R.3 E., Sec. 8, SE. 1/4, SW. 1/4, SW. 1/4; on south bank of creek, 200 feet from south line, 400 feet from east line

Drilled: December 3, 1940

Elevation: 269 feet

Water level: 7 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Citronelle formation
1	1.2	1.2	Sand, medium-grained to coarse-grained red-buff; coarse white cherty gravel
			Upper (continental) Zilpha
2	5.5	4.3	Clay, slightly silty pinkish-tan slightly micaceous fairly lignitic
3	6.5	1.0	Clay, silty pinkish-buff slightly micaceous
4	7.6	1.1	Sand, medium-grained to coarse-grained yellowish-brown limonitic
5	12.7	5.1	Sand, medium-grained white; a few coarse yellow grains
6	25.6	12.9	Sand, medium-grained to coarse-grained yellowish-brown

MISSISSIPPI CLAY PRODUCTS COMPANY LEASE PROPERTY

TEST HOLE RECORD H126

Location: T.26 N., R.2 E., Sec. 1, NE. 1/4, SE. 1/4, SE. 1/4; on east bank of small stream, 150 feet southeast of house, 200 feet from north line, 200 feet from east line

Drilled: December 3, 1940

Elevation: 250 feet

Water level: 3 feet

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	5.1	5.1	Clay, very slightly silty pinkish-tan red mottled very plastic; P1
2	9.0	3.9	Clay, light-gray very plastic; lignite fragments; P2
3	15.0	6.0	Clay, light-greenish-gray mottled dark-green very plastic; lignite fragments; P3
4	19.2	4.2	Clay, light-gray very plastic; silicified roots in lower portion; P4
5	(?)	(?)	Quartzitic sandstone, fine-grained light-gray

J. W. STOGNER PROPERTY

TEST HOLE RECORD H127

Location: T.26 N., R.3 E., Sec. 17, NW. 1/4, NE. 1/4, NW. 1/4; at sandstone in creek bed, 200 feet above creek fork, 100 feet from north line, 325 feet from west line

Drilled: December 3, 1940

Elevation: 265 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	0.9	0.9	Quartzitic sandstone, fine-grained greenish-gray vertically fluted
2	3.0	2.1	Clay, grayish-white kaolinitic; laminae of light-buff silty sand; P2
3	5.2	2.2	Clay, very slightly silty white kaolinitic very plastic; mottled purple and red; P3

A. N. NEWMAN AND S. R. NEWMAN PROPERTY

TEST HOLE RECORD H128

Location: T.26 N., R.3 E., Sec. 6, E. 1/2, SW. 1/4, SW. 1/4; clay outcrop in small ravine, 200 feet from east line, 500 feet from south line

Drilled: December 12, 1940

Elevation: 265 feet

Water level: dry

No.	Depth	Thick.	Description of strata and designations of samples
			Upper (continental) Zilpha
1	5.0	5.0	Clay, white yellow mottled plastic; P1
2	9.9	4.9	Clay, white buff mottled very plastic; P2
3	15.2	5.3	Clay, white; P3
4	20.1	4.9	Clay, very slightly silty white buff mottled semi-plastic; P4
5	23.1	3.0	Clay, slightly silty light-gray; P5
6	28.1	5.0	Clay, very slightly silty light-gray very plastic; P6
7	35.0	6.9	Clay, silty light-gray semi-plastic; P7
8	37.1	2.1	Clay silty bluish-gray semi-plastic; P8
9	40.5	3.4	Clay, fairly silty light-grayish-blue
10	43.1	2.6	Clay, silty bluish-gray
11	48.3	5.2	Sand, silty light-gray fairly micaceous

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TALLAHATCHIE COUNTY MINERAL RESOURCES TESTS

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INTRODUCTION

The clays of economic importance are described by Priddy in the geologic section of this report as being from the Zilpha formation. Bond clays or ball clays, commonly known as the Enid clays, constitute the most important variety. Clay similar to the bond clays but containing an appreciable amount of silt compose the second type of clay. For convenience of identification this silt phase has been classified as Brick and Tile Clays: Group 1, Group 2, and Group 3. Group 1 is the buff burning variety, and Groups 2 and 3 are the salmon and red to brown burning varieties. Group 2 and Group 3 are very similar; however, the clays in Group 3 contain less silt, have a slightly greater total shrinkage, and burn to stronger bodies.

A third type of clay in the Zilpha formation is described by Priddy as laminated, slightly silty, carbonaceous, and in colors of tan, chocolate brown, and brownish black. This material has some of the characteristics of a shale. The texture is coarse, and the burned color is buff. The clay grades into a salmon to red burning phase, and this is described by Priddy as being from the top of the lower (marine) Zilpha. Both the buff and red burning phases are classified as Brick and Tile Clays—Group 4.

Five clays, three of which are similar, are classified in this report as Miscellaneous Clays. Their properties and characteristics are described under the headings of Miscellaneous Clays and Possibilities for Utilization.

In this section of the report samples are identified as to county, test hole number, and sample number. The letter "H" represents Tallahatchie County. The numerals immediately following represent the test hole number corresponding to the test hole record. The laboratory sample number, which follows, represents the interval from which the sample was taken as described in the test hole record. Sample numbers consisting of two numerals separated by a hyphen represent a composite sample of material from the interval so designated. The letter "W" which in some instances precedes the sample number indicates that the sample was washed through a 200-mesh screen before forming into test pieces.

Under the heading of Bond Clays, five samples are identified as HA, HB, HC, HD, and HE. These samples are from commercial pits and represent the material that is being marketed (May 1942).

BOND CLAYS

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Hole No.	Sample No.	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in pounds per square inch	Color
			Volume in percent	Linear in percent		
H5	7–11	32.38	37.23	14.41	530	Lt. gray
H7	4–7	29.94	34.73	13.29	482	Lt. gray
H7	W4–7	26.74	29.52	11.04	N. D.	Lt. gray
H7	W8–17	36.00	31.41	11.85	N. D.	Gray
H24	4–5	29.99	35.18	13.46	463	Lt. gray
H24	6–7	38.35	53.52	22.58	820	Lt. gray
H24	8–9	40.08	54.17	22.92	922	Gray
H31	1–2	36.15	34.47	13.15	262	Dark cream
H46	2	36.65	40.00	15.66	430	Reddish gray
H58	1–2	34.33	32.01	12.11	365	Yellowish gray
H58	3	35.93	36.33	14.00	682	Brownish gray
H59	1–2	36.35	34.38	13.11	533	Gray
H59	3–5	32.73	31.81	12.02	558	Gray
H65	3	29.00	29.49	11.00	358	Cream
H93	4–9	37.42	36.28	13.96	317	Dark Cream
H126	1–4	37.26	35.70	13.69	292	Lt. gray
H128	1–2	41.11	45.98	18.57	430	Lt. gray
H128	3–4	39.62	43.74	17.48	471	Lt. gray
H128	5–6	32.58	35.96	13.82	442	Lt. gray
H128	7–8	32.35	32.80	12.41	400	Lt. gray
HA	HA	39.34	45.92	18.57	507	Lt. gray
HB	HB	39.25	44.95	18.07	544	Lt. gray
HC	HC	35.02	35.98	13.82	508	Lt. gray
HD	HD	36.84	38.48	14.96	452	Lt. gray
HE	HE	28.24	30.33	11.38	447	Lt. gray

SCREEN ANALYSES

SAMPLE H7 4-7

Retained on screen	Percent	Character of residue
60	.71	Abundance of lignitic clay nodules; small amount of marcasite.
100	.32	Abundance of lignitic clay nodules; small amount of pyrite; trace of quartz.
250	.44	Abundance of lignitic clay nodules; considerable quantity of quartz; small amount of white clay nodules.
Cloth	98.53	Clay substance including residue from above.

SAMPLE H46 2

Retained on screen	Percent	Character of residue
60	.77	Abundance of calcareous clay nodules; small amount of limonite.
100	3.49	Abundance of calcareous clay nodules; considerable quantity of quartz; small amount of hematite.
250	10.96	Abundance of quartz; small amount of hematite stained calcareous clay nodules.
Cloth	84.78	Clay substance including residue from above.

SAMPLE H128 1-2

Retained on screen	Percent	Character of residue
60	.26	Abundance of quartz; small amount of plant fragments.
100	.31	Abundance of clay nodules, some stained with limonite; considerable quantity of quartz; small amount of plant fragments.
250	.08	Abundance of clay nodules; considerable quantity of plant fragments; small amount of quartz; traces of lignite and marcasite.
Cloth	99.35	Clay substance including residue from above.

SAMPLE H128 3-4

Retained on screen	Percent	Character of residue
60	.19	Abundance of clay nodules, considerable quantity stained with limonite; considerable quantity of quartz; trace of calcareous material.
100	.50	Abundance of clay nodules; small amount of quartz; trace of calcareous material.
250	.24	Abundance of clay nodules; small amounts of quartz and limonitic stained clay.
Cloth	99.07	Clay substance including residue from above.

SAMPLE H128 5-6

Retained on screen	Percent	Character of residue
60	.17	Abundance of gray clay nodules; considerable quantity of quartz; traces of limonite and marcasite
100	.08	Abundance of gray clay nodules; considerable quantity of quartz; small amount of lignitized wood; trace of pyrite.
250	1.68	Abundance of gray clay nodules; small amount of quartz; trace of lignite.
Cloth	98.07	Clay substance including residue from above.

SAMPLE H128 7-8

Retained on screen	Percent	Character of residue
60	.25	Abundance of gray clay nodules; considerable quantities of quartz and marcasite.
100	.85	Abundance of gray clay nodules; considerable quantity of quartz; small amount of pyrite.
250	2.88	Abundance of quartz; considerable quantity of gray clay nodules; trace of pyrite.
Cloth	96.02	Clay substance including residue from above.

SAMPLE HA

Retained on screen	Percent	Character of residue
60	.22	Abundance of gray clay nodules; small amount of pyrite and carbonaceous material; trace of silicified wood.
100	.19	Abundance of gray clay nodules; small amounts of marcasite, carbonaceous material, and limonitic clay nodules.
250	.12	Abundance of gray clay nodules; considerable quantity of quartz; small amounts of pyrite, carbonaceous material, muscovite, and limonitic nodules.
Cloth	99.47	Clay substance including residue from above.

SAMPLE HB

Retained on screen	Percent	Character of residue
60	.09	Abundance of gray clay nodules; small amount of marcasite, quartz, and lignitic material.
100	.29	Abundance of gray clay nodules; small amount of limonitic material, quartz, and marcasite.
250	.08	Abundance of quartz; considerable quantity of limonitic nodules, carbonaceous material, and marcasite.
Cloth	99.64	Clay substance including residue from above.

SAMPLE HC

Retained on screen	Percent	Character of residue
60	.14	Abundance of gray clay nodules; small amount of marcasite and lignite.
100	.20	Abundance of gray clay nodules; small amount of marcasite and quartz.
250	.24	Abundance of quartz; considerable quantity of gray clay nodules; small amount of lignite.
Cloth	99.42	Clay substance including residue from above.

SAMPLE HD

Retained on screen	Percent	Character of residue
60	.14	Abundance of gray clay nodules; considerable quantity of marcasite; small amount of limonitic stained nodules.
100	.24	Abundance of gray clay nodules; considerable quantity of quartz; small amount of lignitic material and plant fragments.
250	1.86	Abundance of quartz.
Cloth	97.76	Clay substance including residue from above.

SAMPLE HE

Retained on screen	Percent	Character of residue
60	.16	Abundance of arenaceous white clay nodules; small amount of lignite.
100	.15	Abundance of white clay nodules; considerable quantity of lignitized wood; small amount of quartz.
250	.70	Abundance of white clay nodules; considerable quantity of lignitized wood; small amount of quartz.
Cloth	98.99	Clay substance including residue from above.

Alta Ray Gault, laboratory geologist.

CHEMICAL ANALYSES*

SAMPLE H7 4-7

Ignition loss	9.80	Iron ozide, Fe_2O_3	1.94	Magnesia, MgO	0.23
Silica, SiO_2	60.24	Titania, TiO_2	0.79	Manganese, MnO_2	None
Alumina, Al_2O_3	25.64	Lime, CaO	0.65	Alkalies, (K_2O, Na_2O)	0.52

SAMPLE H46 2

Ignition loss	9.13	Iron oxide, Fe_2O_3	1.98	Magnesia, MgO	0.16
Silica, SiO_2	60.01	Titania, TiO_2	0.47	Manganese, MnO_2	None
Alumina, Al_2O_3	25.22	Lime, CaO	1.51	Alkalies, (K_2O, Na_2O)	0.38

SAMPLE H128 1-2

Ignition loss	9.99	Iron oxide, Fe_2O_3	1.93	Magnesia, MgO	0.65
Silica, SiO_2	55.69	Titania, TiO_2	1.06	Manganese, MnO_2	None
Alumina, Al_2O_3	29.50	Lime. CaO	0.17	Alkalies, (K_2O, Na_2O)	0.26

SAMPLE H128 3-4

Ignition loss	9.69	Iron oxide, Fe_2O_3	2.19	Magnesia, MgO	0.18
Silica, SiO_2	57.32	Titania, TiO_2	0.81	Manganese, MnO_2	None
Alumina, Al_2O_3	29.22	Lime, CaO	0.27	Alkalies, (K_2O, Na_2O)	0.31

SAMPLE H128 5-6

Ignition loss 8.73	Iron oxide, Fe_2O_3 ... 2.17	Magnesia, MgO 0.26
Silica, SiO_2 .... 59.17	Titania, TiO_2 .... 0.43	Manganese, MnO_2 .. None
Alumina, Al_2O_3 ...... 26.32	Lime, CaO 0.79	Alkalies, (K_2O, Na_2O) 0.33

SAMPLE H128 7-8

Ignition loss 9.33	Iron oxide, Fe_2O_3 ... 1.70	Magnesia, MgO 0.30
Silica, SiO_2 .... 58.64	Titania, TiO_2 .... 0.30	Manganese, MnO_2 .. None
Alumina, Al_2O_3 ...... 28.07	Lime, CaO 0.49	Alkalies, (K_2O, Na_2O) 0.24

SAMPLE HA

Ignition loss 9.42	Iron oxide, Fe_2O_3 ... 2.01	Magnesia, MgO 0.51
Silica, SiO_2 .... 58.35	Titania, TiO_2 .... 1.22	Manganese, MnO_2 . None
Alumina, Al_2O_3 ...... 26.93	Lime, CaO 0.16	Alkalies, (K_2O, Na_2O) 0.36

SAMPLE HB

Ignition loss 9.37	Iron oxide, Fe_2O_3 ... 1.99	Magnesia, MgO 0.49
Silica, SiO_2 .... 58.23	Titania, TiO_2 .... 1.25	Manganese, MnO_2 .. None
Alumina, Al_2O_3 ...... 27.31	Lime, CaO 0.31	Alkalies, (K_2O, Na_2O) 0.34

SAMPLE HC

Ignition loss 9.41	Iron oxide, Fe_2O_3 ... 1.97	Magnesia, MgO 0.71
Silica, SiO_2 .... 58.25	Titania, TiO_2 .... 1.28	Manganese, MnO_2 None
Alumina, Al_2O_3 ...... 27.06	Lime, CaO 0.42	Alkalies, (K_2O, Na_2O) 0.35

SAMPLE HD

Ignition loss 10.72	Iron oxide, Fe_2O_3 ... 1.74	Magnesia, MgO ... 0.58
Silica, SiO_2 .... 56.08	Titania, TiO_2 .... 1.78	Manganese, MnO_2 None
Alumina, Al_2O_3 ...... 28.52	Lime, CaO 0.48	Alkalies, (K_2O, Na_2O) 0.32

SAMPLE HE

Ignition loss 6.96	Iron oxide, Fe_2O_3 ... 1.36	Magnesia, MgO 0.22
Silica, SiO_2 .... 67.82	Titania, TiO_2 .... 1.25	Manganese, MnO_2 None
Alumina, Al_2O_3 ...... 20.64	Lime, CaO 0.57	Alkalies, (K_2O, Na_2O) 0.33

* Samples ground to pass 100-mesh screen.

B. F. Mandlebaum, analyst.

PYRO-PHYSICAL PROPERTIES

Test Holes H5, H7, H24

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
H5 7-11	03	21.41	10.64	2.01	2.60	15.84	5.61	3014	Cream St. H.
	01	15.71	7.40	2.13	2.53	20.46	7.36	3979	Cream
	2	13.18	6.14	2.17	2.52	21.47	7.75	4634	Lt. buff
	4	5.94	2.65	2.24	2.39	24.81	9.10	3587	Lt. buff
	6	1.37	.60	2.29	2.29	25.15	9.22	288	Lt. buff
	8	1.66	.73	2.26	2.30	25.05	9.18	2185	Lt. grayish buff
	10	1.38	.60	2.30	2.33	26.50	9.75	5063	Gray
	12	1.17	.50	2.32	2.35	26.73	9.88	6643	Gray
	14	1.07	.46	2.30	2.32	26.54	9.79	5073	Gray
H7 4-7	03	21.39	10.86	1.98	2.52	13.67	4.79	3345	Cream St. H.
	01	16.32	7.80	2.09	2.50	18.79	6.71	3383	Cream
	2	14.78	6.97	2.12	2.49	19.52	7.01	3576	Lt. buff
	4	10.31	4.75	2.16	2.41	22.18	8.03	3538	Lt. buff
	6	10.23	4.76	2.15	2.40	20.83	7.52	344	Lt. buff
	8	7.21	3.20	2.19	2.34	22.11	8.03	949	Lt. grayish buff
	10	.59	.20	2.24	2.25	24.14	8.82	6523	Gray
	12	.39	.17	2.24	2.25	24.21	8.88	6431	Gray
	14	.51	.23	2.24	2.25	23.89	8.70	5751	Gray
H7W 4-7	03	17.05	7.98	2.14	2.58	17.18	6.10	N.D.	Cream St. H.
	01	13.62	6.22	2.19	2.54	19.44	6.98	N.D.	Cream
	2	9.55	4.27	2.23	2.42	20.83	7.52	N.D.	Lt. buff
	4	7.54	3.38	2.23	2.47	20.83	7.52	N.D.	Lt. buff
	6	3.92	1.73	2.25	2.35	21.83	7.91	N.D.	Lt. buff
	8	2.13	.93	2.28	2.34	22.13	8.03	N.D.	Lt. grayish buff
	10	.90	.39	2.32	2.34	23.69	8.62	N.D.	Gray
	12	1.08	.46	2.32	2.34	23.45	8.54	N.D.	Gray
	14	.34	.15	2.29	2.30	22.76	8.26	N.D.	Gray
H7W 8-17	03	26.89	14.82	1.81	2.48	14.75	5.20	N.D.	Cream St. H.
	01	18.59	9.39	1.98	2.48	21.53	7.79	N.D.	Lt. buff
	2	17.79	8.82	2.02	2.46	23.72	8.66	N.D.	Lt. buff
	4	18.81	9.39	2.02	2.46	23.24	8.46	N.D.	Buff
	6	16.51	8.10	2.04	2.44	24.39	8.90	N.D.	Buff
	8	12.88	6.11	2.11	2.42	27.04	10.00	N.D.	Buff
	10	8.05	3.68	2.19	2.38	29.64	11.08	N.D.	Buff
	12	7.05	3.22	2.19	2.36	29.83	11.17	N.D.	Buff
	14	3.46	1.60	2.15	2.23	28.70	10.66	N.D.	Grayish buff
H24 4-5	03	23.69	12.59	1.88	2.47	5.49	1.87	1636	Cream*
	01	20.73	10.56	1.96	2.47	9.21	3.20	3119	Lt buff* St. H.
	2	19.79	10.01	1.97	2.47	10.00	3.45	2663	Lt. buff*
	4	14.14	6.84	2.07	2.40	13.94	4.90	3035	Lt. buff*
	6	15.52	7.53	2.02	2.39	12.01	4.21	1517	Lt. buff*
	8	11.44	7.01	2.06	2.40	13.40	4.68	3243	Lt. buff*
	10	10.63	5.06	2.10	2.35	15.37	5.42	4991	Buff*
	12	8.26	3.90	2.12	2.31	16.32	5.80	4769	Grayish brown*
	14	7.17	3.34	2.14	2.30	16.91	6.02	5392	Grayish brown*

* Stained with calcium sulfate.

Abbreviation: St. H., steel hard.

TEST HOLES H24, H31, H46, H58

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
H24 6-7	03	12.09	5.71	2.12	2.41	18.46	6.59	2005	Lt. buff St. H.
	01	4.02	1.80	2.24	2.34	23.04	8.38	2144	Grayish buff Cr.
	2	3.82	1.73	2.24	2.32	23.10	8.38	2340	Grayish buff
	4	2.01	.89	2.28	2.32	24.17	8.82	2754	Grayish buff
	6	1.42	.63	2.27	2.29	23.49	8.54	3720	Grayish buff
	8	1.64	.72	2.29	2.32	24.45	8.94	3518	Grayish buff
	10	1.61	.71	2.26	2.28	22.95	8.44	4742	Grayish buff
	12	1.78	.82	2.18	2.22	21.01	7.60	5748	Grayish brown Cr.
	14	5.29	2.87	1.89	1.99	13.12	4.61	3460	Grayish brown Cr.
H24 8-9	03	9.48	4.44	2.13	2.35	20.15	7.25	2176	Lt. buff St. H.
	01	4.27	1.97	2.16	2.26	21.17	7.63	972	Grayish buff
	2	4.29	2.08	2.06	2.15	17.43	6.21	750	Grayish buff Cr.
	4	3.83	1.81	2.14	2.23	20.74	7.48	906	Grayish buff
	6	3.36	1.70	1.99	2.05	18.28	6.74	1187	Grayish buff
	8	1.01	.46	2.21	2.23	23.29	8.46	1443	Grayish buff
	10	2.33	1.09	2.15	2.20	20.77	7.48	N.D.	Grayish brown
	12	1.69	.79	2.15	2.19	20.82	7.52	2288	Grayish brown
	14	6.91	3.73	1.85	1.65	8.55	2.95	N.D.	Grayish brown Cr.
H31 1-2	03	30.85	17.56	1.76	2.54	9.85	3.42	1120	Cream
	01	27.46	14.82	1.85	2.55	14.43	5.09	1563	Cream St. H.
	2	23.91	12.26	1.95	2.56	18.88	6.74	1505	Cream
	4	22.45	11.40	1.97	2.55	19.51	7.01	924	Cream
	6	18.80	9.07	2.07	2.54	23.59	8.58	1200	Buff
	8	13.05	5.93	2.14	2.50	26.38	9.71	1724	Buff
	10	7.74	3.48	2.23	2.41	28.70	10.66	2916	Grayish brown
	12	3.77	1.66	2.27	2.36	30.13	11.29	3313	Grayish brown
	14	1.23	.53	2.31	2.33	31.55	11.89	2589	Grayish brown
H46 2	03	25.83	13.92	1.86	2.51	12.34	4.32	1795	Cream St. H.
	01	19.90	9.94	2.00	2.50	18.52	6.63	2498	Lt. buff
	2	19.41	9.57	2.03	2.52	19.94	7.17	2062	Lt. buff
	4	14.62	6.87	2.13	2.49	23.47	8.54	2081	Lt. buff
	6	13.26	6.29	2.12	2.44	23.27	8.46	1575	Buff
	8	9.56	4.43	2.16	2.38	24.73	9.06	1430	Buff
	10	4.20	1.86	2.25	2.35	27.77	10.29	3136	Grayish brown
	12	3.76	1.65	2.26	2.35	28.54	10.65	2954	Grayish brown
	14	2.48	1.09	2.29	2.35	29.24	10.91	3538	Grayish brown
H58 1-2	03	20.55	10.40	1.98	2.49	19.48	6.98	2329	Salmon buff** St. H.
	01	17.93	8.78	2.04	2.49	22.32	8.11	2189	Salmon buff**
	2	12.60	6.07	2.07	2.46	25.11	9.22	2661	Salmon buff**
	4	12.09	5.61	2.14	2.44	25.75	9.47	3529	Salmon buff**
	6	10.87	4.91	2.22	2.48	28.74	10.71	5046	Grayish buff**
	8	5.24	2.36	2.22	2.35	28.86	11.75	5384	Grayish buff**
	10	.21	.09	2.29	2.30	30.84	11.59	4538	Gray**
	12	.47	.21	2.27	2.28	29.62	11.08	5997	Gray**
	14	8.92	4.57	1.95	2.14	19.34	6.94	5346	Gray**

** Stained with iron and calcium sulfates.

Abbreviations: Cr., cracked; St. H., steel hard.

TEST HOLES H58, H59, H65, H93

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
H58 3	03	18.97	9.69	1.96	2.42	20.74	7.48	3135	Buff* St. H.
	01	15.48	7.60	2.03	2.41	24.08	8.78	3540	Buff*
	2	13.13	6.33	2.08	2.39	25.62	9.43	3010	Buff*
	4	8.15	3.86	2.11	2.30	26.74	9.88	3229	Buff*
	6	8.82	3.07	2.07	2.55	25.55	9.39	1615	Buff*
	8	5.62	2.60	2.16	2.29	28.59	10.62	4913	Grayish buff*
	10	.51	.24	2.20	2.21	29.78	11.13	5077	Grayish brown*
H59 1-2	03	24.23	13.13	1.85	2.44	16.32	5.80	2532	Grayish salmon* St. H.
	01	21.61	11.47	1.88	2.40	18.09	6.44	3574	Grayish salmon*
	2	15.82	7.94	2.00	2.37	22.77	8.26	4664	Grayish salmon*
	4	15.82	7.87	2.01	2.38	23.18	8.42	4013	Grayish buff*
	6	15.71	7.57	2.09	2.45	26.20	9.63	4525	Grayish buff*
	8	9.87	4.66	2.12	2.35	27.31	10.12	4968	Grayish buff*
	10	.45	.20	2.20	2.21	30.56	11.46	5217	Grayish brown*
	12	.38	.17	2.23	2.23	30.69	11.51	4618	Grayish brown*
	14	14.37	7.69	1.87	2.19	17.63	6.29	2570	Grayish brown*
H59 3-5	03	22.68	12.39	1.83	2.36	11.07	3.85	2694	Grayish salmon St. H.
	01	21.83	11.63	1.88	2.40	13.21	4.65	2919	Grayish salmon
	2	18.75	9.81	1.91	2.35	14.71	5.20	3618	Grayish buff
	4	16.04	8.06	1.99	2.35	18.28	6.52	3818	Grayish buff
	6	13.92	6.98	2.00	2.32	18.51	6.63	4291	Grayish buff
	8	10.90	5.25	2.08	2.32	21.79	7.83	4524	Grayish buff
	10	2.74	1.26	2.17	2.23	25.14	9.22	4754	Grayish brown
	12	2.98	1.37	2.17	2.24	25.49	9.35	3497	Grayish brown
	14	14.80	7.81	1.76	2.22	14.48	5.09	3398	Grayish brown
H65 3	03	26.00	13.95	1.86	2.52	8.49	2.92	2198	Cream St. H.
	01	20.92	10.61	1.93	2.49	13.35	4.68	2249	Cream
	2	22.85	11.49	1.99	2.58	15.17	5.35	1852	Cream
	4	22.41	11.48	1.96	2.53	12.99	4.54	2414	Cream
	6	19.51	9.66	2.02	2.49	15.77	5.57	2789	Cream
	8	14.26	6.77	2.11	2.46	19.40	6.94	2742	Lt. buff
	10	9.09	4.20	2.16	2.37	21.19	7.63	4898	Lt. buff***
	12	5.79	2.96	2.19	2.33	22.63	8.22	3493	Grayish buff***
	14	1.79	.81	2.22	2.26	23.65	8.62	N.D.	Grayish buff***
H93 4-9	03	28.58	15.89	1.80	2.52	12.11	4.24	952	Cream St. H.
	01	28.06	15.37	1.83	2.54	13.31	4.68	1336	Cream
	2	22.57	11.51	1.96	2.54	19.27	6.90	1057	Cream
	4	26.75	14.43	1.85	2.53	14.56	5.12	1989	Buff
	6	11.43	5.32	2.17	2.45	26.38	9.71	1359	Buff
	8	12.11	5.86	2.07	2.35	23.95	8.74	1364	Buff
	10	6.17	2.75	2.24	2.38	29.65	11.08	2389	Buff
	12	3.59	1.57	2.29	2.37	30.74	11.55	2541	Grayish buff
	14	.95	.41	2.33	2.35	32.33	12.24	2900	Grayish brown

* Stained with calcium sulfate.

*** Shows calcium sulfate specks.

Abbreviation: St. H., steel hard.

TEST HOLES H126, H128

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
H126 1-4	03	30.61	16.96	1.80	2.60	13.69	4.79	709	Cream St. H.
	01	26.40	13.86	1.90	2.59	18.28	6.52	1258	Cream
	2	26.19	13.85	2.05	2.56	24.44	8.94	1239	Cream
	4	19.88	9.68	1.90	2.57	18.05	6.44	947	Cream
	6	12.40	5.64	2.20	2.58	29.47	11.00	985	Cream
	8	7.37	3.35	2.20	2.38	29.95	11.21	1571	Lt. buff
	10	2.34	1.02	2.29	2.34	32.43	12.28	2488	Grayish buff
	12	1.91	.83	2.31	2.35	32.89	12.45	2031	Grayish buff
	14	1.55	.66	2.35	2.38	34.13	13.02	1915	Grayish buff
H128 1-2	03	22.39	11.47	1.96	2.52	18.88	6.74	2960	Cream St. H.
	01	20.56	10.16	2.02	2.54	21.61	7.83	3917	Cream
	2	14.18	6.64	2.14	2.50	26.32	9.71	3522	Cream
	4	11.32	4.81	2.24	2.45	29.55	11.04	4544	Buff
	6	4.75	2.17	2.24	2.46	29.85	11.17	4038	Buff
	8	.81	.36	2.29	2.31	31.17	11.72	2450	Buff
	10	1.10	.47	2.36	2.39	33.06	12.54	5586	Gray
	12	1.02	.43	2.37	2.40	33.21	12.63	4144	Gray
	14	.83	.35	2.36	2.37	33.05	12.54	5971	Gray
H128 3-4	03	23.27	11.94	1.95	2.54	18.19	6.48	2794	Cream St. H.
	01	21.31	10.96	2.01	2.54	20.34	7.32	2772	Cream
	2	11.19	4.89	2.21	2.49	28.43	10.58	1949	Cream
	4	5.09	2.22	2.29	2.38	30.73	11.55	2354	Buff Cr.
	6	3.70	1.61	2.27	2.35	29.93	11.21	1006	Buff Cr.
	8	1.12	.48	2.30	2.33	31.08	11.68	756	Buff
	10	.74	.31	2.36	2.38	32.83	12.45	3425	Grayish buff
	12	.67	.28	2.37	2.38	33.04	12.54	4528	Grayish buff Cr.
	14	.87	.37	2.37	2.39	32.88	12.45	N.D.	Grayish buff Cr.
H128 5-6	03	21.81	11.03	1.98	2.53	15.27	5.38	3436	Cream St. H.
	01	17.99	8.69	2.07	2.53	19.15	6.86	4043	Cream
	2	11.50	5.27	2.18	2.47	23.21	8.46	4320	Cream
	4	6.30	2.90	2.25	2.31	25.87	9.51	3136	Buff
	6	2.59	1.17	2.22	2.37	24.49	8.94	3389	Buff
	8	1.33	.59	2.26	2.30	26.05	9.59	Cr.	Buff
	10	.51	.21	2.31	2.31	27.76	10.29	7200	Grayish buff
	12	.36	.15	2.31	2.32	27.51	10.21	6313	Grayish buff
	14	.45	.19	2.32	2.33	27.91	10.37	N.D.	Grayish buff
H128 7-8	03	25.94	13.61	1.91	2.57	14.54	5.12	1094	Cream St. H.
	01	23.25	12.05	1.93	2.51	15.85	5.61	1340	Cream
	2	15.71	7.41	2.12	2.52	23.42	8.54	1468	Cream Cr.
	4	11.78	5.35	2.21	2.51	26.67	9.84	1416	Buff
	6	12.21	5.56	2.20	2.51	26.08	9.59	1633	Buff Cr.
	8	6.29	2.83	2.24	2.39	27.49	10.16	1185	Buff Cr.
	10	3.17	1.38	2.30	2.37	29.53	11.04	3570	Grayish buff
	12	2.67	1.15	2.32	2.38	30.09	11.25	2888	Grayish buff
	14	1.87	.81	2.01	2.05	30.64	11.51	2270	Grayish buff Cr.

Abbreviations: Cr., cracked; St. H., steel hard.

TEST HOLES HA, HB, HC, HD, HE

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks	
HA	1	15.61	7.23	2.16	2.56	24.71	9.06	1127	Cream	St. H.
	7	1.61	.72	2.25	2.28	27.59	10.21	7275	Grayish brown	
	12	2.80	1.51	2.31	2.41	28.29	10.50	7756	Grayish brown	
HB	1	14.19	6.54	2.18	2.53	25.08	9.18	4749	Cream	St. H.
	7	1.55	.68	2.26	2.30	28.40	10.54	6741	Grayish brown	
	12	1.63	.71	2.30	2.34	29.47	11.00	8018	Grayish brown	
HC	1	22.55	11.11	2.03	2.63	21.99	7.95	1825	Cream	St. H.
	7	7.86	3.59	2.19	2.37	26.96	9.92	5705	Buff	
	12	1.86	.84	2.22	2.26	28.09	10.41	5556	Grayish buff	
HD	1	14.64	6.71	2.18	2.55	27.43	10.16	2532	Cream	St. H.
	7	2.88	1.26	2.29	2.36	31.19	11.72	3320	Grayish brown	
	12	2.35	1.02	2.31	2.36	31.78	11.98	3437	Gray	
HE	1	24.26	12.57	1.93	2.55	8.39	2.88	3436	Cream	St. H.
	7	16.83	8.47	1.99	2.42	10.69	3.70	5926	Lt. buff	
	12	13.02	6.47	2.01	2.31	12.60	4.39	5811	Buff	

Abbreviation: St. H., steel hard.

FUSION POINTS, PYROMETRIC CONE EQUIVALENT

Sample		Cone
H7	4-7	29
H46	2	29
H128	1-2	30
H128	3-4	30
H128	5-6	29
H128	7-8	30

Sample	Cone
HA	29
HB	29-30
HC	29-30
HD	30
HE	28

POSSIBILITIES FOR UTILIZATION

The bond clays of Tallahatchie County were extensively mined during World War I for use as a refractory bond in the manufacture of glass pots and metallurgical crucibles. In later years and at the present time the clay is being marketed as an enamel clay where it serves as a suspending medium for the wet enamel batch.

The clays have many desirable properties some of which are unexcelled by other American bond clays. They also have some undesirable properties which limit their uses. The plastic, drying, and working properties of the clays are typical of high grade ball clays. The clays mature at low temperatures and are not overburned at cones 12-14. Typical clay burns to cream and light buff colors through cone 8. At cones 10, 12, and 14 the color darkens to grayish buff and brown.

The fired color at elevated temperatures is the prime feature which limits the use of these clays in whiteware bodies. Considerable experimentation was conducted to beneficiate the clays by washing, removal of iron, and by neutralizing the coloring effect of iron. The results were generally negative. Washing and screening tests were of value in removing lignite, silt, marcasite, and gypsum from the lower grade clays. With the higher grade clays no improvement was observed. Since there is an abundant supply of the better grade of clay, beneficiation of lower grades by washing is economically impractical. The coloring effect of iron oxide is intensified by titanium oxide. These oxides appear to be present in chemical combination with the clay molecule and are not readily removed by leaching with acids or corrosive gases without destroying the plastic properties of the clay.

The Engineering Experiment Station at Ohio State University has conducted a study of domestic ball clays in ivory and earthenware bodies. The results are published in their bulletin No. 69, May, 1932. In this work pottery dinner ware was made on a commercial basis. The investigation compared the properties of dinner ware made with commercial ball clays. In the report bodies 19, 20, and 21 contained respectively 20 percent, 25 percent, and 30 percent M & D ball clay. This clay is mined to the north of Tallahatchie County but is so similar to the better grades of the Enid bond clay that their conclusion concerning the use of this type of clay in dinner ware bodies is applicable to the Enid clays. Their conclusions concerning the M & D clay are as follows:

"The plasticity and workability of these three bodies was the best of the series, No. 19 having as good plasticity and workability as the best of the bodies containing 30 percent of the other ball clays included in this study, while Nos. 20 and 21 had the best plasticity and workability of all (see Table V or XVI). While the ease of filtering the slip has not been mentioned in discussing the properties of the other bodies, it should be stated here that these bodies containing 'M and D' Mississippi ball clay required nearly double the time to filter required by the other bodies in the series, considering like percentages of ball clay. The linear drying shrinkages and dry strength moduli of these three bodies were the highest determined in this study. These strengths were double or more than double those of the bodies which were second best with respect to dry strength, No. 19 with 20 percent of ball clay having a much higher strength than any of the others containing 30 percent of ball clay. With regard to drying warpage, none of the ware of No. 19 was visibly warped in drying, while there were two of No. 20, and eight of No. 21 of the five dozen made of each body. The average warpage was .05 inch in both cases. No. 21 showed the most warpage of any of the bodies covered. There was no loss in drying and finishing the ware of Bodies 19 and 20, but 6.6 per cent of No. 21 were cracked in drying.

"The fired shrinkages of Bodies 19, 20 and 21 were the lowest determined in this investigation (see Table VI or XVI). These low firing shrinkages offset the high drying shrinkages of these bodies so that the total shrinkages were lower than some of the other bodies. The percentages of absorption were the lowest of any of the bodies in the series. The average measurements of firing warpage of the ware of these three bodies were among the lowest determined in this study. The fired strengths, especially those of Bodies 20 and 21, were the highest determined in this investigation. The fired color of Body 19 was a dark ivory. While darker than the average commercial ware of this type it was a pleasing shade. Bodies 20 and 21, however, were a decided yellow and were much too deep in color to be classed as ivory dinnerware bodies. The ware of all three of these bodies was free from specks, the color being quite uniform. The percentage of cracked bisque of these bodies was comparatively low, being 1.6, 3.3, and 5.3 per cent.

"The thermal expansions of these three bodies, especially Nos. 20 and 21, were among the highest determined in this study (see Tables VII and VIII). Nos. 20 and 21 had the highest expansion of any of the bodies tested at 254°C, which probably accounts for the dunting in the quenching test to be considered later. The percentage expansion curves for the three bodies are shown in Figs. 11, 14, 15, and 16.

"The impact values of the ware of Bodies 19, 20, and 21 (see Table IX or XVI) were next to the highest determined in this study. In the quenching test of resistance to crazing or dunting, the ware of Bodies 19, 20, and 21 when fired to cone 8, was among the best tested, but when fired to cone 9 the ware of all three bodies failed early in the test by dunting of the edges. As already mentioned, the high thermal expansion of Bodies 20 and 21 at the lower temperatures is believed to be the main cause of their failure by dunting in this test but this would not account for the dunting of the ware of No. 19, fired to cone 9, since the expansion of this body was no higher than others which showed no indication of dunting.

"In the autoclave test, the ware of these three bodies was among the best in the series, none of the ware fired to cone 9 being crazed by the autoclave treatment. There was no dunting in this test. The one plate of No. 21 fired to cone 8 likewise showed no indication of crazing. The plate of No. 19 fired to cone 8, however, was badly crazed by the autoclave treatment, as in the case of nearly all of the ware fired to cone 8 which was subjected to this test in this investigation."

The report further makes it clear that no single ball clay possesses all the desired properties. It is believed that a substantial portion of the Enid clays blended with other Amercian ball clays would produce a pottery body superior to that produced by any single ball clay. Of the clays tested for this report samples HA, HB, HC, HD, H5 7-11, H7 4-7, H93 4-9, H126 1-4, H128 1-2, H128 3-4, and H128 5-6 are sufficiently free from contaminating impurities to be used in a blend of ball clays for production of a superior pottery body.

A peculiarity of some of these clays is the development of a very weak structure at certain cone temperatures. The strength of the clays generally decreases at cones 4-6-8 and thereafter increases. The use of these clays in the temperature ranges where they are weak would be unsatisfactory. It would be advisable to investigate thoroughly this peculiarity in relation to use of a particular clay in a pottery body.

The clays are suited for use as a refractory bond in medium heat duty refractories. Their fusion points are not sufficiently high to permit their use in high heat duty refractories.

BRICK AND TILE CLAYS-GROUP 1

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Hole No.	Sample No.	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in pounds per square inch	Color
			Volume in percent	Linear in percent		
H5	12–14	24.95	27.91	10.37	488	Lt. gray
H5	15–21	37.32	31.73	11.98	483	Lt. gray
H7	8–17	26.05	30.67	11.51	517	Lt. gray
H7	18–20	25.06	25.65	9.43	524	Lt. gray
H7	W18–20	27.11	28.17	10.45	N. D.	Lt. gray
H39	4–6	24.91	17.90	6.36	178	Yellowish gray
H44	1–3	27.12	25.13	9.22	555	Lt. gray
H57	1	27.71	21.72	7.87	477	Gray
H71	2	29.80	28.71	10.71	584	Gray
H79	2	30.05	32.97	12.50	747	Gray
H96	2–7	28.82	28.65	10.66	624	Gray
H107	3–7	27.26	15.86	5.61	346	Gray

SCREEN ANALYSES

SAMPLE H7 8-17

Retained on screen	Percent	Character of residue
60	.41	Abundance of ferruginous rock; considerable quantity of lignitic clay nodules; small amount of marcasite; trace of lignite.
100	.40	Abundance of quartz; considerable quantities of ferruginous rock and lignitic clay nodules.
250	4.49	Abundance of white clay nodules; considerable quantity of quartz; small amount of muscovite; trace of lignite.
Cloth	94.70	Clay substance including residue from above.

SAMPLE H7 18-20

Retained on screen	Percent	Character of residue
60	8.88	Abundance of arenaceous clay nodules; trace of lignite.
100	5.95	Abundance of arenaceous clay nodules; traces of marcasite and muscovite.
250	14.15	Abundance of quartz; considerable quantity of argillaceous nodules; small amount of muscovite.
Cloth	70.02	Clay substance including residue from above.

SAMPLE H44 1-3

Retained on screen	Percent	Character of residue
60	13.51	Abundance of arenaceous micaceous gray clay nodules.
100	8.12	Abundance of arenaceous micaceous gray clay nodules.
250	5.95	Abundance of arenaceous micaceous gray clay nodules.
Cloth	72.42	Clay substance including residue from above.

SAMPLE H79 2

Retained on screen	Percent	Character of residue
60	14.60	Abundance of lignitic micaceous arenaceous clay nodules.
100	5.30	Abundance of lignitic micaceous arenaceous clay nodules; considerable quantity of quartz; small amount of muscovite.
250	23.92	Abundance of quartz; traces of magetite and clay.
Cloth	56.28	Clay substance including residue from above.

SAMPLE H96 2-7

Retained on screen	Percent	Character of residue
60	28.54	Abundance of lignitic arenaceous micaceous clay nodules.
100	6.31	Abundance of lignitic arenaceous micaceous clay nodules.
250	11.89	Abundance of arenaceous clay nodules; considerable quantity of quartz; small amount of muscovite; trace of lignite.
Cloth	53.26	Clay substance including residue from above.

Alta Ray Gault, laboratory geologist.

CHEMICAL ANALYSES*

SAMPLE H7 8-17

Ignition loss	8.18	Iron oxide, Fe_2O_3	1.56	Magnesia, MgO	0.30
Silica, SiO_2	66.47	Titania, TiO_2	0.78	Manganese, MnO_2	None
Alumina, Al_2O_3	21.16	Lime, CaO	0.49	Alkalies, (K_2O, Na_2O)	0.49

SAMPLE H7 18-20

Ignition loss	5.20	Iron oxide, Fe_2O_3	1.79	Magnesia, MgO	0.54
Silica, SiO_2	73.85	Titania, TiO_2	0.80	Manganese, MnO_2	None
Alumina, Al_2O_3	16.30	Lime, CaO	0.53	Alkalies, (K_2O, Na_2O)	0.47

SAMPLE H44 1-3

Ignition loss	5.28	Iron oxide, Fe_2O_3	1.73	Magnesia, MgO	0.41
Silica, SiO_2	73.20	Titania, TiO_2	0.98	Manganese, MnO_2	Trace
Alumina, Al_2O_3	15.87	Lime, CaO	0.74	Alkalies, (K_2O, Na_2O)	0.53

SAMPLE H79 2

Ignition loss	5.12	Iron oxide, Fe_2O_3	1.96	Magnesia, MgO	Trace
Silica, SiO_2	75.80	Titania, TiO_2	0.66	Manganese, MnO_2	None
Alumina, Al_2O_3	13.31	Lime, CaO	1.20	Alkalies, (K_2O, Na_2O)	0.64

SAMPLE H96 2-7

Ignition loss	4.87	Iron oxide, Fe_2O_3	2.32	Magnesia, MgO	0.35
Silica, SiO_2	73.88	Titania, TiO_2	0.61	Manganese, MnO_2	None
Alumina, Al_2O_3	14.94	Lime, CaO	1.02	Alkalies, (K_2O, Na_2O)	0.77

* Samples ground to pass 100-mesh screen.

B. F. Mandlebaum, analyst.

PYRO-PHYSICAL PROPERTIES

TEST HOLES H5, H7

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks	
H5 12-14	03	21.60	11.20	1.93	2.47	6.72	2.32	2067	Cream	St. H.
	01	20.91	10.70	1.95	2.47	7.89	2.71	2388	Cream	
	2	18.48	9.24	2.00	2.46	10.01	3.49	2803	Cream	
	4	18.47	9.29	1.99	2.44	9.44	3.27	2173	Cream	
	6	15.83	7.90	2.00	2.38	10.15	3.52	1886	Cream	
	8	15.90	7.88	2.02	2.39	11.10	3.85	3226	Cream	
	10	13.97	6.80	2.06	2.40	12.75	4.46	3393	Buff	
	12	12.55	6.07	2.07	2.36	13.08	4.57	4416	Buff	
	14	11.49	5.50	2.09	2.36	14.00	4.90	3672	Buff	
H5 15-21	03	23.15	12.10	1.92	2.50	6.85	2.36	2747	Cream	St. H.
	01	22.62	11.32	1.99	2.52	10.27	3.56	3105	Cream	
	2	17.92	8.81	2.03	2.48	11.75	4.10	2838	Cream	
	4	13.55	6.60	2.08	2.41	13.91	4.90	2603	Cream	
	6	14.51	7.21	2.06	2.41	13.14	4.61	803	Cream	
	8	13.78	6.63	2.08	2.41	13.70	4.79	3773	Cream	
	10	9.30	4.37	2.13	2.35	16.23	5.76	4208	Dk. buff	
	12	8.17	3.83	2.14	2.33	16.30	5.76	3816	Dk. buff	
	14	6.58	3.05	2.16	2.31	17.25	6.14	5080	Dk. buff	
H7 8-17	03	23.98	12.59	1.90	2.50	5.42	1.87	2746	Cream	St. H.
	01	20.30	10.27	1.97	2.48	9.05	3.13	2865	Cream	
	2	18.11	8.99	2.01	2.46	11.00	3.81	3083	Cream	
	4	18.92	9.27	2.00	2.46	10.63	3.70	2115	Cream	
	6	16.52	8.14	2.03	2.43	11.78	4.10	2623	Cream	
	8	15.04	7.32	2.06	2.42	12.97	4.54	4202	Cream	
	10	9.57	4.50	2.13	2.35	16.02	5.68	4760	Buff	
	12	9.80	4.60	2.13	2.36	15.86	5.61	3671	Buff	
	14	7.75	3.65	2.14	2.32	16.53	5.87	3627	Buff	
H7 18-20	03	20.78	14.78	1.81	2.47	.58	.20	1304	Lt. buff	St. H.
	01	28.73	15.78	1.82	2.50	.87	.30	1475	Lt. buff	
	2	26.98	14.60	1.85	2.53	2.47	.84	1446	Lt. buff	
	4	26.04	14.11	1.84	2.50	2.17	.74	1304	Lt. buff	
	6	24.21	13.04	1.86	2.50	2.93	1.01	1551	Lt. buff	
	8	21.65	11.35	1.91	2.45	5.57	1.90	1673	Lt. buff	
	10	20.60	10.62	1.94	2.44	7.26	2.50	2465	Dk. buff	
	12	20.37	10.55	1.94	2.44	7.31	2.53	2390	Dk. buff	
	14	18.55	9.46	1.96	2.41	8.37	2.88	2568	Dk. buff	
H7 W18-20	03	25.29	13.31	1.90	2.54	1.51	.54	N.D.	Buff	St. H.
	01	25.47	13.29	1.91	2.57	2.44	.84	N.D.	Buff	
	2	23.71	12.37	1.93	2.54	2.90	.98	N.D.	Buff	
	4	23.51	12.08	1.95	2.53	4.26	1.46	N.D.	Buff	
	6	22.42	11.43	1.95	2.51	4.41	1.52	N.D.	Buff	
	8	17.85	8.79	2.03	2.48	7.62	2.64	N.D.	Buff	
	10	15.69	7.63	2.06	2.44	9.41	3.27	N.D.	Buff	
	12	16.04	7.80	2.06	2.45	9.01	3.13	N.D.	Buff	
	14	11.39	5.44	2.09	2.37	11.15	3.88	N.D.	Dk. buff	

Abbreviation: St. H., steel hard.

TEST HOLES H39, H44, H57, H71, H79

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
H39 4-6	03	32.02	18.57	1.72	2.53	.92	.33	775	Pink
	01	32.22	18.59	1.73	2.54	1.17	.40	738	Pink
	2	31.35	17.72	1.77	2.58	3.52	1.21	791	Grayish pink
	4	31.21	17.83	1.75	2.54	2.36	.81	840	Grayish pink
	6	30.23	16.87	1.79	2.57	4.87	1.66	719	Grayish pink St. H.
	8	29.57	16.47	1.80	2.55	4.88	1.66	1228	Grayish pink
	10	27.41	15.02	1.82	2.52	6.46	2.22	1557	Buff
	12	26.41	14.35	1.84	2.50	7.50	2.57	2000	Buff
	14	24.47	13.13	1.86	2.46	8.51	2.95	2237	Buff
H44 1-3	03	27.41	15.17	1.81	2.49	1.25	.44	1611	Lt. buff St. H.
	01	26.99	14.65	1.84	2.52	3.32	1.15	1864	Lt. buff
	2	26.02	13.91	1.86	2.51	4.42	1.52	1463	Lt. buff
	4	24.30	12.92	1.88	2.49	5.14	1.76	2130	Lt. buff
	6	20.75	10.75	1.93	2.47	7.66	2.64	1840	Buff
	8	16.18	7.96	2.03	2.43	12.11	4.24	2041	Buff
	10	11.94	5.62	2.12	2.40	15.82	5.61	3599	Grayish buff
	12	5.85	2.74	2.13	2.27	16.66	5.91	4255	Grayish buff
	14	6.32	3.03	2.09	2.23	14.42	5.09	4342	Grayish buff
H57 1	03	33.86	20.59	1.64	2.48	.66	.24	895	Cream St. H.
	01	34.73	21.04	1.65	2.53	1.31	.47	804	Cream
	2	33.92	20.45	1.66	2.51	1.70	.57	1089	Cream
	4	33.15	19.75	1.68	2.51	2.34	.81	880	Cream
	6	33.60	20.11	1.67	2.52	2.19	.74	1101	Cream
	8	31.78	18.75	1.70	2.49	3.62	.91	1138	Cream
	10	29.29	16.74	1.75	2.47	6.49	2.22	1928	Cream
	12	26.94	15.39	1.75	2.40	6.66	2.29	N.D.	Cream
	14	26.34	15.17	1.74	2.26	6.05	2.08	N.D.	Buff
H71 2	03	30.75	17.42	1.77	2.55	–1.14	–.40	953	Buff St. H.
	01	31.15	17.54	1.77	2.58	–.83	–.30	931	Buff
	2	31.40	17.48	1.78	2.57	–.42	–.17	1168	Buff
	4	31.01	17.42	1.78	2.57	–.42	–.17	966	Buff
	6	30.53	17.09	1.79	2.57	.00	.00	1063	Buff
	8	29.07	16.12	1.80	2.54	1.38	.47	1270	Buff
	10	27.33	14.96	1.83	2.51	2.49	.84	1373	Buff
	12	26.87	14.62	1.84	2.51	3.07	1.04	1211	Buff
	14	23.11	12.26	1.88	2.45	9.56	3.31	1397	Dk. buff
H79 2	03	30.47	17.13	1.78	2.56	.00	.00	1192	Buff St. H.
	01	30.21	16.75	1.80	2.58	.93	.33	1207	Buff
	2	29.26	16.16	1.81	2.55	1.53	.54	1248	Buff
	4	29.53	16.37	1.80	2.56	1.40	.47	1336	Buff
	6	28.75	15.77	1.82	2.56	2.51	.87	1347	Buff
	8	27.80	15.14	1.84	2.54	3.55	1.21	1510	Buff
	10	25.92	13.84	1.87	2.54	4.72	1.63	1470	Buff
	12	25.14	13.42	1.87	2.50	5.02	1.73	1613	Buff
	14	22.36	11.69	1.91	2.46	6.56	2.25	1515	Dk. buff

Abbreviation: St. H., steel hard.

TEST HOLES H96, H107

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
H96 2-7	03	27.19	15.13	1.80	2.48	2.29	.77	1347	Buff St. H.
	01	27.39	15.05	1.82	2.50	3.69	1.25	1540	Buff
	2	28.55	15.85	1.81	2.52	2.46	.84	1474	Buff
	4	26.99	14.91	1.81	2.48	2.69	.91	1664	Buff
	6	25.33	13.61	1.86	2.49	5.51	1.90	1552	Buff
	8	22.76	11.90	1.91	2.48	8.22	2.85	1820	Buff
	10	20.15	10.27	1.96	2.45	10.22	3.56	2250	Buff
	12	18.63	9.47	1.97	2.42	10.88	3.77	2036	Buff
	14	13.05	6.57	1.98	2.28	11.47	3.99	2529	Grayish buff
H107 3-7	03	35.01	21.27	1.65	2.53	-.39	-.13	657	Buff
	01	35.06	21.08	1.66	2.56	1.05	.37	554	Buff
	2	36.03	21.72	1.66	2.59	.66	.24	706	Buff
	4	33.93	20.21	1.68	2.54	1.83	.64	751	Buff
	6	33.27	19.49	1.71	2.55	3.30	1.11	741	Buff St. H.
	8	29.91	16.98	1.76	2.52	6.30	2.15	792	Buff
	10	23.86	12.71	1.87	2.47	11.91	4.17	1370	Buff
	12	23.86	12.51	1.91	2.51	13.51	4.76	N.D.	Buff
	14	17.21	8.64	1.99	2.41	17.33	6.17	N.D.	Grayish buff

Abbreviation: St. H., steel hard.

POSSIBILITIES FOR UTILIZATION

Brick and Tile Clays, Group 1, are the silty and buff burning group of clays that are closely related to the bond clays. They are actually the same as the bond clays except that they contain so much fine quartz silt that their physical properties are altered and can not be placed in the same category as the bond clays.

The clays have excellent plastic and drying properties. Their strength in the dry state is unusually high for brick and tile clay. These properties point to economical processing with low dryer loss. On burning there is little alteration of the clays over a wide firing range. The colors are warm shades of cream, salmon buff, buff, and grayish buff. The burned strength of samples H39 4-6, H57 1, H71 2, H79 2, H96 2-7, and H107 3-7 is too low for structural tile, however, face brick, fireproofing and drain tiles are products for which these clays are well suited. Samples H5 12-14, H5 15-21, H7 8-17, H7 18-20, and H44 1-3 are suited for the manufacture of structural tile, enameled and salt glaze facing tile, faience, buff colored flower pots, face brick, fireproofing and drain tile.

BRICK AND TILE CLAYS-GROUP 2

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Hole No.	Sample No.	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in pounds per square inch	Color
			Volume in percent	Linear in percent		
H39	7-8-9	30.26	13.92	4.90	120	Gray
H55	1-8	32.81	24.47	8.94	486	Gray
H71	1	27.18	27.43	10.16	574	Gray
H78	1-7	28.50	13.82	4.87	200	Gray
H78	8-18	27.60	15.06	5.31	293	Gray
H78	20-21	27.25	26.60	9.79	456	Grayish red
H79	1	24.60	24.05	8.78	510	Gray
H89	1-5	31.45	20.93	7.56	298	Gray
H90	1-3	30.84	29.16	10.87	453	Gray
H90	5-6	32.33	20.09	7.21	286	Gray
H90	8-12	27.91	15.12	5.35	260	Gray
H97	2-4	28.63	16.48	5.83	262	Gray
H98	1-4	31.67	21.23	7.67	369	Gray
H100	7-12	30.59	17.53	6.25	278	Gray
H111	1	30.27	22.04	7.99	424	Gray
H111	2-3	27.32	15.09	5.31	188	Gray

SCREEN ANALYSES

SAMPLE H55 1-8

Retained on screen	Percent	Character of residue
60	9.78	Abundance of arenaceous gray clay nodules; trace of lignite.
100	10.56	Abundance of arenaceous gray clay nodules; considerable quantity of quartz; small amount of muscovite; trace of marcasite.
250	28.39	Abundance of quartz; considerable quantity of clay nodules; trace of muscovite.
Cloth	51.27	Clay substance including residue from above.

SAMPLE H79 1

Retained on screen	Percent	Character of residue
60	.71	Abundance of arenaceous gray clay nodules; considerable quantity of quartz.
100	7.91	Abundance of quartz; considerable quantity of clay nodules; small amount of muscovite.
250	34.12	Abundance of quartz; traces of clay and dark minerals.
Cloth	57.26	Clay substance including residue from above.

SAMPLE H90 1-3

Retained on screen	Percent	Character of residue
60	6.64	Abundance of arenaceous gray clay nodules, some stained with limonite.
100	6.40	Abundance of arenaceous gray clay nodules, some stained with limonite; small amount of quartz.
250	29.72	Abundance of quartz; small amounts of clay nodules, some stained with limonite.
Cloth	57.19	Clay substance including residue from above.

Alta Ray Gault, laboratory geologist.

CHEMICAL ANALYSES*

SAMPLE H55 1-8

Ignition loss	4.75	Iron oxide, Fe_2O_3	3.07	Magnesia, MgO	0.40
Silica, SiO_2	73.74	Titania, TiO_2	0.53	Manganese, MnO_2	Trace
Alumina, Al_2O_3	14.94	Lime, CaO	1.07	Alkalies, (K_2O, Na_2O)	0.20

SAMPLE H79 1

Ignition loss	3.54	Iron oxide, Fe_2O_3	2.37	Magnesia, MgO	0.53
Silica, SiO_2	78.91	Titania, TiO_2	0.64	Manganese, MnO_2	None
Alumina, Al_2O_3	12.51	Lime, CaO	1.17	Alkalies, (K_2O, Na_2O)	0.52

SAMPLE H90 1-3

Ignition loss	3.98	Iron oxide, Fe_2O_3	3.06	Magnesia, MgO	0.22
Silica, SiO_2	76.31	Titania, TiO_2	0.76	Manganese, MnO_2	None
Alumina, Al_2O_3	13.62	Lime, CaO	0.91	Alkalies, (K_2O, Na_2O)	0.48

* Samples ground to pass 100-mesh screen.

B. F. Mandlebaum, analyst.

PYRO-PHYSICAL PROPERTIES

TEST HOLES H39, H55, H71, H78

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks	
H39 7-8-9	03	34.98	21.62	1.62	2.49	4.04	1.39	716	Salmon*	
	01	34.93	20.66	1.69	2.59	7.98	2.74	654	Salmon*	
	2	33.58	19.53	1.71	2.58	8.99	3.09	397	Salmon*	
	4	33.20	19.47	1.71	2.55	8.82	3.06	804	Salmon*	
	6	31.97	18.31	1.75	2.55	11.29	3.92	641	Lt. red	
	8	27.71	15.19	1.82	2.52	15.22	5.38	805	Lt. red	St. H.
	10	14.68	7.12	2.06	2.44	24.83	9.10	1324	Brown	
H55 1-8	03	31.50	18.62	1.69	2.47	4.34	1.49	1032	Salmon	
	01	32.60	19.05	1.71	2.52	5.35	1.83	1125	Salmon	
	2	32.62	18.99	1.72	2.55	6.14	2.11	1083	Lt. red	
	4	30.08	17.39	1.73	2.48	6.66	2.29	1108	Lt. red	
	6	31.12	17.77	1.75	2.54	7.71	2.67	1290	Red	St. H.
	8	26.39	14.20	1.86	2.53	13.04	4.57	1066	Red	
	10	4.52	2.60	1.74	1.82	6.73	2.32	1325	Brown	
H71 1	03	30.20	16.92	1.79	2.55	−1.21	−.44	867	Salmon	
	01	30.65	17.12	1.79	2.58	−.92	−.33	936	Salmon	
	2	31.83	17.72	1.79	2.58	−.46	−.17	869	Salmon	
	4	29.88	16.65	1.80	2.56	−.46	−.17	954	Salmon	
	6	31.19	17.34	1.80	2.58	−.46	−.17	954	Red	
	8	28.96	16.09	1.80	2.54	.00	.00	1057	Red	St. H.
	10	29.00	15.97	1.88	2.55	.62	.24	1150	Buff	
	12	26.53	14.53	1.83	2.49	.76	.27	1146	Buff	
	14	25.29	13.47	1.87	2.51	4.03	1.39	1159	Dk. buff	
H78 1-7	03	35.90	22.05	1.63	2.54	1.93	.67	345	Salmon	
	01	35.79	21.44	1.69	2.62	4.53	1.56	494	Salmon	
	2	35.48	21.22	1.67	2.59	4.67	1.59	422	Salmon	
	4	34.41	20.51	1.68	2.55	4.36	1.49	431	Salmon	
	6	35.31	21.05	1.68	2.58	4.89	1.66	605	Red	
	8	31.87	18.36	1.73	2.54	8.09	2.78	590	Buff	
	10	26.07	14.25	1.83	2.48	11.67	4.06	1084	Dk. buff	St. H.
	12	23.16	12.31	1.88	2.45	15.21	5.38	1203	Dk. buff	
	14	8.41	5.14	1.66	2.25	10.34	3.59	1013	Dk. buff	
H78 8-18	03	33.67	19.94	1.69	2.60	2.80	.94	435	Salmon	
	01	33.73	19.71	1.71	2.59	4.24	1.46	592	Salmon	
	2	33.60	19.57	1.72	2.58	4.91	1.70	685	Salmon	
	4	33.47	19.47	1.72	2.57	4.16	1.42	608	Salmon	
	6	33.38	19.33	1.72	2.59	5.01	1.73	835	Lt. red	
	8	31.77	18.29	1.76	2.58	7.59	2.60	813	Buff	St. H.
	10	26.38	14.47	1.82	2.48	10.08	3.49	1180	Buff	
	12	16.92	9.31	1.82	2.18	9.50	3.27	968	Brown	
	14	6.39	3.58	1.81	1.95	5.73	1.97	963	Brown	

Abbreviations: St. H., steel hard. * Stained with calcium sulfate.

TEST HOLES H78, H79, H89, H90

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks	
H78 20-21	03	30.71	16.97	1.81	2.61	.00	.00	640	Salmon	St. H.
	01	30.52	16.65	1.83	2.64	1.31	.47	860	Salmon	
	2	30.65	16.75	1.83	2.70	1.16	.40	929	Salmon	
	4	30.41	16.52	1.84	2.64	2.59	.87	959	Lt. red	
	6	28.71	15.63	1.84	2.58	1.30	.44	1042	Lt. red	
	8	28.15	15.43	1.85	2.58	2.30	.77	1049	Lt. red	
	10	26.70	14.48	1.89	2.58	3.97	1.35	1249	Dk. buff	
	12	26.17	13.85	1.89	2.56	3.98	1.35	1180	Dk. buff	
	14	21.98	11.28	1.95	2.50	7.03	2.42	1396	Brown	
H79 1	03	31.21	17.51	1.78	2.59	–1.43	–.50	700	Salmon	
	01	30.99	17.35	1.78	2.59	–1.30	–.44	728	Salmon	
	2	30.73	17.15	1.79	2.59	–1.01	–.37	700	Lt. red	
	4	30.88	17.26	1.79	2.59	–.85	–.30	775	Lt. red	
	6	31.01	17.40	1.78	2.58	–1.14	–.40	840	Red	
	8	30.53	17.02	1.79	2.58	–.71	–.27	894	Red	
	10	29.99	16.65	1.80	2.57	–.44	–.17	874	Buff	St. H.
	12	28.81	16.03	1.80	2.52	–.72	–.27	947	Buff	
	14	28.37	15.75	1.80	2.51	–.85	–.30	927	Buff	
H89 1-5	03	36.25	21.97	1.65	2.59	1.36	.47	442	Salmon	
	01	35.11	21.04	1.67	2.57	2.18	.74	404	Salmon	
	2	36.47	21.73	1.65	2.60	1.79	.60	497	Salmon	
	4	34.08	19.97	1.70	2.61	4.17	1.42	673	Red	St. H.
	6	35.31	20.93	1.68	2.60	3.49	1.18	746	Red	
	8	31.30	17.96	1.74	2.53	6.87	2.36	730	Dk. buff	
	10	24.94	13.26	1.88	2.50	13.63	4.79	985	Dk. buff	
	12	20.29	10.49	1.94	2.44	16.02	5.68	896	Dk. buff	
	14	5.77	3.11	1.85	1.97	12.49	4.35	1224	Brown	
H90 1-3	03	34.47	20.25	1.70	2.60	.00	.00	553	Salmon	
	01	33.47	19.41	1.73	2.60	.61	.24	649	Lt. red	
	2	34.40	20.02	1.72	2.62	.44	.17	635	Lt. red	
	4	33.54	19.54	1.72	2.59	1.04	.37	765	Red	St. H.
	6	33.55	19.55	1.72	2.58	.45	.17	680	Red	
	8	31.73	18.26	1.74	2.55	1.28	.44	919	Red	
	10	29.63	16.43	1.80	2.56	4.95	1.70	941	Buff	
	12	28.88	15.89	1.82	2.56	5.90	2.01	1017	Buff	
	14	22.32	14.86	1.94	2.49	11.81	4.14	1125	Dk. buff	
H90 5-6	03	35.68	21.63	1.62	2.53	3.68	1.25	456	Salmon	
	01	35.13	20.88	1.68	2.59	5.86	2.01	458	Salmon	
	2	35.83	21.42	1.68	2.60	5.15	1.76	574	Salmon	
	4	34.29	20.29	1.69	2.58	6.42	2.22	729	Salmon	
	6	35.19	20.94	1.68	2.59	5.73	1.97	725	Lt. red	St. H.
	8	31.23	17.81	1.75	2.55	10.03	3.49	850	Lt. red	
	10	25.17	13.63	1.85	2.47	14.33	5.05	1176	Dk. buff	
	12	24.58	13.27	1.88	2.51	15.91	5.65	1344	Dk. buff	
	14	4.28	2.24	1.91	2.00	17.37	6.17	1362	Brown	

Abbreviation: St.H., steel hard.

TEST HOLES H90, H97, H98, H100, H111

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks	
H90 8-12	03	35.99	21.53	1.67	2.61	.95	.33	343	Salmon	
	01	34.99	20.59	1.69	2.60	2.19	.74	358	Salmon	
	2	34.92	26.63	1.69	2.60	2.18	.74	285	Salmon	
	4	34.42	20.39	1.69	2.57	2.57	.87	422	Lt. red	
	6	34.23	20.26	1.69	2.57	2.41	.84	372	Lt. red	
	8	32.66	18.63	1.74	2.58	5.02	1.73	350	Red	St. H.
	10	27.83	15.17	1.83	2.53	9.95	3.45	702	Dk. buff	
	12	25.81	14.00	1.84	2.49	10.64	3.70	832	Dk. buff	
	14	7.12	3.80	1.87	2.02	14.19	4.98	979	Brown	
H97 2-4	03	34.19	20.19	1.69	2.57	2.72	.94	440	Salmon	
	01	33.43	19.39	1.71	2.58	4.20	1.42	587	Salmon	
	2	33.77	19.66	1.72	2.59	4.41	1.52	452	Salmon	
	4	33.41	19.52	1.71	2.57	4.22	1.46	631	Salmon	
	6	32.89	19.02	1.73	2.63	4.92	1.70	652	Lt. red	
	8	29.37	16.47	1.78	2.53	7.82	2.71	560	Lt. red	St. H.
	10	24.04	12.73	1.89	2.49	13.45	4.72	962	Dk. buff	
	12	11.23	5.67	1.98	2.23	17.15	6.10	1203	Dk. buff	
	14	6.37	3.37	1.88	1.99	13.16	4.61	1343	Dk. buff	
H98 1-4	03	34.51	20.56	1.67	2.56	3.03	1.04	763	Salmon*	
	01	33.79	19.79	1.71	2.58	4.63	1.59	728	Salmon*	
	2	34.23	19.99	1.71	2.60	4.77	1.63	714	Salmon*	
	4	33.35	19.54	1.71	2.56	4.52	1.56	817	Salmon*	
	6	32.73	18.74	1.73	2.57	5.37	1.83	769	Buff	St. H.
	8	29.62	16.70	1.77	2.52	8.34	2.88	910	Buff	
	10	23.45	12.35	1.90	2.48	14.08	4.94	1169	Dk. buff	
	12	22.32	11.55	1.93	2.49	15.62	5.53	1448	Dk. buff	
	14	5.04	2.87	1.76	1.85	7.71	2.67	1239	Brown	
H100 7-12	03	31.29	17.93	1.73	2.52	9.10	3.13	1232	Salmon	
	01	30.65	16.99	1.80	2.60	12.37	4.32	1436	Salmon	
	2	30.18	16.74	1.80	2.58	12.02	4.21	1325	Lt. red	St. H.
	4	24.82	13.18	1.88	2.50	15.77	5.57	1720	Red	
	6	26.37	14.29	1.84	2.50	14.35	5.05	1468	Red	
	8	22.27	11.35	1.96	2.52	19.50	6.98	1446	Red	
	10	18.79	10.31	1.83	2.25	13.56	4.76	2015	Buff	
	12	9.15	4.92	1.86	2.05	14.75	5.20	2229	Brown	
	14	17.94	11.34	1.58	1.93	.40	.13	2440	Brown	Bl.
H111 1	03	32.16	18.52	1.74	2.56	4.49	1.52	790	Salmon	
	01	31.03	17.46	1.77	2.57	6.78	2.32	1112	Salmon	
	2	31.79	18.02	1.77	2.59	6.28	2.15	1338	Salmon	
	4	26.63	14.24	1.87	2.56	11.62	4.06	844	Salmon	St. H.
	6	29.35	16.05	1.84	2.58	9.21	3.20	1202	Lt. red	
	8	22.01	13.40	1.89	2.54	12.22	4.28	1620	Lt. red	
	10	12.44	6.13	2.03	2.30	18.47	6.59	2419	Brown	
	12	15.13	7.27	2.08	2.46	20.39	7.32	2139	Brown	
	14	6.47	3.40	1.88	1.99	11.96	4.17	2186	Brown	

Abbreviations: Bl., bloated; St. H., steel hard. * Stained with calcium sulfate.

TEST HOLE H111

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks	
H111 2-3	03	33.01	18.97	1.74	2.60	4.50	1.87	268	Salmon	
	01	32.49	18.41	1.76	2.61	6.08	2.08	406	Salmon	
	2	32.89	18.79	1.75	2.60	5.38	1.83	641	Salmon	
	4	29.96	16.65	1.79	2.57	7.69	2.64	521	Buff	St. H.
	6	30.74	17.21	1.79	2.58	7.21	2.50	687	Red	
	8	27.16	14.64	1.85	2.55	10.83	3.77	918	Red	
	10	5.96	2.89	2.06	2.20	19.99	7.17	1166	Brown	

Abbreviation: St. H., steel hard.

POSSIBILITIES FOR UTILIZATION

Brick and Tile Clays, Group 2, are the salmon to red burning clays which in many respects are similar to the buff burning clays of Group 1. The clays contain so much quartz silt that they possess little strength on burning. They possess excellent plastic, drying, and working properties and could be manufactured into beautiful face brick at a minimum of expense. However, since some of the clays are structurally unsound after burning, it would be advisable that they be blended with clays containing less silt. Bond clays are locally available for this purpose. Samples H55 1-8, H100 7-12, and H111 1 possess sufficient strength after burning to make serviceable face brick, common brick, drain tile, and fireproofing.

BRICK AND TILE CLAYS-GROUP 3

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Hole No.	Sample No.	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in pounds per square inch	Color
			Volume in percent	Linear in percent		
H74	5	38.62	43.67	17.43	867	Gray
H83	1–3	31.48	32.63	12.37	574	Gray
H83	4–5	36.53	41.22	16.27	790	Gray
H93	1–3	33.10	29.81	11.17	267	Reddish brown
H113	1–3	31.19	33.07	12.54	610	Tan
H115	1–3	31.27	36.31	14.00	868	Yellowish gray

SCREEN ANALYSIS

SAMPLE H113 1-3

Retained on screen	Percent	Character of residue
60	2.02	Abundance of limonitic arenaceous nodules; considerable quantity of quartz; small amount of plant fragments.
100	7.26	Abundance of limonitic stained kaolin nodules; considerable quantity of quartz; small amounts of muscovite and kaolin.
250	18.19	Abundance of quartz; small amount of clay nodules.
Cloth	72.53	Clay substance including residue from above.

Alta Ray Gault, laboratory geologist.

CHEMICAL ANALYSIS*

SAMPLE H113 1-3

Ignition loss	4.74	Iron oxide, Fe_2O_3	3.52	Magnesia, MgO	0.24
Silica, SiO_2	73.51	Titania, TiO_2	0.70	Manganese, MnO_2	Trace
Alumina, Al_2O_3	14.84	Lime, CaO	1.02	Alkalies, (K_2O, Na_2O)	0.20

* Sample ground to pass 100-mesh screen.

B. F. Mandlebaum, analyst.

PYRO-PHYSICAL PROPERTIES

Test Holes H74, H83, H93, H113

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
H74 5	03	29.00	16.23	1.79	2.52	5.83	2.01	1190	Buff
	01	28.99	15.94	1.82	2.56	7.30	2.50	1875	Buff
	2	28.40	15.52	1.83	2.56	7.65	2.64	1874	Buff St. H.
	4	27.47	15.04	1.83	2.52	7.90	2.71	2153	Buff
	6	27.76	15.16	1.83	2.53	8.31	2.88	2218	Buff
	8	25.29	13.49	1.87	2.51	10.09	3.49	1912	Buff
	10	19.63	9.91	1.98	2.47	14.73	5.20	2399	Buff
	12	18.14	8.93	2.02	2.48	16.35	5.80	2399	Grayish buff
	14	8.43	4.20	2.03	2.21	30.27	11.34	2901	Brown
H83 1-3	03	31.24	17.61	1.77	2.59	.48	.17	848	Salmon St. H.
	01	29.65	16.72	1.79	2.56	2.01	.70	1005	Lt. red
	2	30.32	16.83	1.80	2.58	2.15	.74	901	Lt. red
	4	30.45	16.99	1.79	2.58	2.00	.67	1119	Lt. red
	6	30.25	16.98	1.79	2.56	2.28	.77	1110	Red
	8	27.06	14.69	1.84	2.53	4.31	1.49	1109	Red
	10	23.80	12.51	1.91	2.50	7.38	2.53	1343	Buff
	12	7.68	3.78	2.03	2.20	13.78	4.83	1525	Brown
	14	4.76	2.57	1.85	1.93	5.11	1.76	1520	Brown
H83 4-5	03	29.75	16.67	1.78	2.54	2.89	.98	1151	Buff St. H.
	01	24.99	15.52	1.83	2.54	5.53	1.90	1188	Lt. red
	2	29.31	16.11	1.82	2.57	4.80	1.63	1661	Lt. red
	4	28.32	15.55	1.88	2.52	8.38	2.88	1307	Lt. red
	6	24.43	13.56	1.82	2.55	6.12	2.11	1651	Red
	8	24.19	12.89	1.90	2.49	9.60	3.31	1746	Red
	10	18.24	9.19	2.03	2.47	13.21	4.65	2411	Grayish buff
	12	13.56	6.79	2.02	2.36	13.25	4.65	2350	Grayish buff
	14	4.81	2.86	1.69	1.78	–1.59	–.54	1951	Brown
H93 1-3	03	30.87	17.36	1.79	2.59	7.99	2.74	1729	Lt. red St. H.
	01	28.25	15.05	1.88	2.62	12.18	4.24	2261	Lt. red
	2	24.70	12.65	1.95	2.59	15.55	5.50	2334	Lt. red
	4	25.29	13.33	1.93	2.59	14.29	5.01	2372	Lt. red
	6	20.57	10.23	2.01	2.52	18.25	6.52	3072	Lt. red
	8	19.81	9.74	2.03	2.54	18.99	6.78	2160	Lt. red
	10	11.03	5.03	2.22	2.49	25.35	9.31	4083	Red
	12	10.11	4.53	2.23	2.49	25.79	9.47	4257	Red
	14	4.38	1.91	2.29	2.39	28.24	10.50	N.D.	Gunmetal
H113 1-3	03	32.13	18.20	1.76	2.60	–.77	–.27	904	Salmon
	01	32.84	18.45	1.78	2.66	.46	.17	928	Salmon
	2	32.47	18.15	1.79	2.65	.61	.24	769	Lt. red St. H.
	4	31.46	17.55	1.79	2.62	.77	.27	831	Lt. red
	6	31.87	17.87	1.78	2.62	.46	.17	830	Red
	8	31.21	17.39	1.80	2.61	.91	.33	1020	Red
	10	30.63	17.03	1.80	2.60	1.52	.54	1168	Red
	12	30.37	16.89	1.80	2.58	1.05	.37	1025	Lt. brown
	14	28.81	15.87	1.82	2.55	1.93	.67	1027	Lt. brown

Abbreviation: St. H., steel hard.

TEST HOLE H115

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks	
H115 1-3	03	25.37	13.64	1.86	2.49	2.03	.70	1452	Salmon	St. H.
	01	26.27	13.51	1.94	2.64	6.15	2.11	1850	Salmon	
	2	24.69	12.93	1.91	2.54	4.45	1.52	1984	Red	
	4	24.23	12.63	1.92	2.53	5.07	1.73	1837	Red	
	6	23.63	12.27	1.93	2.53	5.41	1.87	2167	Red	
	8	19.80	9.99	1.97	2.46	7.87	2.71	2710	Red	
	10	11.93	5.75	2.07	2.35	12.22	4.28	2875	Brown	
	12	6.52	3.09	2.11	2.26	13.68	4.79	2915	Brown	
	14	16.19	9.57	1.69	2.02	−7.75	−2.67	N.D.	Brown	Bl.

Abbreviations: Bl., bloated; St. H., steel hard.

POSSIBILITIES FOR UTILIZATION

The brick and tile clays of group 3 are similar to those of group 2 except that they contain less silt, possess greater strength in the dried and burned states, and are suited for a greater variety of products. The clays burn to warm shades of salmon, red, buff, and brown. Their shrinkage from the plastic to dry state is somewhat greater than the clays of group 2, however, it is not excessive for machine made products.

Samples H74 5, H93 1, and H115 1-3 are well suited for the manufacture of hollow tile for structural use, fireproofing, face brick, common brick, silo tile, flower pots, and drain tile. Samples H83 1-3, H83 4-5, and H113 1-3 possess less burned strength but are suited for the manufacture of face brick, common brick, fireproofing, and drain tile.

All of the clays mature at low temperatures and have a wide firing range. Processing into finished products could be accomplished at minimum expense.

BRICK AND TILE CLAYS-GROUP 4

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Hole No.	Sample No.	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in pounds per square inch	Color
			Volume in percent	Linear in percent		
H61	2	24.31	9.47	3.27	N. D.	Brownish black
H61	3	42.47	45.86	18.52	N. D.	Dark gray
H61	4	40.58	37.17	14.36	N. D.	Gray
H68	7–9	32.61	35.63	13.69	682	Gray
H68	10–11	32.41	21.88	7.91	N. D.	Dark gray
H74	6	47.12	24.75	9.06	318	Grayish brown
H74	8–12	35.52	13.80	4.83	N. D.	Dark gray
H80	1	45.52	12.86	4.50	N. D.	Brownish gray
H80	6	43.19	25.58	9.39	354	Gray
H85	4–6	42.55	30.79	11.55	431	Gray
H87	2–4	47.30	24.79	9.06	327	Gray
H100	2–6	34.63	21.52	7.79	303	Gray

SCREEN ANALYSES

SAMPLE H61 2

Retained on screen	Percent	Character of residue
60	73.08	Abundance of waxy lignitic clay nodules.
100	9.54	Abundance of waxy lignitic clay nodules.
250	7.90	Abundance of waxy lignitic clay nodules.
Cloth	9.48	Clay substance including residue from above.

SAMPLE H74 8-12

Retained on screen	Percent	Character of residue
60	56.35	Abundance of micaceous lignitic clay nodules; considerable quantity of glauconite; traces of muscovite and quartz.
100	11.82	Abundance of micaceous lignitic clay nodules; considerable quantity of glauconite; small amount of quartz.
250	10.74	Abundance of lignitic clay nodules; small amounts of quartz and glauconite.
Cloth	21.09	Clay substance including residue from above.

SAMPLE H87 2-4

Retained on screen	Percent	Character of residue
60	63.73	Abundance of micaceous lignitic clay nodules; traces of limonite and gypsum.
100	9.49	Abundance of micaceous lignitic clay nodules; small amount of limonite; traces of quartz and gypsum.
250	9.02	Abundance of micaceous lignitic clay nodules; small amounts of quartz and limonite.
Cloth	17.76	Clay substance including residue from above.

Alta Ray Gault, laboratory geologist.

CHEMICAL ANALYSES*

SAMPLE H61 2

Ignition loss	18.03	Iron oxide, Fe_2O_3	2.66	Magnesia, MgO	0.37
Silica, SiO_2	49.42	Titania, TiO_2	0.87	Manganese, MnO_2	None
Alumina, Al_2O_3	25.87	Lime, CaO	1.47	Alkalies, (K_2O, Na_2O)	1.04

SAMPLE H74 8-12

Ignition loss	8.40	Iron oxide, Fe_2O_3	5.41	Magnesia, MgO	0.23
Silica, SiO_2	63.87	Titania, TiO_2	1.02	Manganese, MnO_2	Trace
Alumina, Al_2O_3	16.37	Lime, CaO	1.30	Potash, K_2O	2.81
				Soda, Na_2O	0.42

SAMPLE H87 2-4

Ignition loss	7.89	Iron oxide, Fe_2O_3	4.66	Magnesia, MgO	0.44
Silica, SiO_2	65.75	Titania, TiO_2	0.80	Manganese, MnO_2	Trace
Alumina, Al_2O_3	16.10	Lime, CaO	0.89	Alkalies, (K_2O, Na_2O)	0.88

* Samples ground to pass 100-mesh screen.

B. F. Mandlebaum, analyst.

PYRO-PHYSICAL PROPERTIES

TEST HOLES H61, H68

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks	
H61 2	03	34.26	20.13	1.70	2.59	23.34	8.50	N.D.	Buff	
	01	31.46	18.27	1.72	2.51	24.80	9.06	N.D.	Buff	St. H.
	2	30.84	17.77	1.73	2.50	25.10	9.18	N.D.	Buff	
	4	29.97	15.24	1.76	2.40	25.93	9.55	N.D.	Buff	
	6	27.15	15.60	1.74	2.39	25.17	9.22	N.D.	Buff	
	8	26.83	14.87	1.81	2.47	28.34	10.54	N.D.	Buff	
	10	23.99	12.69	1.89	2.48	30.95	11.63	N.D.	Dk. buff	
	12	23.45	12.43	1.89	2.46	31.62	11.93	N.D.	Dk. buff	
	14	22.35	11.70	1.91	2.46	32.66	12.37	N.D.	Dk. buff	
H61 3	03	19.16	9.95	1.93	2.38	23.57	8.58	N.D.	Buff	
	01	19.08	9.86	1.94	2.39	23.89	8.70	N.D.	Buff	St. H.
	2	19.52	10.27	1.93	2.39	23.16	8.42	N.D.	Buff	
	4	16.33	8.50	1.93	2.26	23.65	8.62	N.D.	Buff	
	6	14.40	7.40	1.92	2.29	23.28	8.46	N.D.	Buff	
	8	11.82	5.88	2.02	2.24	26.13	9.63	N.D.	Buff	
	10	8.12	3.87	2.10	2.28	29.83	11.17	N.D.	Dk. buff	
	12	8.43	4.19	2.08	2.25	26.83	9.92	N.D.	Dk. buff	
	14	10.67	5.51	1.93	2.17	24.41	8.94	N.D.	Dk. buff	
H61 4	03	25.73	14.25	1.81	2.43	17.74	6.32	N.D.	Buff	
	01	24.78	13.41	1.85	2.46	19.87	7.13	N.D.	Buff	St. H.
	2	20.11	10.60	1.89	2.37	20.58	7.40	N.D.	Buff	
	4	18.64	9.80	1.89	2.30	23.04	8.38	N.D.	Buff	
	6	13.83	7.02	1.97	2.29	24.86	9.10	N.D.	Buff	
	8	12.89	6.37	2.02	2.32	26.79	9.88	N.D.	Buff	
	10	5.97	2.88	2.08	2.20	28.48	10.58	N.D.	Dk. buff	
	12	4.96	2.02	2.10	2.21	29.54	11.04	N.D.	Dk. buff	
	14	5.87	2.90	2.02	2.15	26.93	9.96	N.D.	Dk. buff	
H68 7-9	03	19.04	9.43	2.02	2.49	16.30	5.76	855	Buff	
	01	15.16	7.31	2.08	2.45	18.65	6.67	2977	Buff	St. H.
	2	14.65	7.05	2.08	2.44	18.93	6.78	2824	Buff	
	4	15.01	7.22	2.08	2.44	19.07	6.82	2631	Buff	
	6	8.62	4.06	2.12	2.32	20.83	7.52	4001	Buff	
	8	6.35	2.88	2.20	2.35	23.68	8.62	4785	Buff	
	10	3.62	1.59	2.26	2.35	25.30	9.27	5283	Dk. buff	
	12	3.05	1.36	2.26	2.33	25.51	9.39	5740	Dk. buff	
	14	5.85	2.76	2.14	2.27	21.29	7.67	4577	Dk. buff	
H68 10-11	03	31.03	17.35	1.79	2.59	22.12	8.03	N.D.	Buff	
	01	28.79	15.64	1.83	2.55	24.61	9.02	N.D.	Buff	St. H.
	2	29.25	16.07	1.82	2.57	23.08	8.38	N.D.	Buff	
	4	26.80	14.44	1.85	2.53	24.97	9.14	N.D.	Buff	
	6	26.98	14.67	1.84	2.52	24.53	8.98	N.D.	Buff	
	8	22.23	11.44	1.94	2.50	28.63	10.66	N.D.	Buff	
	10	19.16	9.52	2.02	2.50	31.07	11.68	N.D.	Dk. buff	
	12	17.84	8.74	2.04	2.49	32.05	12.11	N.D.	Dk. buff	
	14	15.67	7.60	2.06	2.45	32.06	12.11	N.D.	Dk. buff	

Abbreviation: St. H., steel hard.

TEST HOLES H74, H80. H85, H87

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks	
H74 6	03	39.97	27.75	1.44	2.41	11.39	3.95	578	Salmon	Ch.
	01	37.96	24.89	1.52	2.46	16.19	5.72	1322	Salmon	Ch.
	2	38.20	25.23	1.52	2.47	15.50	5.46	1348	Salmon	Ch.
	4	33.22	20.47	1.62	2.42	21.16	7.63	1322	Buff	Ch., St. H.
	6	31.87	18.90	1.69	2.47	24.22	8.86	1457	Lt. red	Ch.
	8	28.77	16.29	1.77	2.48	27.69	10.25	N.D.	Lt. red	Ch.
	10	11.24	5.35	2.10	2.36	39.11	15.28	N.D.	Brown	Ch.
H74 8-12	03	41.80	29.27	1.43	2.45	5.85	2.01	N.D.	Lt. red	Ch.
	01	41.45	28.59	1.45	2.45	7.55	2.60	N.D.	Lt. red	Ch.
	2	39.67	26.82	1.48	2.44	10.23	3.56	N.D.	Lt. red	Ch.
	4	40.57	28.43	1.42	2.41	7.20	2.46	N.D.	Lt. red	Ch.
	6	40.74	28.17	1.45	2.44	8.63	2.99	N.D.	Red	Ch.
	8	38.97	25.55	1.54	2.44	13.34	4.68	N.D.	Red	Ch.
H80 1	03	48.85	38.17	1.28	2.54	6.97	2.39	N.D.	Buff	St. H.
	01	49.54	37.73	1.31	2.60	9.25	3.20	N.D.	Salmon	
	2	46.90	34.42	1.36	2.57	12.19	4.24	N.D.	Salmon	
	4	46.70	34.05	1.37	2.57	13.13	4.61	N.D.	Salmon	
	6	45.84	32.79	1.39	2.58	14.80	5.20	N.D.	Salmon	
	8	42.32	28.54	1.48	2.57	19.49	6.98	N.D.	Salmon	
	10	30.91	17.99	1.72	2.49	30.89	11.59	N.D.	Dk. buff	
	12	31.99	18.52	1.73	2.54	31.11	11.72	N.D.	Dk. buff	
	14	24.65	13.46	1.88	2.49	36.61	14.14	N.D.	Dk. buff	
H80 6	03	41.48	28.80	1.44	2.46	5.71	1.97	830	Salmon	Ch.
	01	42.63	29.39	1.45	2.52	6.05	2.08	825	Salmon	Ch.
	2	41.68	28.40	1.47	2.51	7.62	2.64	861	Salmon	Ch.
	4	40.16	27.23	1.47	2.46	7.94	2.74	789	Lt. red	Ch.
	6	40.63	27.24	1.49	2.51	8.93	3.09	802	Lt. red	Ch.
	8	37.03	23.41	1.58	2.51	13.85	4.87	832	Red	Ch.
	10	29.78	17.45	1.71	2.42	20.44	7.36	1273	Brown	Ch., St. H.
H85 4-6	03	38.03	24.66	1.56	2.51	5.95	2.04	641	Salmon*	Ch.
	01	37.08	22.96	1.62	2.56	9.22	3.20	730	Lt. red*	Ch.
	2	36.43	22.86	1.60	2.56	9.16	3.11	711	Lt. red	Ch.
	4	34.63	20.72	1.59	2.51	8.19	2.81	809	Lt. red	Ch.
	6	35.12	21.57	1.63	2.51	10.19	3.52	770	Red	Ch.
	8	27.84	15.23	1.83	2.53	20.29	7.28	1009	Red	Ch., St. H.
	10	20.63	12.06	1.84	2.08	17.09	6.06	1402	Brown	Bl.
H87 2-4	03	41.99	29.59	1.42	2.44	9.40	3.24	738	Salmon	Ch.
	01	41.16	28.27	1.45	2.47	11.96	4.17	858	Salmon	Ch.
	2	40.74	27.71	1.47	2.48	13.03	4.57	950	Salmon	Ch.
	4	39.87	27.33	1.46	2.39	12.34	4.32	947	Salmon	Ch.
	6	36.35	23.52	1.53	2.40	16.46	5.83	1073	Buff	Ch.
	8	25.45	14.09	1.82	2.42	29.35	10.96	1074	Dk. red	Ch., St. H.
	10	21.98	12.79	1.72	2.20	25.51	9.39	1835	Dk. red	Ch.

Abbreviations: Ch., checked; Bl., bloated; St. H., steel hard.

* Stained with calcium sulfate.

TEST HOLE H100

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
H100 2-6	03	25.04	14.15	1.77	2.37	18.23	6.52	645	Buff Ch., St. H.
	01	25.57	14.47	1.77	2.38	18.24	6.52	2730	Buff Ch.
	2	24.21	13.51	1.79	2.37	19.19	6.86	2344	Buff Ch.
	4	21.95	12.35	1.78	2.28	18.19	6.48	2184	Buff Ch.
	6	21.19	12.03	1.76	2.23	17.36	6.17	2608	Buff Ch.
	8	19.73	9.76	2.03	2.52	28.44	10.58	2578	Buff Ch.
	10	13.97	6.81	2.05	2.38	28.95	10.79	2783	Buff Ch.
	12	9.45	4.55	2.08	2.30	29.98	11.21	4053	Dk. buff Ch.
	14	12.11	6.62	1.83	2.08	20.46	7.36	N.D.	Dk. buff Ch.

Abbreviations: St. H., steel hard; Ch., checked.

POSSIBILITIES FOR UTILIZATION

The brick and tile clays of group 4 are the silty shale variety. Although the clays appear similar to each other in the raw state, some contain more silt than others and are consequently less desirable.

The plastic properties of the clays are suited for machine made ware. They are not very plastic but develop strong bodies on drying.

Samples H61 2, H61 3, H61 4, H68 7-9, and H68 10-11 burn to cool shades of buff and dark buff. Sample H80 1 burns to salmon buff colors. The shale-like texture of the burned clays is very desirable in face brick, and could best be developed in a semi-dry-press product.

Samples H76 6, H74 8-12, H80 6, H85 4-6, and H87 2-4 burn to salmon and red colors. These clays contain more silt than the before mentioned series and develop little strength on burning. It is doubtful that they are of economic value.

MISCELLANEOUS CLAYS

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Hole No.	Sample No.	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in pounds per square inch	Color
			Volume in percent	Linear in percent		
H46	7	30.02	29.99	11.21	347	Lt. gray
H93	11–12	27.06	24.71	9.06	N. D.	Lt. gray
H127	2–3	30.70	18.43	6.59	106	Cream
H100	1	44.94	51.22	21.32	615	Yellow
H57	2–3	14.58	2.08	.70	N. D.	Gray

SCREEN ANALYSES

Sample H57 2-3

Retained on screen	Percent	Character of residue
60	7.20	Abundance of arenaceous micaceous lignitic clay nodules; considerable quantity of lignite; small amount of marcasite; trace of muscovite.
100	21.19	Abundance of quartz; small amount of clay nodules; traces of marcasite and lignite.
250	49.47	Abundance of quartz; traces of lignite, clay, and pyrite.
Cloth	22.14	Clay substance including residue from above.

Sample H93 11-12

Retained on screen	Percent	Character of residue
60	.87	Abundance of clay nodules; considerable quantity of quartz; small amount of marcasite.
100	3.76	Abundance of clay nodules; considerable quantity of quartz.
250	12.30	Abundance of clay nodules; considerable quantity of quartz; trace of marcasite.
Cloth	83.07	Clay substance including residue from above.

Alta Ray Gault, laboratory geologist.

CHEMICAL ANALYSES*

SAMPLE H57 2-3

Ignition loss 3.53	Iron oxide. Fe_2O_3 ... 1.33	Magnesia, MgO 0.45
Silica, SiO_2 ....81.68	Titania, TiO_2 .... 0.59	Manganese, MnO_2 None
Alumina, Al_2O_3 ...... 9.82	Lime, CaO 1.41	Alkalies, (K_2O, Na_2O) 0.46

SAMPLE H93 11-12

Ignition loss 7.19	Iron oxide, Fe_2O_3 ... 1.03	Magnesia, MgO 0.32
Silica, SiO_2 ....68.37	Titania, TiO_2 .... 1.16	Manganese, MnO_2 None
Alumina, Al_2O_3 ......20.15	Lime, CaO 0.85	Alkalies, (K_2O, Na_2O) 0.17

* Samples ground to pass 100-mesh screen.

B. F. Mandlebaum, analyst.

PYRO-PHYSICAL PROPERTIES

TEST HOLES H46, H93, H127, H100, H57

Hole No. Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear shrinkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
H46 7	03	27.41	15.32	1.81	2.50	6.10	2.08	1725	Cream St. H.
	01	25.74	13.64	1.89	2.54	10.05	3.49	1888	Cream
	2	24.52	12.97	1.89	2.51	10.09	3.49	2343	Cream
	4	23.83	12.44	1.92	2.51	11.14	3.88	2291	Cream
	6	22.18	11.40	1.95	2.50	12.91	4.54	3084	Cream
	8	18.72	9.20	2.04	2.50	16.51	5.87	3651	Cream
	10	13.18	6.27	2.10	2.42	19.29	6.90	4801	Cream
	12	11.66	5.49	2.12	2.40	20.15	7.25	4890	Cream
	14	6.77	3.08	2.19	2.36	22.43	8.15	4604	Grayish buff
H93 11-12	03	29.59	16.71	1.77	2.48	3.48	1.18	953	Cream St. H.
	01	29.35	16.45	1.80	2.54	4.56	1.56	1022	Cream
	2	26.34	14.29	1.84	2.50	7.65	2.64	998	Cream
	4	27.09	14.94	1.81	2.49	5.92	2.04	1307	Cream
	6	23.16	12.13	1.91	2.49	10.71	3.74	901	Cream
	8	19.89	10.01	1.99	2.49	14.47	5.09	1530	Cream
	10	18.82	9.31	2.01	2.48	15.35	5.42	2715	Cream
	12	18.51	9.16	2.02	2.48	16.02	5.68	N.D.	Cream
	14	17.45	8.63	2.03	2.45	15.92	5.65	N.D.	Buff
H127 2-3	03	36.34	22.29	1.63	2.56	6.17	2.11	498	Cream
	01	37.91	22.08	1.72	2.78	11.02	3.85	630	Cream
	2	34.24	20.44	1.69	2.59	9.76	3.38	415	Cream
	4	35.34	21.30	1.70	2.59	10.25	3.56	838	Cream
	6	28.83	15.39	1.87	2.63	18.62	6.67	615	Buff St. H.
	8	24.05	12.15	1.98	2.61	22.95	8.34	N.D.	Buff
	10	19.23	9.19	2.09	2.58	26.91	9.96	N.D.	Buff
	12	22.89	9.54	2.05	2.55	25.66	9.43	N.D.	Buff
	14	16.55	8.06	2.05	2.46	25.79	9.47	N.D.	Dk. buff.
H100 1	03	17.01	7.86	2.13	2.61	24.99	9.14	2612	Red St. H.
	01	17.21	7.92	2.18	2.63	25.58	9.39	3355	Red
	2	8.63	3.75	2.30	2.52	29.31	10.96	3612	Red
	4	9.66	4.23	2.29	2.54	29.32	10.96	488	Red Cr.
	6	.74	.33	2.36	2.38	31.98	12.06	1162	Dk. red Cr.
	8	.29	.12	2.43	2.43	33.09	12.54	8032	Dk. red
	10	.45	.18	2.46	2.47	34.07	12.98	6636	Dk. red
	12	.44	.18	2.46	2.47	34.21	13.07	6322	Chocolate
	14	3.42	1.61	2.13	2.20	23.84	8.70	N.D.	Gunmetal
H57 2-3	03	32.62	18.50	1.77	2.62	–2.92	–1.01	N.D.	Grayish buff
	01	33.38	18.94	1.75	2.64	–2.73	–.94	N.D.	Grayish buff
	2	32.92	18.63	1.76	2.63	–2.86	–.98	N.D.	Grayish buff
	4	33.05	18.85	1.76	2.62	–2.39	–.81	N.D.	Grayish buff
	6	32.84	18.66	1.76	2.62	–2.24	–.77	N.D.	Grayish buff
	8	32.19	18.16	1.77	2.61	–2.10	–.70	N.D.	Grayish buff
	10	31.44	17.59	1.78	2.60	–1.35	–.47	N.D.	Grayish buff
	12	30.35	16.91	1.79	2.58	–1.31	–.47	N.D.	Grayish buff
	14	29.14	16.17	1.80	2.54	–1.07	–.57	N.D.	Grayish buff

Abbreviations: Cr., cracked; St. H., steel hard.

POSSIBILITIES FOR UTILIZATION

Three distinct materials are represented in the group of miscellaneous clays. Samples H46 7, H93 11-12, and H127 2-3 are the clays which burn to light cream and buff colors. Sample H46 7 is a pottery clay. It has excellent plastic, drying, and burning properties and is suitable for making art pottery, faience, decorative tiles, and distinctive face brick in natural and enameled finishes. Sample H93 11-12 is similar except that it contains more quartz silt and does not develop sufficient strength on burning for tiles and pottery but would make attractive light colored face brick. Sample H127 2-3 is similar to sample H93 11-12 but burns to darker shades of cream and buff.

Sample H100 1 is a low maturing red burning bond clay. It has excellent strength in both the dry and burned states. The clay develops a vitreous glassy structure at cone 6 and does not overburn at cone 12. It is especially suited as a red burning slip clay and as a bond clay for heavy clay products such as sewer pipe.

Sample H57 2-3 is essentially a sand or silt containing some clay. It has little ceramic value but could probably be used as a road material.

SANDS

SCREEN ANALYSES

Sample H70 1

Retained on screen	Percent	Character of residue
60	32.83	Abundance of quartz; considerable quantities of glauconite, limonitic clay nodules; small amount of marcasite.
100	33.49	Abundance of quartz; considerable quantity of glauconite; small amount of limonitic nodules; trace of marcasite.
250	15.44	Abundance of quartz; considerable quantity of glauconite and clay nodules; trace of muscovite.
Cloth	18.24	Clay substance including residue from above.

SAMPLE H70 2

Retained on screen	Percent	Character of residue
60	22.49	Abundance of quartz; considerable quantity of limonitic silt nodules and glauconite; small amount of marcasite.
100	43.98	Abundance of quartz; considerable quantity of glauconite; small amount of limonitic nodules.
250	18.40	Abundance of quartz; small amount of glauconite and ferruginous material.
Cloth	15.13	Clay substance including residue from above.

Alta Ray Gault, laboratory geologist.

POSSIBILITIES FOR UTILIZATION

Glauconitic sand is mined commercially as a source of potash. In Tallahatchie County, sample H70 1 and H70 2 are glauconitic sands. These sands were tested for possible use as a fertilizer or an ingredient of a commercial fertilizer. However, the alkali and phosphorous contents were too low for commercial use. It may be possible to locate deposits richer in glauconite and having a commercial value. Sample H70 1 contains 0.55 percent alkalies determined as Na_2O and K_2O, and 0.10 percent phosphorous determined as P_2O_5. Sample H70 2 contains 0.41 percent alkalies determined as Na_2O and K_2O and 0.15 percent phosphorous determined as P_2O_5.

Glauconite grains were separated from the sands and analyzed with the following results:

Ignition loss	7.78	Iron oxide, Fe_2O_3	28.22	Magnesia, MgO	3.20
Silica, SiO_2	50.75	Titania, TiO_2	None	Potash, K_2O	4.16
Alumina, Al_2O_3	4.83	Lime, CaO	0.65	Soda, Na_2O	0.78
		Total	100.37		

The above analysis is typical of glauconite, the potash bearing mineral.

LABORATORY PROCEDURE

PREPARATION

Preliminary drying of the clays was unnecessary, for they had been collected in the field and stored in a steam-heated laboratory several months prior to testing. Primary samples of about 200 pounds were crushed in a No. 2 jaw crusher. The crushed material was screened through a No. 20-mesh Tyler standard screen; residue coarser than 20-mesh was ground in a burr mill until it passed the 20-mesh screen. The clay which had passed 20-mesh screen was thoroughly mixed and reduced to a 10-pound sample by coning and quartering. This operation was accomplished in a metal lined tray approximately 4 feet square and 8 inches deep. The 10-pound sample was reserved for screen analysis, chemical analysis, and for making pyrometric cones. Approximately 75 pounds of clay from the remainder was mixed with water and kneaded by hand to a plastic consistency. The plastic mass was divided into small portions and thoroughly wedged to remove entrapped air and to develop a homogenous plastic body. The small portions were recombined in the same manner and stored in a metal lined damp box until used for making test pieces.

FORMING OF TEST PIECES

Test pieces were of two sizes: short bars, 1 inch square by 2 inches long, and long bars, 1 inch square by 7 inches long. The test pieces were made by wire-cutting bars of approximate size from the plastic mass and pressing in molds to the final size. The long bars were pressed by hand in a hardwood mold of the plunger type. The short bars were formed in a Patterson screw press fitted with a steel die. Each test piece was identified as to test hole number, sample number, and individual piece number. The identification was made by stamping the necessary letters and numerals on the test pieces. A shrinkage mark of 10 centimeters was stamped on the long bars. Sixty long bars and thirty short bars were made from each primary clay sample. Certain samples were not large enough to make the full number of test pieces.

PLASTIC, DRY, AND WORKING PROPERTIES

Immediately on forming the short bars their plastic volume was determined in a mercury volumeter. The plastic weight was measured to .01 gram using a triple beam balance. All of the test pieces were allowed to air-dry several days on slatted wooden pallets and then oven-dried by gradually increasing the temperature on the oven from room temperature to 100°C. in 4 hours and maintaining the oven temperature between 100°C. and 110°C. for an additional hour. After drying, the short bars were placed in descicators, and on cooling to room temperature they were reweighed, and their volume was determined as above described. Five long bars were broken on a Fairbanks cross-breaking machine to determine modulus of rupture.

The workability of the clay was observed during grinding, wedging, and the forming of the test pieces. The water of plasticity, modulus of rupture, and volume shrinkage were calculated by methods outlined by the American Ceramic Society. The linear shrinkage was calculated from the volume shrinkage and is based on the dry volume.

FIRED PROPERTIES

The long and short bars were burned in a down-draft surface combustion kiln especially designed for the purpose. Butane gas was used for fuel. Oxidizing conditions were maintained in the kiln during the entire period of firing. The test pieces were stacked criss-cross in the kiln to permit complete circulation of gases. The kiln was fired at the rate of 200°F. per hour to within 200°F. of the maximum temperature. The last 200°F. rise was accomplished in two to three hours. The rate of firing was measured by means of a Chromel-Alumel termocouple up to 2,100°F., at which point the couple was withdrawn from the kiln; and, by means of pyrometric cones above 2,100°F.

On completing the firing of the long and short test pieces the kiln was cooled gradually in twenty-four to thirty-six hours, after which the short bars were immediately placed in descicators and weighed to an accuracy of .01 gram on a triple beam balance. After weighing, the bars were placed in water which was then heated to the boiling point and was kept boiling for four hours. They were allowed to cool in the water to room temperature and were reweighed as before mentioned. Immediately thereafter the volumes of the test pieces were determined in a mercury volumeter. Volume shrinkage, porosity, absorption, bulk specific gravity, and apparent specific gravity were calculated in accordance with methods outlined by the American Ceramic Society. The long bars were broken on a Fairbanks testing machine to determine modulus of rupture. Five long

CONVERSION TABLE

Cones to Temperatures

Cone No.	When fired slowly, 20°C. per hour		When fired rapidly, 150°C. per hour	
	°C	°F	°C	°F
010	890	1,634	895	1,643
09	930	1,706	930	1,706
08	945	1,733	950	1,742
07	975	1,787	990	1,814
06	1,005	1,841	1,015	1,859
05	1,030	1,886	1,040	1,904
04	1,050	1,922	1,060	1,940
03	1,080	1,976	1,115	2,039
02	1,095	2,003	1,125	2,057
01	1,110	2,030	1,145	2,039
1	1,125	2,057	1,160	2,120
2	1,135	2,075	1,165	2,129
3	1,145	2,093	1,170	2,138
4	1,165	2,129	1,190	2,174
5	1,180	2,156	1,205	2,201
6	1,190	2,174	1,230	2,246
7	1,210	2,210	1,250	2,282
8	1,225	2,237	1,260	2,300
9	1,250	2,282	1,285	2,345
10	1,260	2,300	1,305	2,381
11	1,285	2,345	1,325	2,417
12	1,310	2,390	1,335	2,435
13	1,350	2,462	1,350	2,462
14	1,390	2,534	1,400	2,552
15	1,410	2,570	1,435	2,615
16	1,450	2,642	1,465	2,669
17	1,465	2,669	1,475	2,687
18	1,485	2,705	1,490	2,714
19	1,515	2,759	1,520	2,768
20	1,520	2,768	1,530	2,786

Cone No.	When heated at 100°C. per hour		Cone No.	When heated at 100°C. per hour	
	°C	°F		°C	°F
23	1,580	2,876	32	1,700	3,092
26	1,595	2,903	33	1,745	3,173
27	1,605	2,921	34	1,760	3,200
28	1,615	2,939	35	1,785	3,245
29	1,640	2,984	36	1,810	3,290
30	1,650	3,002	37	1,820	3,308
31	1,680	3,056	38	1,835	3,335

The properties and uses of pyrometric cones: The Standard Pyrometric Cone Company, Columbus, Ohio.

bars were burned and tested for each clay at each cone temperature indicated in the table of pyro-physical properties. Three short bars were fired as test pieces for each clay at each cone temperature.

SCREEN ANALYSES

A quantity of clay from each quartered sample was dried at 110°C.—constant weight, after which exactly 100 grams were blunged in approximately two liters of water by pouring the slip back and forth until all the substance apparently disintegrated.

The disintegrated clay in slip form was poured through a nest of Tyler standard screens, the sizes being 60, 100, and 250. The material passing through the 250-mesh screen was caught on a cloth in a plaster vat. After a fair sample was caught on the cloth, the screens, still in nest, were then washed with a stream of water until no further material passed through the screens. The screens were dried at 110°C., after which the residue from each screen was weighed and collected in glass vials for further study.

It is evident that the above treatment would not completely disintegrate all of the clay nodules; and, though this could have been accomplished by blunging with rubber balls, it was not the purpose of this screen analysis to break the clay down to a finer state of division than would ordinarily occur in usual commercial blunging procedure; consequently, the screen analysis will show residue as "clay nodules" which indicates that a very thorough blunging will be necessary to disintegrate completely the clay in commercial use.

The residue from each screen was examined carefully under a binocular microscope. The finer material was examined under a petrographic microscope. Determinations were made from the physical appearances of mineral grain and crystal form corroborated by use of physical properties test, magnetized needle, reactions to wet reagents; and, where grain size permitted, blow pipe analyses were made.

Undoubtedly there were minerals present in the clays that could not be distinguished under the microscope, because of their fine state of division. However, those that have been recorded have been definitely identified.

Terms used in the tables of screen analyses for describing quantity of residue are: "abundance," meaning one-half or more of residue on screen; "considerable quantity," between one-fourth and one-half; "small amount," less than one-fourth; and "trace," few grains scattered throughout residue.

CHEMICAL ANALYSES

Grinding: Samples were ground to pass a 100 mesh screen.

Ignition loss: One gram of each sample was heated in a platinum crucible at full heat of a blast burner for one hour.

Silica: Ignited samples were fused with 6 to 8 times their weight of anhydrous sodium carbonate, and the fusion dissolved in dilute hydrochloric acid. The samples were double dehydrated with hydrochloric acid. The silica was filtered off, washed, ignited, weighed, volatilized by hydrofluoric acid, and the crucible reweighed. SiO_2 was found by loss in weight. Any residue after evaporation was fused with sodium carbonate and dissolved in the original filtrate for alumina determination.

Alumina: Alumina, iron, and titania were precipitated together by ammonium hydroxide in the presence of ammonium chloride. Double precipitations were necessary to remove all the chlorides. The mixed hydroxides were filtered off, washed free of chlorides, ignited and weighed. The weight represents the total of alumina, iron, and titania. The mixed oxides were fused with potassium bisulphate and dissolved in dilute sulphuric acid. In some cases small amounts of silica were recovered by filtration, ignition, and volatilization with hydrofluoric acid. This was added to silica and deducted from alumina.

Iron: An aliquot of the solution of bisulfate solution was reduced with aluminum dust in sulphuric acid solution and titrated with standard potassium permanganate solution. The iron was calculated as Fe_2O_3.

Titania: Another aliquot of the bisulfate solution was placed in a Schreiner type colorimeter tube and a few drops of hydrogen peroxide added. This was compared in color with a standard titania solution. The total of iron and titania was subtracted from the mixed precipitate of alumina, iron, and titania, leaving alumina.

Manganese: Manganese was removed from the sample used for the ultimate analysis, but discarded, and the determination was made on a separate larger sample. The sample was treated with hydrofluoric acid, twice evaporated, and the insoluble residue removed by filtering. Manganese was determined colorimetrically using potassium periodate as the color reagent, and matching against a standard color sample.

Lime: Lime was determined from the filtrate of the manganese determination by precipitation as the oxalate in the presence of ammonium acetate in alkaline solution. It was weighed as CaO.

Magnesia: Magnesia was determined from the lime filtrate by precipitation as mixed ammonium phosphate in alkaline solution. It was ignited and weighed as $Mg_2P_2O_7$, and calculated to MgO.

Alkalies: Alkalies were determined by the J. Lawrence Smith method as outlined in Scott "Standard Methods of Chemical Analysis." Sodium and potassium were not separated but reported as combined oxides.

Duplicates were made on all samples and the average was reported.

PAGE REFERENCES TO TEST HOLES

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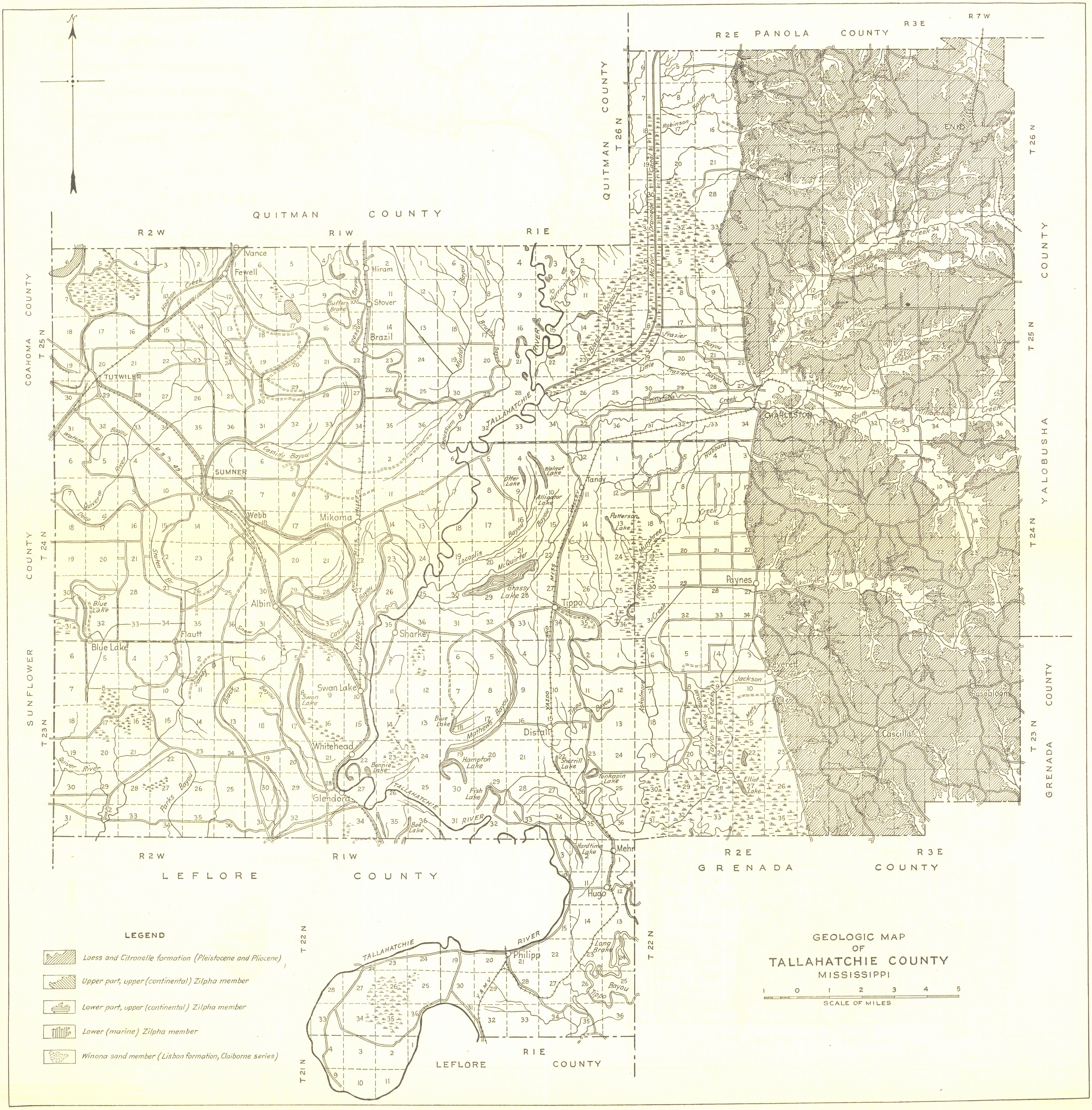
GEOLOGIC MAP
OF
TALLAHATCHIE COUNTY
MISSISSIPPI
SCALE OF MILES
LEGEND
Loess and Citronelle formation (Pleistocene and Pliocene)
Upper part, upper (continental) Zilpha member
Lower part, upper (continental) Zilpha member
Lower (marine) Zilpha member
Winona sand member (Lisbon formation, Claiborne series)
QUITMAN COUNTY
PANOLA COUNTY
YALOBUSHA COUNTY
GRENADA COUNTY
LEFLORE COUNTY
SUNFLOWER COUNTY
COAHOMA COUNTY
CHARLESTON
SUMNER
TUTWILER
Glendora
Tippo
Philipp
Hugo
Paynes
Teasdale
Enid
Cascilla
Rosebloom
Webb
Mikoma
Albin
Sharkey
Swan Lake
Whitehead
Blue Lake
Flautt
Vance
Fewell
Hiram
Stover
Brazil
Tandy
Distall
Mehr
Enville
TALLAHATCHIE RIVER